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IFB NO. Y18-729-TA **ISSUED: January 4, 2018**

INVITATION FOR BIDS

FOR

South Water Reclamation Facility (SWRF) Influent Pump Station Improvements

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PART H
TECHNICAL SPECIFICATIONS

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PART H
VOLUME II

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ORANGE COUNTY UTILITIES
SOUTH WATER RECLAMATION FACILITY
INFLUENT PUMP STATION
Issued for Bid

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SECTION 01000
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE AND INTENT

A. The Work is located at 4760 W Sand Lake Road, Orlando, FL 32819. The Contractor shall furnish all labor materials, equipment and incidentals required and construct the proposed work which is generally described as follows:

1. Construction of a New Influent Pump Station (IPS) at Orange County Utilities' (OCU's) South Water Reclamation Facility (SWRF). The new IPS includes construction of a pump station with two self-cleaning wet wells and space for up to eight (8), submersible pumps (450 horsepower, 31-million gallon per day (MGD) pumps), an outlet box, an isolation box, slide gates, odor control piping modifications, gravity sewer pipe, gravity sewer manholes, demolition of the old IPS and adjacent storage room, roadway modifications, 23'x60' one-story electrical building, electrical, instrumentation and controls (I&C) including SCADA and miscellaneous appurtenances, necessary for system operation. The project also includes modifications to the existing screen channels that will divert flow from the existing IPS to the new IPS, three (3) 63" HDPE pipes that will connect the new outlet box to the isolation box and two (2) 64" ductile iron discharge piping that will connect to existing on-site discharge piping.

B. The work will require the contractor to construct the project while maintaining operations and vehicle access (for operations and maintenance) to the existing IPS and WRF. Maintenance of operations will include, but not limited to, the influent screens, pumps and the odor control ventilation systems. Maintenance of operations shall be required thru the completion of start-up and commission of the new IPS.

C. Work required to maintain operations includes, but is not limited to, providing by-pass pumping, bulkheads and temporary services required for the plant and public utilities required for operations for electrical power service, existing utilities, odor control ductwork and access for trucks for screenings removal.

D. Owner will have full access to and use of the Site and all existing facilities during the entire period of construction for the conduct of his normal operations. Cooperate with Owner's Representative in all construction operations to minimize conflict and to facilitate Owner usage.

E. Work Included:

1. The Contractor shall furnish all supervision, labor, materials, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion of the work. The Contractor shall obtain and pay for all required permits. The Contractor shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the Owner, and in strict accordance with the Contract Documents. The Contractor shall clean up the work and maintain it during and after construction, until accepted, and shall do all work and pay all costs incidental thereto. The Contractor shall repair or restore all structures and property that may be damaged or disturbed during performance of the work.

2. The cost of incidental work described in these General Work Requirements, for which there are no specific Contract Items, shall be considered as part of the general cost of doing the work and shall be included in the prices for the various Contract Items. No additional payment will be made therefore.

3. The Contractor shall provide and maintain such modern materials, tools, and equipment as may be necessary, in the opinion of the Engineer, to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his/her workmanship, materials and equipment, prior approval of the Engineer notwithstanding.

F. Public Utility Installations and Structures:

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, vaults, manholes and all other appurtenances and facilities pertaining thereto whether owned or controlled by the Owner, other governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage, water or other public or private property which may be affected by the work shall be deemed included hereunder.

2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his/her own investigations to inform himself fully of the character, condition and extent of all such installations and structures as may be encountered and as may affect the construction operations.

3. The Contractor shall protect all public utility installations and structures from damage during the work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the Engineer. The Contractor shall so arrange his/her operations as to avoid any damage to these facilities. All required protective devices and

construction shall be provided by the Contractor at his/her expense. All existing public utilities damaged by the Contractor which are shown on the Drawings or have been located in the field by the utility shall be repaired by the Contractor, at his/her expense, as directed by the Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.

4. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as a part of the general cost of doing the work and shall be included in the price bid for the various contract items. No separate payment shall be made therefore.

5. Where public utility installations of structures owned or controlled by the Owner or other governmental body are encountered during the course of the work, and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the Engineer, removal, relocation, replacement or rebuilding is necessary to complete the work under this Contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the Engineer, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement. The Contractor shall obtain approval in writing from the Owner prior to performing such work.

6. The Contractor shall, at all times in performance of the work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of public utility installations and structures; and shall, at all times in the performance of the work, avoid unnecessary interference with, or interruption of, public utility services, and shall cooperate fully with the owners thereof to that end.

7. The Contractor shall give written notice to Owner, other governmental utility departments and other owners of public utilities of the location of his/her proposed construction operations, at least forty-eight (48) hours in advance of breaking ground in any area or on any unit of the work.

8. The maintenance, repair, removal, relocation or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the Owners of such utilities.

1.02 DRAWINGS AND PROJECT MANUAL

A. Drawings: When obtaining data and information from the Drawings, figures shall be used in preference to scaled dimensions, and large scale drawings in preference to small scale drawings.

B. Copies Furnished to Contractor:

1. After the Contract has been executed, the Contractor will be furnished documents to include County Purchasing required and Contractor executed documents and all addenda bound with the technical specifications. Contractor shall be provided five (5) full size drawings signed and sealed sets of construction drawings and five (5) project manuals (collectively referred to as the "Conformed Contract Documents") for use during the construction phase.

2. The Contractor shall furnish each of the subcontractors, manufacturers, and material suppliers such copies of the Contract Documents as may be required for their work. All copies of the Contract Documents shall be printed from the reproducible sets furnished to the Contractor. All costs of reproduction and printing shall be borne by the Contractor.

C. Supplementary Drawings:

1. When, in the opinion of the Engineer, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the Engineer and the Contractor will be furnished one (1) complete set of drawings (24 inches by 36 inches) and one (1) copy of the Project Manual.

2. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of work, credit to the Owner or compensation therefore to the Contractor shall be subject to the terms of the Agreement.

D. Contractor to Check Drawings and Data:

1. The Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, schedules, Specifications or other data received from the Engineer, and shall notify him of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction or improper operation resulting there from nor from rectifying such conditions at his/her own expense. The Contractor will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer, should such errors or omissions be discovered.

2. All schedules are given for the convenience of the Engineer and the Contractor and are not guaranteed to be complete. The contractor shall assume all responsibility for the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

E. Specifications: The Conformed Specifications consist of three parts: General, Products and Execution. The General Section contains General Requirements which govern the work. Products and Execution modify and supplement these by detailed requirements for the work and shall always govern whenever there appears to be a conflict.

F. Intent:

1. All work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Drawings or in the Specifications, but involved in carrying out their intent or in the complete and proper execution of the work, is required and shall be performed by the Contractor as though it were specifically delineated or described.

2. The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.

1.03 MATERIALS AND EQUIPMENT

A. Manufacturer:

1. The names of proposed manufacturers, material suppliers, and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be submitted to the Engineer for approval, as early as possible, to afford proper investigation and checking. Such approval must be obtained before Shop Drawings will be reviewed. No manufacturer will be approved for any materials to be furnished under this Contract unless shall be of good reputation and have a plant of ample capacity. The Contractor shall, upon the request of the Engineer, be required to submit evidence that he/she has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

2. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his/her full responsibility under this Contract.

3. Any two or more pieces of material or equipment of the same kind, type or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery:

1. The Contractor shall deliver materials to the site in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time. However, the Contractor shall not store materials on site for more than thirty (30) days before installation.

2. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.

3. All materials and equipment shall be properly stored on site in accordance with these specifications and the manufacturer's recommendations.

C. Tools and Accessories:

1. The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind or size of equipment, one complete set of suitably marked high grade special tools and appliances which may be needed to adjust, operate, maintain or repair the equipment. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.

2. Spare parts shall be furnished as specified.

3. Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight and principal rate data.

D. Manufacturer's Field Services:

1. The Contract prices for equipment shall include the cost of furnishing a competent and experienced Engineer or superintendent who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test and place in operation, the equipment in conformity with the Contract Documents.

2. See Section 01820 for additional requirements for manufacturer’s field services, including training and certifications.

3. After the equipment is placed in permanent operation by the Owner, such engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that such equipment is in proper and satisfactory operating condition, and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

1.04 INSPECTION AND TESTING

A. General:

1. Inspection and testing of materials will be provided by the Contractor unless otherwise specified.

2. For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Five copies of the reports shall be submitted and authoritative certification thereof must be furnished to the Engineer as a prerequisite for the acceptance of any material or equipment.

3. If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof and he/she will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the Owner.

4. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.

5. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner normally takes over the operation thereof.

B. Costs:

1. Inspection and testing of materials furnished under this Contract will be provided by the Owner, unless otherwise specified.

2. The cost of shop and field tests of equipment and certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the Contract price.

3. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Owner for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment which are rejected for non-compliance.

C. Inspection of Materials:

1. The Contractor shall give notice in writing to the Engineer, sufficiently in advance of his/her intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the

permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, the Engineer will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he/she will notify the Contractor that the inspection will be made at a point other than the point of manufacture.

2. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Certificate of Manufacture:

1. When inspection is waived or when the Engineer so requires, the Contractor shall furnish to him authoritative evidence in the form of Certificate of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Contract Documents.

2. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

E. Shop Tests:

1. Testing for pressure, duty, capacity, rating, efficiency, performance, function or special requirements which are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.

2. No such equipment or materials shall be shipped to the work site until the Engineer notifies the Contractor, in writing, that the results of such tests are acceptable.

3. Five (5) copies of the manufacturers' actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to be a responsible official of the manufacturing company and/or independent laboratory, shall be forwarded to the Engineer for approval.

4. The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.

F. Final Field Tests:

1. Upon completion of the work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance tests as specified or required to provide compliance with the Contract Documents.

2. The Contractor shall furnish labor, fuel, energy, water and all other materials, equipment and instruments necessary for all acceptance tests, at no additional

cost to the Owner. The furnishing Contractor shall assist in the final field tests as applicable.

G. Final Inspection: During such final inspections, the work shall be clean and functional. In no case will the final estimate be prepared until the Contractor has complied with all requirements set forth and the Engineer and Owner have made their final inspection of the entire work and are satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

1.05 SITE ADMINISTRATION

A. Contractor shall be responsible for all areas of the Site used by it and by all subcontractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to the Owner or others employed by Orange County or regulatory agencies. Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and may require all persons on the Site (except Owner's and Engineer's employees) to observe the same regulations as Contractor requires of its employees.

B. Access to the Site will be limited to the main gate off of Sand Lake Road unless specific alternate arrangements are made with the Owner. Contractor shall supply a list, and periodically update it, that contains the names of all personnel with driver license numbers and license plate numbers of all vehicles that will be on-site during construction. Contractor shall also supply the Owner's Plant Manager and Owner's Security Representative a daily list of any scheduled visitors. Only scheduled visitors will be permitted to enter upon verification of identify.

C. The Owner reserves the right to direct Contractor to permanently remove any employee, subcontractor or subcontracted employee from the site for breach of security, policy, unsafe working practice, unprofessional behavior, or failure to comply with access restrictions.

1.06 SECURITY

A. Contractor shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons. Contractor shall comply with Orange County's security requirements to protect the SWRF site.

B. The Owner has special security measures to protect the public wastewater system and the Contractor shall provide the same level of security. The Contractor shall provide the following security measures:

1. Contractor will supply list of all personnel that will work on the SWRF site each morning to the Owner's Resident Project Representative (RPR)

2. All personnel, employees, and or subcontractors and suppliers that pass through the security perimeter shall wear Contractor-issued photo identification badges.

3. Contractor will supply list with names, driver license numbers, and license plate numbers of all personnel.

4. All Contractor's and subcontractor's personnel passing through security perimeter shall have background checks to identify any historical crimes dealing with terrorism, sabotage, or other government-related illegal activities at the cost of the Contractor and before entering the SWRF site. Proof of background checks shall be submitted to the Owner.

5. All project deliveries shall be inspected prior to entering the security perimeter of the Facility in order to verify contents. All delivery personnel and delivery vehicles shall be under supervision while within the security perimeter of the Facility in lieu of issuance of photo identification badges. The Contractor shall maintain staff to accept all deliveries to the site; the Owner will not be responsible for receipt of any deliveries.

6. If access other than the main gate off Sand Lake Road is utilized, a full-time guard shall be provided at the construction gate during Contractor working hours at the cost of the Contractor. All arrangements for alternate access shall be pre-arranged with the Owner. All alternative access must be secured and locked when not in use.

C. No claim shall be made against the Owner by reason of any act of an employee or trespasser, and Contractor shall make good all damage to the Owner's property resulting from Contractor's failure to provide security measures as specified.

1.07 TOBACCO-FREE POLICY – TOBACCO-FREE CAMPUS

A. In order to protect the public health, safety, and welfare of citizens and employees, smoking or other use of tobacco or any other substance is prohibited in County-owned or operated facilities and vehicles. Contractor's personnel will not be permitted to use tobacco products on County property, including County parking lots, break areas, and worksites. Smoking means the lighting of any cigarette, cigar or pipe, or the possession of any lighted cigarette, cigar or pipe, regardless of its composition. Other use includes chewing, dipping, and using electronic cigarette, cigar or pipe. This requirement will be enforced from the beginning of construction and violators will be removed from the property.

1.08 COUNTY'S WORK SCHEDULE

A. The Owner reserves the right to have their RPR present to witness and inspect all Work performed by the Contractor. Working hours for the RPR are a 10-hour period

between the hours of 7:00 am and 7:00 pm, Monday through Friday. Any Work beyond the 10-hour period shall be considered overtime and shall be requested in writing 24 hours prior. Contractor, with verbal permission of the RPR, may work 24 hours a day to provide clean-up, maintenance of vehicles and equipment, and other such items without the RPR present.

B. Any Work required on Saturday or Sunday shall be considered overtime and shall be requested in writing 48 hours in advance. All requests must be approved by the Owner in advance. Under emergency situations, a verbal request may be made with a follow-up written request.

C. The Owner observes the following holidays: New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

D. Contractor shall pay for the RPR's overtime. Overtime shall be defined as time beyond the 10-hour working period between 7:00 am and 7:00 pm on Monday through Friday, and all time on Saturdays, Sundays, and on holidays observed by the Owner. The overtime pay rate for RPRs will be $51.00 per hour, or higher if the current rate is higher as listed in the County Fee Directory prepared by the Office of Management and Budget, in section "Orange County Utilities Engineering & Construction", under the heading of "Inspection Fee other than Normal Working Hours". The Contractor agrees that the Owner will deduct charges for work outside normal work hours and for overtime pay from payments due to the Contractor.

1.09 PERMITS

A. The Contractor shall comply with all laws, rules, regulations, and ordinances of any authority having jurisdiction over the Work, as required by the General Conditions. Permits obtained by the Owner are attached to the Specifications. The term "Engineer" in the Building Department Permit Holds refers to the Contractor's engineer.

1.10 WORK PERFORMED BY OTHERS

A. All existing valves, equipment and facilities are to be operated only by the Owner. The Contractor shall coordinate and schedule operation and shutdown control of existing valves and facilities with the Owner at least seven (7) days in advance by processing a C.A.R. (Construction Assistance Request).

B. Other Projects on site:

1. South Water Reclamation Facility (SWRF) Phase V Expansion – The Owner is administering a contract to expand the SWRF facilities. The work by Others will be primarily performed at the North Plant, and at the South Plant and the Solids Handling Building, nearby this Work.

2. SWRF Dewatering Improvements – The Owner is administering a contract to improve biosolids dewatering facilities on the SWRF site. That contract includes the removal and relocation the existing belt filter presses and installation of new equipment within the Solids Handling Building.

3. SWRF Hypochlorite System – The Owner is administering a contract to provide two sodium hypochlorite facilities on the SWRF site, east and south of this Work.

4. SWRF Fats, Oils and Grease (FOG) Septage and Receiving Stations – The Owner is administering a contract to provide a FOG receiving station and rehabilitation of the existing septage receiving station.

1.11 TRAINING

A. Refer to Section 01820 for training requirements.

1.12 DEMOLITION

A. Perform demolition as designated within the Contract Documents.

B. Unless otherwise noted, remove all materials and equipment from areas indicated for demolition.

C. Cap abandoned utilities and conduit that remain in place.

D. Utilities to be abandoned in place are to be capped and grout filled.

E. Dispose of all removed materials and equipment as required by the appropriate jurisdictional authority, or as directed by the Owner, to an acceptable disposal site.

F. Disconnect existing electrical services and controls to items being removed as a requirement of this section. Conduit is to be cut down to finished floor elevation and capped or sealed. Unless otherwise noted, cables are to be removed to their source.

1.13 TEMPORARY STRUCTURES

A. Temporary Fences: If, during the course of the work, it is necessary to remove or disturb any fence or part thereof, the Contractor shall provide a suitable temporary fence at his/her own expense.

B. Responsibility for Temporary Structures: In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and hold harmless the Owner and Engineer from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.14 ACCIDENT PREVENTION

A. Precautions shall be exercised at all times for the protection of person and property. The safety provisions of applicable laws, building and construction codes shall be observed.

B. The Contractor shall comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Hours and Safety Standards Act Section 107 of the contract Work. Hours and Safety Standards Act (PL 91-54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act, shall be complied with.

C. First Aid: The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when men are employed on the work.

1.15 LINES AND GRADES

A. Grade:

1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

2. Bench marks and base line controlling points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall also place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. Contractor shall remove any obstructions placed contrary to this provision.

B. Surveys:

1. The Contractor shall furnish and maintain, at his/her own expense, stakes and other such materials, and give assistance, including qualified helpers, for setting reference marks to the satisfaction of Utilities and the Engineer.

2. The Contractor shall check such reference marks by such means as he/she may deem necessary and, before using this, shall call the Utilities' attention to any inaccuracies.

3. The Contractor shall, at his/her own expense, establish all working or construction lines and grades as required from the reference marks and shall be solely responsible for the accuracy thereof. However, the Contractor shall be subject to the check and review by Utilities. Field engineering shall be in accordance with Section 01050.

4. The Contractor shall, at his/her own expense, provide a surveyor to survey and monument all easements or proposed easements on private property prior to the start of Utilities Work. Monuments shall be preserved throughout the Work.

5. The Contractor shall, at his/her own expense, provide a Surveyor to survey stake or monument the proposed Right-of-Way of property to be turned over to the Public prior to the start of Utilities Work. Monuments shall be preserved throughout the Work.

C. Safeguarding Marks:

1. The Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, bear the cost of reestablishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes and marks.

2. The Contractor shall safeguard all existing and known property corners, monuments and marks adjacent to but not related to the work and, if required, shall bear the cost of reestablishing them if disturbed or destroyed.

1.16 ADJACENT STRUCTURES AND LANDSCAPING

A. Responsibility:

1. The Contractor shall also be entirely responsible and liable for all damage or injury as a result of his/her operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work.

2. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Drawings, and the removal, relocation and reconstruction of such items called for on the Drawings or specified shall be included in the various Contract Items and no separate payments will be made therefore.

3. Contractor is expressly advised that the protection of buildings, structures, tanks, pipelines, etc. and related work adjacent and in the vicinity of his/her operations, wherever they may be, is solely his/her responsibility.

4. Conditional inspection of buildings or structures in the immediate vicinity of the project which may reasonably be expected to be affected by the Work shall be performed by and be the responsibility of the Contractor.

5. Contractor shall, before starting operations, make an examination of the adjacent structures, buildings, facilities, etc., and record by notes, measurements, photographs, etc., conditions which might be aggravated by open excavation and construction. Repairs or replacement of all conditions

disturbed by the construction shall be made to the satisfaction of the Owner and to the satisfaction of the Owner. This does not preclude conforming to the requirements of the insurance underwriters. Copies of surveys, photographs, reports, etc., shall be given to the Owner.

6. Prior to the beginning of any excavations the Contractor shall advise the Owner of all structures on which he/she intends to perform work or which performance of the project work will affect.

B. Protection of Trees and Shrubs: The Contractor at his/her expense, shall protect all trees and shrubs not shown to be removed on the Plans, in accordance with "Article VIII, 'Tree Protection and Removal', Chapter 15, Orange County Code". No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Contractor or his/her employees shall be replaced in accordance with "Article VIII, 'Tree Protection and Removal', Chapter 15, Orange County Code" at the sole expense of the Contractor.

C. Protection of Lawn Areas: Lawn areas shall be left in as good or better condition as before starting of the Work. Where sod is to be removed, it shall be carefully restored with new sod of the same type.

D. Restoration of Fences:

1. Any fence, or part thereof, that is damaged or removed during the course of the Work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired or replaced and the materials used shall be subject to the approval of Utilities.

2. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence shall be deemed included in the appropriate Contract Item or items, or if no specific item is provided therefore, as part of the overhead cost of the work, and no additional payment will be made therefore.

1.17 PROTECTION OF WORK AND PUBLIC

A. Barricades, Guards and Safety Provisions:

1. The Contractor shall be solely responsible for adhering to the rules and regulations of OSHA and appropriate authorities regarding safety provisions. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, lights and guards as required shall be placed and maintained by the Contractor at his/her expense during the progress of the Work and until it is safe for traffic to use the roads and streets. Material piles, equipment and pipe which may serve as obstructions for traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor.

2. Signage and barricades shall be in accordance with applicable FDOT manuals.

B. Noise:

1. The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing equipment shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. The Contractor shall construct sound barriers as necessary to eliminate noise.

2. The County noise ordinance shall be observed at all times.

C. Access to Public Services: Neither the materials excavated nor the materials or equipment used in the construction of the work shall be so placed as to prevent free access to public services. All excavated material shall be piled in a safe manner that will not endanger the Work and that will avoid obstructing streets, sidewalks and driveways. Excavated material suitable for backfilling shall be stockpiled separately on the site. No material shall be placed closer than two feet from the edge of an excavation. Fire hydrants, valve pit covers, valve boxes, curb stop boxes or other utility controls shall be left unobstructed and accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Natural watercourses shall not be obstructed or polluted. Surplus material and excavated material unsuitable for backfilling shall be transported and disposed of off the site in disposal areas obtained by the Contractor.

D. Dust Prevention: The Contractor shall prevent dust nuisance from his/her operations or from traffic by keeping the roads and/or construction areas sprinkled with water at all times.

1.18 CUTTING AND PATCHING

A. The Contractor shall do all cutting, fitting or patching of his/her portion of the work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the Engineer and in accordance with the Drawings and Specifications.

B. The work must be done by competent workmen skilled in the trade required by the restoration.

1.19 CLEANING

A. During Construction:

1. During construction the Contractor shall, at all times, keep the construction site and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of Utilities, such material, debris, or rubbish constitutes a nuisance or is objectionable. The Contractor shall implement appropriate best management practices (BMPs) to prevent off-site tracking of material, and if tracking occurs, shall use all means necessary to remove the material, prevent

material from entering roadway stormwater system and will adjust the associated BMPs to prevent future tracking.

B. Final Cleaning:

1. At the conclusion of the work, all tools, temporary structures and materials belonging to the Contractor shall be promptly taken away. The Contractor shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances in a legal manner.

2. The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished and new operating condition.

C. Salvage

1. Any existing Utilities owned equipment or material including but not limited to valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction, may be designated as salvage by Utilities, and if so, shall be carefully excavated if necessary and delivered to Utilities at a location designated by Utilities.

1.20 MISCELLANEOUS

A. Erosion and Sediment Control

1. Erosion and sediment control implemented as part of a SWPPP is performance based. If the best management practices (BMPs) initially installed are not maintaining compliance with the permit, the BMPs shall be adjusted or replaced in order to achieve compliance.

2. If BMPs originally included in the SWPPP are changed, the SWPPP document shall be adjusted to reflect the change.

B. Existing Facilities: The work shall be so conducted to maintain existing equipment in operation.

C. Disturbed Areas: Restore all areas disturbed by construction to a condition at least equal to the preconstruction condition including, but not limited to, all landscaping, driveways, roads, sprinkler systems, and other improvements. Grassed areas shall be sodded. Maintain ingress and egress to all areas adjacent to construction and minimize inconvenience to plant operations.

D. Use of Chemicals: Chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must indicate approval of either United States Environmental Protection Agency, National Safety Foundation, or United States Department of Agriculture. Use of such chemicals and disposal of residues shall be in strict conformance with label instructions. Material Safety Data Sheets (MSDS) for

chemicals used during project construction shall be submitted to Utilities for approval.

E. Cooperation with Other Contractors and Forces:

1. During progress of work under this Contract, it may be necessary for other contractors and persons employed by the Owner to work in or about the project.

2. The Owner reserves the right to put such other contractors to work and to afford such access to the Site of the Work to be performed hereunder at such times as the Owner deems proper.

3. The Contractor shall not impede or interfere with the work of such other contractors engaged in or about the Work and shall so arrange and conduct his/her work that such other contractors may complete their work at the earliest date possible.

F. Construction shall be conducted and shall result in construction of the improvements of this project in full accordance with the conditions of the permits granted for the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01010
SUMMARY OF PROJECT

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The Contract is for the construction of a New Influent Pump Station (IPS) at Orange County Utilities' (OCU's) South Water Reclamation Facility (SWRF). The new IPS includes construction of a pumping station with two self-cleaning wet wells and space and piping, fittings and valves for up to eight (8), submersible pumps, installation of six (6), 21,500 gpm at 62 feet TDH submersible pumps, provision of one (1) spare pump, construction of an outlet box from the existing IPS, three (3) 63-inch HDPE transfer pipelines from the new outlet box to the IPS, an isolation box at the head end of the new IPS, slide gates, odor control piping modifications, gravity sewer pipe, gravity sewer manholes, demolition of the abandoned old IPS and adjacent storage building, roadway modifications, and construction of a 23'-4" x 59'-4" one-story electrical building, associated electrical work, MCC's, VFD's, instrumentation and controls (I&C) including SCADA, system integration and miscellaneous appurtenances necessary for system operation. The project also includes modifications to the existing IPS screen channels that will divert flow from the existing IPS to the new IPS, and two (2) 64" ductile iron discharge pipes that will connect to existing on-site raw wastewater transmission piping to the grit chamber.

B. The Contractor shall furnish all labor, equipment, materials and incidentals for the construction of the Work consisting of, but not limited to the equipment, structures and incidentals as shown on the Drawings and defined in the Project specifications.

C. Owner shall have the right to review and approve or reject the Contractor's initial selection of superintendent and project manager for the project. If the Contractor chooses to make a substitution of their project manager or superintendent during construction, the owner shall have the same right to review and approve or reject the substitution, in accordance with Article 9 of the General Conditions.

D. The major items of Work included in the Contract include, but are not limited to, the following:

1. Construction of temporary access roads and pavement required to maintain site access and provide access to the Existing Influent Pumping Station screening bays for daily removal of screening dumpsters.
2. Construction of bypass piping and pumping of existing flows around the new Influent Pumping Station (IPS) construction site area before proceeding with the construction of the new IPS. Complete temporary services, tie-ins and interconnections to existing sewer, force mains, electrical services, SCADA

systems, and underground utilities and duct banks prior to excavation for the IPS.

3. Locating, abandoning and modifying existing site piping including water and reclaimed water systems, sewers, odor control ductwork, electrical services and the existing IPS discharge piping. Work includes field location of existing piping, demolition and abandonment, tie-ins, temporary and permanent modifications.

4. Maintaining the existing odor control system for collection and treatment of odorous air for all operating facilities throughout the project execution. Maintaining the system in operation may require the installation of temporary ductwork, additional power supply and balancing dampers.

5. Installation of temporary groundwater dewatering wells and pumping equipment. Construction of the groundwater cut-off wall and other temporary earthwork retaining walls around the excavation area of the new IPS. The contractor shall protect existing underground utilities that will remain during and after construction of the new IPS.

6. Perform and complete the physical hydraulic modeling for the new IPS. The results of the physical hydraulic modeling may result in changes to the internal shape of the influent isolation box and baffling; or the shape or depth of the self-cleaning wet wells; or the length and shape of the pump intake cones; or any combination of these. The final model report must be completed and approved before construction of structural reinforced concrete walls for the new IPS has begun or the new submersible pumps have been ordered.

7. Construction of the new IPS structure, influent slide gates, slide gate electric actuators and all associated piping, valves, fittings, pumps, conduit, wiring, associated electrical work, instrumentation and accessories required for the installation and full operation of the IPS pumps and variable speed drives. Addition of new odor control ductwork and modifications to the existing odor control system ductwork.

8. Construction of the new one story 23’-4” x 59’-4” IPS Electrical Building structure including but not limited to installation of conduit and wiring, motor control centers, variable frequency drive panels, lighting, miscellaneous electrical panels and transformers, building grounding and lightning protection system, building insulation, HVAC units and ductwork, exterior and interior finishes, FRP doors and flooring.

9. The work for the new IPS and electrical building will include all associated IPS instrumentation and controls for system operation and monitoring, all associated electrical work, SCADA and system integration with the existing plant control systems.

10. Installation of linestops, tapping sleeves and tapping valves and tapping the existing 42-inch and 54-inch PCCP raw wastewater transmission mains and

provide temporary 48-inch bypass piping and fittings to tie-in the new IPS discharge piping headers. Construction of 64-inch ductile iron piping and fittings; and a 54-inch plug valve and 54-inch permanent bypass piping from the pump discharge headers to the tie-in locations on the existing 54-inch and 42-inch PCCP transmission mains.

11. Modifications to the Existing IPS including structural modifications to the existing screening channels, installation of new slide gates and bulkheads, modifications to the existing FRP odor control system ductwork in the existing IPS; and modification and installation of new electrical gear.

12. Temporary by-pass of pipelines discharging to the old IPS junction box for the removal the installation of new watertight bulkheads at the gate locations.

13. Decommissioning and demolishing of the abandoned old IPS electrical system, removal and salvaging of existing equipment and demolition of the old influent pump station structure to a minimum depth of 5 feet below grade. All demolition materials shall be removed from the site and properly disposed. The remaining structure bottom will be cored or otherwise broken to allow the flow of groundwater and the cavity will be filled with clean fill material.

14. Decommissioning of the electrical service and removal and/or, salvage of equipment and piping and demolition of the existing storage building, the chemical storage tank area and demolition of the abandoned packed bed odor control systems. All demolished material will be removed from the site and disposed of in approved landfills.

15. Providing temporary power and ductwork for the operating odor control system. Installation of new permanent power feed and odor control ductwork.

16. Providing Manufacturers' Services to assist in the equipment installation, start-up, commission, production of O&M Manuals and Owner training for the new IPS and electrical building.

17. Start-up and commissioning of the New IPS and electrical building prior to decommissioning the existing IPS pumps, VFD and electrical system.

18. Removal of dewatering piping and equipment, grouting of dewatering wells and removal of temporary earthwork retaining structures to the extent possible without damaging new work or as required in the specifications.

19. All associated site work, finish grading, sidewalks and drainage restoration.

20. All associated landscape, sodding and irrigation.

21. Restore the permanent pavement in the Work Area and provide new pavement where indicated on the Drawings.

22. Construct new decorative CMU wall to match existing perimeter wall to replace existing chain link fence along Sand Lake Road.

E. The Work will require the Contractor to construct the Work in a phased approach to meet several Contract milestones. These milestones and the major work elements that must be completed, tested and ready for continuous and reliable service are but are not limited to:

1. Partial Utilization Milestone – New Influent Pump Station (IPS): The major items of work required to meet the Partial Utilization Milestone includes:

   a. New Influent Pump Station (IPS) including outlet box, isolation box, 63 inch piping and discharge piping.
   b. Modifications to the old IPS influent box and decommissioning / demolition of the old IPS.
   c. Site Decommissioning/Demolition of the existing storage building, chemical storage tank area, Old IPS; and demolition of the abandoned packed bed odor control systems (western portion no longer in use).
   d. Modifications to the odor control system piping and tying in of the new odor control piping.
   e. Construction of the Decorative Wall.
   f. Complete modifications to two (2) screen channels in the Existing IPS.
   g. Site Work and Road systems with the exception of the final driving course of asphalt.
   h. Completion of all Manufacturers' Services, submittal and approved O&M manuals, and operator training for all equipment.
   i. Completion of Electrical Building and all associated electrical work for the new IPS.
   j. Completion of the New IPS Start-up, and Performance Test.

2. Substantial Completion Milestone – Before the contractor can begin work associated with the Substantial Completion Milestone, all work as part of the Partial Utilization Milestone shall be completed, ready for continuous operations and acceptance by the Owner, in accordance with Article 18 of the general conditions. The major items of work required to meet the Substantial Completion Milestone includes but is not limited to:

   a. Completion of modifications of the remaining three (3) screen channels in the Existing IPS.
   b. Decommissioning the Existing IPS from operations.
   c. Demolition and modification of the Existing IPS electrical systems, removal of the existing pumps and motors.
   d. Completion of all Site Work, irrigations systems and landscaping.
   e. Completion of site paving work and milling and resurfacing of the existing pavement.
   f. Ready the Works for inspection and development of the substantial completion punch list.

F. The Contractor is responsible for providing all required dewatering systems, sheeting and shoring systems, piling systems, trench safety systems and any other permanent

or temporary construction system required to complete the Work, including a groundwater cut-off wall around the existing IPS and installation of geotechnical instrumentation for monitoring settlement and vibration. All temporary structural systems required for construction shall be designed, signed and sealed by a professional engineer licensed in Florida.

G. The Contractor shall perform the Work complete, in place, and ready for continuous service, and shall include repairs, testing, permits, cleanup, replacements and restoration required as a result of disruption or damages caused during this Construction

H. All materials, equipment, demolition, skills, tools and labor which is reasonably and properly inferable and necessary for the proper completion of the Work in a substantial manner and in compliance with the requirements stated or implied by these Specification or Drawings shall be furnished and installed by the Contractor without additional compensation, whether specifically indicated in the Contract Documents or not.

1.02 CONTRACTOR'S USE OF PREMISES

A. The Contractor shall assume full responsibility for the protection and safekeeping of products and materials at the job site. If additional storage or work areas are required, they shall be obtained by the Contractor at no additional cost to the Owner.

1.03 SEQUENCE OF WORK

A. The Contractor shall establish his work sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time and as specified in Section 01014.

B. The Contractor shall submit an initial progress schedule and subsequent progress schedules in accordance with Section 01310.

C. All existing systems and the existing IPS will remain in operation until such time as the Contract Documents specify. The Contractor shall provide temporary systems as necessary to keep all existing facilities in operation and maintain these systems throughout construction. In the event the Contractor requires temporary shutdown of any plant systems, equipment, or utilities, such request shall be submitted in writing and approved thorough the Construction Assistance Request (C.A.R.) form.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01014
SEQUENCE OF CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes work sequence requirements necessary for maintaining operation of the facility during construction, including, but not limited to, the following:

1. General construction sequence requirements.
2. Specific construction sequence requirements.
3. Modifications which must be performed according to a specific sequence include the following:
    a. Complete temporary access and pavement required to maintain site access and provide access to the Existing Influent Pumping Station screening bays for daily removal of screening dumpsters.
    b. Provide bypass of existing flows around the new Influent Pumping Station (IPS) construction site area before proceeding with the construction of the new IPS.
    c. Complete temporary services, tie-ins and interconnections to existing sewer, force mains, electrical services, SCADA systems, and underground utilities and duct banks.
    d. Installation of temporary groundwater dewatering wells and pumping equipment.
    e. Construction of the groundwater cut-off wall and other temporary earthwork retaining walls around the excavation area of the new IPS.
    f. Perform and complete the physical hydraulic modeling for the new IPS before construction of structural reinforced concrete walls for the new IPS has begun.
    g. Construction, start-up and commissioning of new Influent Pump Station (IPS)
    h. Construction, start-up and commissioning of the new Electrical Building for the new IPS.
    i. Installation of linestops, tapping sleeves and tapping valves and tapping the existing 42-inch and 54-inch raw wastewater transmission mains to tie-in the new IPS.
    j. Structural modifications inside the Existing IPS and screen installation.
    k. Demolition of the abandoned Old IPS, existing equipment, concrete pads and structures.
    l. Removal of dewatering equipment and temporary earthwork retaining structures to the extent possible.
    m. Permanent pavement replacement, sidewalks, and touch-up painting.

1.02 RELATED SECTIONS

A. Project Coordination is included in Section 01041.

B. Progress Schedules are included in Section 01310.

C. Electrical is included in Division 16.

D. Process Instrumentation and Controls are included in Section 13300.

1.03 GENERAL CONSTRUCTION SEQUENCE REQUIREMENTS

A. All work shall be performed in a manner that allows continuous operation of the facilities and shall be closely coordinated with Owner's personnel. No lines or valves shall be opened or closed or otherwise altered, equipment turned off or on, or decommissioning performed without authorization and supervision by Owner's personnel. Authorization must be requested in writing at least 48 hours in advance.

B. Sequences of work shall be included as a part of the Progress Schedule required under Section 01310, Construction Progress Schedules.

C. Construction must be performed in the sequence indicated below unless an alternate plan is proposed by the Contractor and approved by the Owner and Engineer. All equipment being installed as part of the modifications being performed must be tested for proper operation and piping associated with the modifications being performed must be pressure tested prior to the completion.

1.04 SITE CONDTIONS

A. Construction under this contract must be coordinated with the Owner's resident project representative (RPR) and accomplished in a logical order to initiate and maintain the process flow through the plant and to allow construction to be completed within the time allowed in the Contract Documents. Contractor shall coordinate their activities with the Owner, Engineer and other contractors, to allow normal operations and maintenance of all plant facilities and other construction work to be continued without disruption.

B. When access through the construction area must be disrupted, Contractor will provide alternate acceptable access for Owner's operators and other contractors.

C. Contractor shall coordinate their activities in the interface or common areas with Owner's personnel and other contractors. Contractor must submit to the Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with Owner's personnel and other contractors.

D. Various temporary and permanent interconnections, bulkheads and pipe closures will be needed to accomplish the work. The Contractor shall coordinate with the Owner prior to attempting any such work and provide any necessary permanent or temporary systems needed to perform this work at no additional cost to the Owner.

E. When the work requires an existing facility or utility service to be taken out of operations, temporarily or permanently, the Contractor shall notify the Engineer and submit a written plan a minimum of seven (7) days in advance, detailing the service to be interrupted, the equipment or facilities it serves and a plan for maintaining

service to the affected equipment or facilities. The Contractor shall maintain services to all existing facilities and utilities at no additional costs to the Owner.

1.05 SPECIFIC CONSTRUCTION SEQUENCE REQUIREMENTS

A. The Contractor shall submit a written plan and receive written approval from the Owner before the Contractor is allowed to begin decommissioning the Existing IPS pumps, VFDs and electrical equipment. Written approval to begin decommissioning of the Existing IPS will require, at a minimum, the New IPS to be completed, tested and commissioned in accordance with the Contract Documents, and ready for continuous and reliable operation.

B. The Contractor shall provide all utility services to the existing IPS throughout construction. The Contractor shall have a crew ready to mobilize within one hour to the site to make repairs to any service that is required to maintain the existing IPS operation.

C. No work on the existing MCC can begin prior to completion, testing and commissioning the new IPS.

D. Once installation of transformers and switchgear at the new IPS is complete, work can begin on the Existing IPS.

E. Equipment to be salvaged must be removed from existing storage area and structures before demolition.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. This Section specifies administrative and procedural requirements to define pay items and determine payable amounts, and includes but is not limited to:

1. General Provisions
2. Cash Allowances
3. Work Not Paid for Separately
4. Measurement for Payment
5. Partial Payment for Stored Materials and Equipment

1.02 GENERAL PROVISIONS

A. This specification includes standard descriptions for all bid items. This Contract's specific bid items are listed in the Bid Schedule.

B. The total Contract Amount shall cover the Work required by the Contract Documents. All costs in connection with the successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction, equipment, and tools; and performing all necessary labor and supervision to fully complete the Work, shall be included in the unit and lump sum prices bid. All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices bid.

C. If used, all estimated quantities stipulated in the Bid Schedule or other Contract Documents are approximate and are to be used only (a) for the purpose of comparing the bids submitted for the Work, and (b) as a basis for determining an initial Contract Amount. The actual amounts of Work completed and materials furnished under unit price items may differ from the estimated quantities. The County does not expressly or by implication represent that the actual quantities involved will correspond exactly to the quantities stated in the Bid Schedule; nor shall the Contractor plead misunderstanding or deception because of such estimate or quantities or of the character, location or other conditions pertaining to the Work. Payment to the Contractor will be made only for the actual quantities of work performed or material furnished in accordance with the Drawings and other Contract Documents, and it is understood that the quantities may be increased or decreased as provided in the General Conditions.

D. If used, the unit prices listed in the Bid Schedule shall include all services, obligations, responsibilities, labor, materials, devices, equipment, royalties and license fees, supervision, temporary facilities, construction equipment, bonds, insurance, taxes, clean up, traffic control, control surveys, field offices, close out, overhead and profit and all connections, appurtenances and any other incidental items of any kind or nature, as are necessary to complete the Work in accordance with the Contract Documents.

E. Except for mobilization/demobilization and project record documents, payment for Work will be based on the percent of completed work of each item in the Schedule of Values, including stored materials, as determined by the County. Progress of work in each item of the Schedule of Values will be determined separately by the County. However, the County will issue a single payment certificate for progress on the Contract.

F. The Contractor agrees that it will make no claim for damages, anticipated profits, or otherwise because of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefore.

G. Where payment by scale weight is specified under certain items, the Contractor shall provide suitable weighing equipment which shall be kept in accurate adjustment at all times and certified. The weighing of all material shall be performed by the Contractor in the presence and under the supervision of the County.

H. All schedules included in the Contract Documents are given for convenience and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quantity of materials and equipment included in work to be done under this Contract.

I. Where pipe fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor from laying and jointing different or additional items where required.

J. All contracts shall be subject to 10% minimum retainage as defined in the General Conditions and the Agreement.

1.03 CASH ALLOWANCES

A. The Contractor shall include in the Total Bid Amount, all cash allowances stated in the Contract Documents. Items covered by these allowances shall be supplied for such amounts and by such persons as the County may direct.

B. The Contractor will obtain the County’s written acceptance before providing equipment, materials or other Work under a cash allowance. Payments under a cash allowance will be made based on actual costs, excluding costs of general conditions, handling, unloading, storage, installation, testing, etc., which will be considered to be included within the Contract Price. Payments within the limits of any Allowance will

exclude overhead and profit and bond and insurance premiums, since those costs will be considered to be included within the Contract Amount. The Contractor shall submit appropriate documentation to validate the actual cost of the item.

C. The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by the Contractor.

1.04 WORK NOT PAID FOR SEPARATELY

A. Delivery: Payment for equipment delivery, storage or freight shall be included in the pay items including their installation and no other separate payment will be made therefore.

B. Bonds: Payment for bonds required by the Contract shall be included in the pay items for the Work covered by the required bonds and no separate payment will be made.

C. Preparation of Site: Payment for preparation of site shall be included in pay items proposed for the various items of Work and no separate payment will be made therefore. Preparation of site includes setting up construction plant, offices, shops, storage areas, sanitary and other facilities required by the specifications or state law or regulations; providing access to the site; obtaining necessary permits and licenses; payments of fees; general protection, temporary heat and utilities including electrical power; providing shop and working drawings, certificates and schedules; providing required insurance; preconstruction photographs and videos; clearing and grubbing; removal of existing pavements, sidewalks and curbs; trench excavation, sheeting, shoring and bracing; dewatering and disposal of surplus water; structural fill, backfill, compaction and grading; testing materials and apparatus; maintenance of drainage systems; appurtenant work; record drawing and close-out documentation; cleaning up; and all other work regardless of its nature which may not be specifically referred to in a Bid Item but is necessary for the complete construction of the project set forth by the Contract.

D. Permitting & Permit Fees.

E. The County reserves the right to delete any item included in the Schedule of Values and decrease the Contract Price by the scheduled amount for the item deleted.

1.05 MEASUREMENT FOR PAYMENT

A. Methods of Measurement - Generally:

1. Units of measurement shall be defined in general terms as follows:

a. Linear Feet (LF)
b. Square Feet (SF)
c. Square Yards (SY)
d. Cubic Yards (CY)

e. Each (EA)
f. Sacks (SK)
g. Lump Sum (LS)

2. Unit Price Contracts/Items:

a. Linear Feet (LF) shall be measured along the horizontal length of the centerline of the installed material, unless otherwise specified. Pipe shall be measured along the length of the completed pipeline, regardless of the type of joint required, without deduction for the length of valves or fittings. Pipe included within the limits of lump sum items will not be measured.

b. Square Feet (SF), Square Yards (SY), Cubic Yards (CY), Each (EA) and Sacks (SK) shall be measured as the amount of the unit of measure installed and compacted within the limits specified and shown in the Specifications and Drawings. Slope angles and elevations shall be measured using land-surveying equipment. Contractor shall provide supporting documentation (i.e. drawings, delivery tickets, invoices, survey calculations, etc.) to verify actual installed quantities.

B. Lump Sum Contracts/Items - Generally:

1. Quantities provided in the Schedule of Values are for the purpose of estimating the completion status for progress payments. Payment will be made for each individual item on a percentage of completion basis as estimated by the Contractor and approved by the County.

2. Adjustments to costs provided in the accepted Schedule of Values may be made only by Change Order.

3. The County reserves the right to delete any item included in the Schedule of Values and decrease the Contract Price by the scheduled amount for the item deleted.

1.06 MEASUREMENT

A. The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the Owner, in accordance with the applicable method of measurement therefore contained herein.

B. Measurement of an item of work will be by the unit indicated in the Bid Form.

C. Measurement will include all necessary and incidental related work not specified to be included in any other item of work listed in the Bid Form.

D. Measurement for payment does not signify acceptance of Work

1.07 PAYMENT

A. Payment will be made at the lump sum price for each of the items shown in the Bid Proposal, stored and/or installed and accepted, which price and payment shall constitute full compensation for furnishing all materials and performing all Work in connection therewith and incidental thereto.

1.08 BASE BID ITEMS

A. Item 1 – South Water Reclamation Facility Influent Pump Station

1. Measurement of the lump sum price in the Bid Form shall be based on the total costs for providing all bonds, insurance, indemnifications, standard conditions, labor, materials, equipment, and incidentals required to complete the work, as specified in Contract Documents.

2. Payment of the lump sum price shall fully compensate the Contractor for any and all work which is required to complete the work of Item 1, as required by the Contract Documents

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01027
APPLICATIONS FOR PAYMENTS

PART 1 - GENERAL

1.01 REQUIREMENT

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment. The Owner will provide the Pay Application Form, Stored Materials, Release of Lien Log, and Draw Schedule Form.

B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings, As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables for the period covered by the monthly payment application shall be submitted and accepted by the County.

1.02 FORMAT

A. Format and Content: Use the accepted Schedule of Values.

1. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

a. Generic name
b. Related specification section
c. Name of subcontractor
d. Name of manufacturer or fabricator
e. Name of supplier
f. Dollar value

2. Round amounts off to the nearest whole dollar. The total shall equal the Contract Amount.

1.03 PREPARATION OF APPLICATION

A. Each Application for Payment shall be consistent with previous applications for payments as certified and paid for by the County.

B. Payment Application Times: As stated in the General Conditions, Payment Applications shall be submitted monthly on a day of the month established by the County at the Pre-Construction Conference.

C. Application Preparation: Contractor shall complete every entry on the Pay Application form. The form shall be executed by a person authorized to sign legal

documents on behalf of the Contractor and the signature notarized. Incomplete applications will be returned without action. The following procedure shall be followed by the Contractor:

1. Submit applications typed on forms provided by the County.
2. Use data on Bid Form and approved Schedule of Values. Provide dollar value in each column for each line item for portion of Work performed and for stored products.
3. List each authorized Change Order and use additional sheets if necessary, list Change Order number and dollar amount for the original item of work.
4. Each item shall have an assigned dollar value for the current pay period and a cumulative value for the project to-date.
5. Submit stored material log, partial waivers of claims and mechanic liens, and Consent of Surety with each application, as further explained below.

D. Contractor shall submit a stored material log with each application for payment that identifies the type, quantity, and value of all stored material that tracks when the stored materials were installed and deducts the installed material from the stored quantity at that time. Include original invoices for all stored materials for which payment is requested.

E. Waivers of Claims and Mechanics Lien (Waivers): With each Application for Payment the Contactor shall submit waivers of claims and mechanic liens from suppliers for the construction period covered by the previous application.

1. The Contractor shall submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.
2. When an application shows completion of an item, the Contractor shall submit final or full waivers.
3. The Contractor shall submit the final Application for Payment with, if not already submitted, the final waivers from every entity involved with performance of work covered by the Application that could lawfully be entitled to a payment claim or lien.
4. Format of Waiver Forms: The Contractor shall submit executed waivers of claims and liens on forms acceptable to the County.
5. The County reserves the right to designate which entities involved in the Work must submit waivers.

F. Transmittal of Pay Applications: Contractor shall submit four (4) executed copies of each Application for Payment to the County. One (1) copy shall include all waivers of lien and similar attachments.

1. The Contractor shall transmit each Pay Application package with a transmittal form that lists attachments and all appropriate information related to the application. The transmittal form shall be acceptable to the County.

2. The Contractor shall include a certification with each application stating that all previous payments received from the County under the Contract have been applied by the Contractor to discharge, in full, all obligations of the Contractor in connection with the Work covered by prior applications for payment. The Contractor shall also certify that all materials and equipment incorporated into the Work are free and clear of all liens, claims, security interest, and encumbrances.

G. Initial Application for Payment Submittal: Administrative actions and submittals that must precede or coincide with submittal of the initial Application for Payment include the following:

1. List of Subcontractors
2. List of principal suppliers and fabricators
3. Schedule of Values
4. Contractor's Construction Progress Schedule (accepted)
5. List of Contractor's staff assignments
6. Copies of building permits
7. Copies of authorizations and licenses from governing authorities for performance of the Work
8. Certificates of insurance and insurance polices
9. Performance and Payment bonds (if required)
10. Data needed to acquire County's insurance

H. Monthly Application for Partial Payment Submittals: Administrative actions and submittals that must precede or coincide with submittal of Monthly Applications for Partial Payment include the following, as applicable:

1. Relevant tests
2. Progressive As-builts (one (1) paper copy and electronic copy)
3. Table 01050-2 Asset Attribute Data Form Examples (one (1) paper copy and electronic copy)
4. Table 01050-3 Pipe Deflection Table (one (1) paper copy and electronic copy)
5. Table 01050-4 Gravity Main Table (one (1) paper copy and electronic copy)
6. An electronic copy of all survey field notes
7. Partial Release of Lien

8. Partial Consent of Surety
9. Site photographs
10. Updated Progress Schedule: submit one (1) electronic copy and five (5) copies
11. Summary of Values
12. Pay Request
13. On-Site Storage of materials

I. Substantial Completion Application for Payment Submittal: Following issuance of the Certificate of Substantial Completion, Contractor shall submit an Application for Payment. This Application shall reflect any Certificates of Partial Substantial Completion issued previously for the County's occupancy of designated portions of the Work.

1. Administrative actions and submittals that shall precede or coincide with this application include:
    a. Occupancy permits and similar approvals
    b. Warranties (guarantees) and maintenance agreements
    c. Test/adjust/balance records
    d. Maintenance instructions
    e. Meter readings
    f. Start-up performance reports
    g. Change-over information related to the County's occupancy, use, operation and maintenance
    h. Final Cleaning
    i. Application for reduction of retainage and consent of surety
    j. Advice on shifting insurance coverage
    k. List of incomplete Work, recognized as exceptions to County's Certificate of Substantial Completion

J. Final Completion Application for Payment Submittal: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

1. Prior to submitting a request for final payment or the County issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the County for approval. Retainage funds will be withheld at the County's discretion based on the quality and accuracy of the final Record Documents.
2. Written signed statements by the Contractor
    a. Completion of project close-out requirements

b. Completion of items specified for completion after Substantial Completion
c. Assurance that unsettled claims are settled
d. Assurance that work not complete and accepted is now completed

3. Transmittal of Record Documents to the County

4. Proof that taxes, fees, and similar obligations have been paid

5. Removal of temporary facilities and services has been completed

6. Removal of surplus materials, rubbish, and similar elements

7. Execute certification by signature of authorized officer.

8. Prepare Application for Final Payment as required in General Conditions

1.04 PAY APPLICATION SUBSTANTIATING DATA

A. When the County requires substantiating data for a Pay Application, submit data justifying Pay Application line item amounts in question.

B. Provide one (1) copy of data with a transmittal letter for each copy of Pay Application submittal. The Pay Application number, date, and line item by number and description shall be clearly stated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01041
PROJECT COORDINATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. This Section includes requirements for coordinating with the Owner's operations during the Work, and includes requirements for tie-ins and shutdowns necessary to complete the Work without impact on the Owner's operations except as allowed in this Section.

2. CONTRACTOR shall provide labor, materials, tools, equipment, bypass pumps, standby generators, and incidentals shown, specified and required to coordinate with the Owner's operations during the Work.

B. Coordination:

1. Review installation procedures under other Specification sections and coordinate Work that must be performed with or before the Work specified in this Section.

2. All contacts, requests, changes, communications, and coordination with the Owner shall be initiated through the Owner's Resident Project Representative (RPR). Any other communication or request that is not initiated through the RPR will be null and void.

C. Construction Administration Request (C.A.R.) Form

1. The Contractor is responsible to submit a C.A.R. to the Owner's RPR for any interaction requiring the involvement of the Owner's Operational Staff for the SWRF, including but not limited to the following examples; existing valve actuation, process interruptions, equipment operation interruption, power interruption, flow diversions, training. The Contractor will not have contact with the Operations Staff without Owner's RPR's knowledge. The Owner's RPR reserves the right to direct the Contractor to provide a C.A.R. at his discretion. Unless otherwise noted by the Owner's RPR, a C.A.R. shall be submitted a minimum of seven (7) calendar days in advance of the intended operation noted within the C.A.R. Unless otherwise noted within the Contract Documents, for all activities affecting treatment process operation, a C.A.R. shall be submitted a minimum of thirty (30) days in advance of the scheduled activity. Unless otherwise noted within the Contract Documents, the schedule for performing work which will require shutting down a unit process must be coordinated with the Owner by C.A.R. submittal a minimum of sixty (60)

days in advance of the schedule activity. Reference a blank copy of the C.A.R. form within this section.

D. Related Sections include:

1. Section 01000, General Requirements
2. Section 01310, Progress Schedules
3. Section 01650, Start-up and Testing
4. Section 01720, Project Record Documents and Survey

E. Except for shutdowns specified, perform the Work such that the Owner's facility remains in continuous, permit compliant operation during the Project. Schedule and conduct the Work such that the Work does not impede the Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products of effluent, or cause odors or other nuisances.

1.02 PIPE LOCATIONS

A. Pipelines shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

1.03 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by workmen.

1.04 TEST PITS

A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated and backfilled by the Contractor. Test pits shall be backfilled immediately after their purpose has been satisfied and maintained in a manner satisfactory to the Engineer. The costs for such test pits shall be borne by the Contractor.

1.05 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the

Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer.

1.06 COORDINATION WITH OTHER PROJECTS

A. Other phases of construction may be ongoing or beginning before this Project is completed. Contractor shall coordinate construction activities with other contractors to allow orderly and timely completion of all work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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CONTRACTOR'S ASSISTANCE REQUEST
FOR ACCESS TO COUNTY FACILITIES

PROJECT: SWRF IPS Expansion and Upgrades

DATE: _____ NUMBER: _____

LOCATION/STRUCTURE: _____

_____

PURPOSE: _____

_____

_____

_____

ADDITIONAL ASSISTANCE REQUESTED: _____

_____

_____

_____

_____

DATE ACCESS NEEDED: _____

DURACTION OF WORK: _____

_____ _____

Contractor O.C.U. Construction

COMMENTS/RESTRICTIONS: _____

_____

_____

_____

_____

_____

_____

PLANT SUPERVISOR

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SECTION 01050
SURVEYING & FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide and pay for field engineering services for the Project.

1. Survey work required in execution of the Project.
2. Civil, structural or other professional engineering services specified or required to execute Contractor's construction methods.
3. The method of field staking for the construction of the work shall be at the option of the Contractor. The Drawings provide the engineering surveys to establish reference points which were judged necessary to enable the Contractor to proceed with his work.
4. The accuracy of any method of staking shall be the responsibility of the Contractor. All engineering for vertical and horizontal control shall be the responsibility of the Contractor.
5. The Contractor shall be held responsible for the preservation of all stakes and marks. If any stakes or marks are carelessly or willfully disturbed by the Contractor, the Contractor shall not proceed with any work until he has established such points, marks lines and elevations as may be necessary for the prosecution of the work.
6. The Contractor shall retain the services of a registered land surveyor licensed in the State of Florida to identify existing control points and maintain a survey during construction and for record drawing purposes.

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

A. Qualified engineer or registered land surveyor, acceptable to the Owner and the Engineer.

B. Registered Professional Engineer of the discipline required for the specific service on the Project, currently licensed in the State of Florida.

1.03 SURVEY REFERENCE POINTS

A. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.

1. Make no changes or relocations without prior written notice to the Engineer.

2. Report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. Require surveyor to replace Project control points which may be lost or destroyed at no additional cost to the Owner. Establish replacement based on original survey control.

1.04 PROJECT SURVEY REQUIREMENTS

A. Establish a minimum of two (2) permanent bench marks on site, referenced to data established by survey control points.

1. Record locations, with horizontal and vertical data, on Project Record Documents

B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:

1. Site improvements:

a. Stakes for grading, fill and topsoil replacement
b. Utility slopes and invert elevations

2. Batter boards for structures

3. Building foundations, column locations and floor levels

4. Controlling lines and levels required for mechanical and electrical trades

C. From time to time, verify layouts by same methods

1.05 RECORDS

A. Maintain a complete, accurate log of all control and survey work as it progresses. The Contractor shall be responsible for recording information on the approved plans concurrently with construction progress.

B. The Contractor's Surveyor shall be responsible for surveying utility assets concurrently (at a minimum monthly) with construction progress and providing as-built data to the Contractor. Monthly survey data and Contractor as-built record drawings shall be retained on the project site and made available to the Utilities representative.

C. Record drawings shall be legibly marked to record actual construction.

D. At the end of the project, submit a record drawing markup set of the original drawings, indicating the building corners and location of all structures, road intersections, and elevations and stationing at 100 foot increments and for all valve and fitting locations.

E. As-Built Asset Attribute Data Table (See Table 3111-2 of the Orange County Standards and Construction Specifications Manual). The Contractor's Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements for the table and include the Surveyor's statement regarding the constructed improvements being with in the specified accuracies as described in Table 3111-1 Minimum Survey Accuracies per Asset (Water, Wastewater, Reclaimed Water and Existing) of the Orange County Standards and Construction Specifications Manual or if not, indicating the variances. Utilities will provide an electronic version of a blank table that shall be used to input data.

F. At the end of the project, submit an electronic survey file of both surveys depicted in C and D above in AutoCAD 2008 or other Engineer approved version of AutoCAD. Submit an electronic file of the As-Built Asset Attribute Data Table as depicted in E above.

1.06 SUBMITTALS

A. Submit name and address of Surveyor and professional engineer to the Engineer.

B. On request of the Engineer, submit documentation to verify accuracy of field engineering work.

C. Submit certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance with the Contract Documents, or if not in conformance, certify as to variances from the Contract Documents.

D. Submit drawings showing locations of all structures constructed. This drawing shall be included with the project record documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01065
PERMITS AND FEES

PART 1 - GENERAL

1.01 REQUIREMENTS

A. General

The Contractor shall:

1. Obtain and pay for all permits and licenses as provided for in the General Conditions, except as otherwise provided herein.
2. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.
3. Comply with all conditions specified in each of the permits and licenses.
4. The Contractor shall, within 14 days of the date of the Notice-to-Proceed, prepare for and attend a meeting with representatives from the Owner and the Engineer to review requirements for preparation of a Florida Department of Environmental Protection (FDEP) Notice-of-Intent (NOI) application and Storm Water Pollution Prevention Plan (SWPPP) for compliance with the USEPA's NPDES General Permit for construction activities.

B. Permits by Contractor

Contractor shall apply and pay for at least the following permits and pay costs to keep permits active:

1. FDEP Notice of Intent to use the Generic Construction NPDES permit (See Section 02270)
2. St. John's River Water Management District Dewatering Permit. Refer to Section D below.
3. Orange County Division of Building Safety – Commercial Building Permit (s).
    a. General Commercial Building Permit – The County will pay all fees associated with the General Commercial Building Permit from the Orange County Division of Building safety. Orange County Utilities Engineering will provide Resident Project Representatives for inspection services associated with the Utilities Engineering Division.
    b. Sub-trade Commercial Building Permit (s) – The Contractor shall pay for and obtain all the Sub-trade Commercial Building Permits associated with the General Building Permit. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.
    c. Fire Alarm System – The Contractor is responsible for paying for and submitting fire alarm drawings signed and sealed by an electrical engineer registered in the state of Florida. These drawings shall be

submitted to the Orange County Division of Building Safety within six (6) weeks of issuance of the Notice to Proceed for this project. The Contractor will be responsible for providing timely responses to any comments received from the Building Department to avoid delaying issuance of the Building Permit. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Fire Alarm System in order to obtain final approval.

C. Permits by County

1. The County will apply and pay for the following permits:

   a. Florida Department of Environmental Protection (FDEP) Domestic Wastewater Facility Permit.
   b. Florida Department of Environmental Protection (FDEP) Environmental Resource Permit.

2. A copy of the FDEP permits obtained by the County will be furnished to the Contractor at the time when the Notice to Proceed is issued.

3. The County will pay all fees associated with the General Commercial Building Permit from the Orange County Division of Building Safety. Orange County Utilities Engineering will provide Resident Project Representatives for inspection services associated with Utilities Engineering Division. The Contractor shall pay for and obtain all the Sub-trade Commercial Building Permits associated with the General Building Permit. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.

D. Dewatering Activities

1. If dewatering is required, the Contractor shall coordinate with the St. John's River Water Management District regarding the applicable rules and regulation. If a dewatering permit is required, the Contractor shall prepare an application to the District and pay any fee.

END OF SECTION

SECTION 01070
ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.01 STANDARDS AND ABBREVIATIONS

A. Referenced Standards: Any reference to published specifications or standards of any organization or association shall comply with the requirements of the specification or standard which is current on the date of Advertisement for Bids. In case of a conflict between the referenced specifications or standards, the one having the more stringent requirements shall govern.

B. In case of conflict between the referenced specifications or standards and the Contract Documents, the Contract Documents shall govern.

C. Abbreviations:

AA	Aluminum Association
AAA	American Arbitration Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHO	The American Association of State Highway Officials
ABA	American Bar Association
ABMA	American Boiler Manufacturers Association
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturers Association

AHA	American Hardboard Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIA	American Insurance Association
AIEE	American Institute of Electrical Engineers (Now IEEE)
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Condition Association
ANSI	American National Standard Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ARI	American Refrigeration Institute
ASA	American Standards Association (Now ANSI)
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSCBC	American Standard Safety Code for Building Construction
ASSHTO	American Association of State Highway Transportation Officials
ASTM	American Society for Testing and Materials

AWG	American Wire Gauge
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CFS	Cubic Feet Per Second
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
DOT Spec	Standard Specification for Road and Bridge Construction Florida Department of Transportation, 1982
E/A	Engineer and/or Architect
EDA	Economic Development Association
EEI	Edison Electric Institute
EPA	Environmental Protection Agency
FCI	Fluid Control Institute
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation

Fed Spec	Federal Specification
FPS	Feet Per Second
FS	Federal Standards
GPM	Gallons Per Minute
HMI	Hoist Manufacturers Institute
HP	Horsepower
HSBII	Hartford Steam Boiler Inspection and Insurance Co.
ID	Inside Diameter
IEEE	Institute of Electrical and Electronic Engineers
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
MGD	Million Gallons Per Day
MHI	Materials Handling Institute
MMA	Monorail Manufacturers Association
NBFU	National Board of Fire Underwriters
NBHA	National Builders' Hardware Association
NBS	National Bureau of Standards
NCSA	National Crushed Stone Association
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors' Association
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
NLA	National Lime Association

NPC	National Plumbing Code
NPT	National Pipe Threads
NSC	National Safety Council
NSF	National Sanitation Foundation
OD	Outside Diameter
OSHA	U.S. Department of Labor, Occupational Safety and Health Act
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	United States Products Standards
PSI	Pounds per Square Inch
PSIA	Pounds per Square Inch Absolute
PSIG	Pounds per Square Inch Gauge
RAS	Return Activated Sludge
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
SDI	Steel Decks Institute
SJI	Steel Joists Institute
SJRWMD	St. Johns River Water Management District
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
SSPC	Structural Steel Painting Council
STA	Station (100 feet) Intervals
TDH	Total Dynamic Head

TH	Total Head
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
USASI or	United States of America Standards Institute

Additional abbreviations and symbols are shown on the Drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01100
SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.01 EXCAVATION AROUND AND CONNECTION TO EXISTING UTILITIES

A. It is essential that the Contractor understand that the existing utilities must be kept in operation with minimal impact and shut-downs. To this end, the Contractor shall coordinate and consult with the Owner's operating personnel before excavating around or cutting into existing utilities on the site. Moreover, the Contractor shall not interfere the operation of trucks picking up screenings at the existing influent pump station. Existing utilities of major concern are water, wastewater, reclaimed water, odor control, electrical power conduits and cables, instrumentation conduits and cables and drain lines.

B. Some areas within the construction site will require hand excavation due to the congestion of underground piping systems and/or due to the criticality of piping systems that may be damaged unavoidably during machine excavation.

C. Cover for underground piping shall not be less than that indicated on the Drawings. In areas where other piping conflicts preclude the minimum cover desired, the piping shall be laid to provide the minimum cover obtainable.

D. All connections to existing piping systems shall be made as shown or indicated on the Drawings after consultation, cooperation, and coordination with the Owner's personnel. Some such connections may have to be made during off-peak hours (late night or early morning hours). The Contractor shall give a minimum of 72 hours notice to the Owner when tie-ins with the existing utilities are required.

E. For major utility pipeline tie-ins and relocations, the Contractor shall submit a detailed Plan of Action for review and approval by the Owner and the Engineer. The review will take a minimum of 30 days. No major utility relocation or tie-ins shall proceed until the Plan of Action for that Work is approved.

1.02 NOISE CONTROL

1. Contractor shall take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All construction machinery and vehicles shall be equipped with practical sound-muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

2. Sound levels shall not exceed 50 dBA from 7:00 P.M. to 7:00 A.M. or 60 dBA 7:00 A.M. to 7:00 P.M. This sound level shall be measured at the

perimeter of the Construction Limits for the Project. Levels adjacent to any construction equipment shall not exceed 85 dBA at any time. Sound levels in excess of these values are sufficient cause to have the Work halted until equipment can be quieted to these required levels. Work stoppage by the Engineer or Owner for excessive noise shall not relieve the Contractor of the other portions of this Specification including, but not limited to, completion dates and bid amounts.

3. During construction activities on or adjacent to occupied buildings, and when appropriate, Contractor shall erect screens or barriers effective in reducing noise in the building and shall conduct its operations to avoid unnecessary noise which might interfere with the activities of building occupants.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. The Contractor shall cooperate and coordinate with the Engineer to schedule and administer the preconstruction meeting, monthly progress meetings, and specifically called meetings throughout the progress of the Work. The Engineer will prepare agenda for meetings in electronic format. The Contractor shall:

   a. Make physical arrangements for meetings
   b. Preside at meetings
   c. Take and distribute meeting minutes electronically

2. Representatives of Contractor, subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

3. The Owner shall attend meetings to ascertain that the Work is expedited consistent with Contract Documents and construction schedules.

4. The Contractor shall record the preconstruction meeting and each progress meeting in its entirety, and shall provide the Engineer with a regular cassette copy of such recording, having good quality and clarity, and a typed transcript of the minutes of each meeting. A copy of the minutes of each progress meeting shall be available five business days after the meeting.

B. Related Requirements Described Elsewhere:

1. Construction Progress Schedules: Section 01310

2. Project Record Documents and Survey: Section 01720

1.02 PRECONSTRUCTION MEETING

A. Engineer will schedule a preconstruction meeting no later than twenty (20) days after date of Notice to Proceed. The meeting shall be scheduled at the convenience of all parties.

B. Location: A local site, convenient for all parties, designated by the Engineer.

C. Attendance:

1. Owner and/or Owner's representative
2. Engineer and his professional consultants
3. Resident Project Representative (RPR)
4. Contractor and his superintendent
5. Major subcontractors
6. Representatives of major suppliers and manufacturers as appropriate
7. Governmental and Utilities representatives as appropriate
8. Others as requested by the Contractor, Owner, and Engineer

D. The Engineer shall preside at the preconstruction meeting. The Engineer shall provide for keeping minutes and distribution of minutes to the Owner, Contractor and others. The purpose of the preconstruction meeting is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.

E. The suggested agenda for the preconstruction meeting would include the following:

1. Distribution and discussion of:
    a. List of major subcontractors and suppliers
    b. Projected schedules
    c. Schedule of Values
2. Critical work sequencing: Relationships and coordination with other contracts and/or work and continuing water treatment plant operation.
3. Major equipment deliveries and priorities
4. Project coordination: Designation and responsible personnel
5. Procedures and processing of:
    a. Field decisions
    b. Proposal requests
    c. Request for Information
    d. Submittals
    e. Change Orders
    f. Applications for Payment
6. Submittal of Shop Drawings, project data and samples.
7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining Record Documents
9. Use of premises:
    a. Office, work, and storage areas
    b. Owner's requirements

c. Access and traffic control

10. Construction facilities, controls, and construction aids
11. Temporary utilities
12. Safety and first aid procedures
13. Check of required Bond and Insurance certifications
14. Completion time for contract and liquidated damages
15. Request for extension of Contract Time
16. Procedures for periodic monthly (or whatever interval is deemed appropriate or necessary, however, a minimum of monthly meetings will be required) progress meetings, for all involved
17. Security procedures
18. Procedures for making partial payments
19. Guarantees on completed work
20. Equipment to be used
21. Project layout and staking of work
22. Project inspection
23. Labor requirements
24. Laboratory testing of material requirements
25. Provisions for material stored on site and monthly inventory of materials stored
26. Requirements of other organizations such as utilities, railroads, highway departments, building departments
27. Rights-of-way and easements
28. Housekeeping procedures
29. Liquidated damages
30. Posting of signs and installation of Project Sign
31. Pay request submittal dates
32. Equal opportunity requirements

1.03 MONTHLY PROGRESS MEETINGS

A. The RPR shall schedule regular periodic meetings. The progress meetings will be held a minimum of once every thirty (30) days and at other times as required by the progress of the Work. The first meeting shall be held within thirty (30) days after the preconstruction meeting or thirty (30) days or less after the date of Notice to Proceed.

B. Hold called meetings as required by progress of the Work

C. Location of the meetings: At Facility Conference Room

D. Attendance:

1. Engineer and his professional Subconsultants as needed
2. Resident Project Representative
3. Contractor and his Superintendent
4. Owner's representatives
5. Subcontractors (active on the site, as appropriate to the agenda)
6. Others as appropriate to the agenda (suppliers, manufacturers, other subcontractors, etc.)

E. The RPR shall preside at the meetings. The Contractor shall provide for keeping minutes and distribution of the minutes to the Owner, Engineer, and others. The purpose of the meetings will be to review the progress of the Work.

F. The suggested agenda for the progress meetings will include but not be limited to the following:

1. Review approval of minutes of previous meeting
2. Review of Work progress since previous meeting and Work scheduled (3-week look ahead schedule)
3. Field observations, problems, conflicts
4. Problems which impede construction schedule
5. Review of off-site fabrication, delivery schedules
6. Corrective measures and procedures to regain projected schedule
7. Status of approved Project Schedule and revisions to the Construction Schedule as appropriate
8. Progress schedule during succeeding work period
9. Coordination of schedules
10. Review status of submittals and submittal schedule, expedite as required
11. Maintenance of quality standards
12. Pending changes and substitutions
13. Shop drawing problems
14. Review proposed changes for:
    a. Effect on Construction Schedule and on completion date
    b. Effect on other contracts of the Project

15. Critical/long lead items

16. Other business

G. The Contractor is to attend progress meetings and is to study previous meeting minutes and current agenda items, and be prepared to discuss pertinent topics and provide specific information including but not limited to:

1. Status of all submittals and what specifically is being done to expedite them.

2. Status of all activities behind schedule and what specifically will be done to regain the schedule.

3. Status of all material deliveries, latest contact with equipment manufacturer, and specific actions taken to expedite materials.

4. Status of open deficiencies and what is being done to correct the same.

H. The Contractor is to provide a current submittal log at each progress meeting in accordance with Section 01300: Submittals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01300
SUBMITTALS

PART 1 - GENERAL

A. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

1.01 SHOP DRAWINGS AND DATA

A. Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

B. All submittals, regardless of origin, shall be approved by Contractor and clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Contractor. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

C. Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp or affixed approval statement of a submittal, is a representation to Owner and Engineer that Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.

D. All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

E. The Contractor shall submit shop drawings in hard copy. All submittals made by any method other than hard copy by the Contractor will be returned without review.

F. Five copies of each drawing and the necessary data shall be submitted to Engineer. Engineer will return two marked copies (or one marked reproducible copy) to Contractor. Facsimile (fax)or electronic copies will not be acceptable. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

1.02 REVIEW OF SHOP DRAWINGS AND SAMPLES

A. The Engineer’s review of Shop Drawings, Data, and Samples as submitted by the Contractor will be to determine if the items(s) generally conform(s) to the information in the Contract Documents and is/are compatible with the design concept. The Engineer's review and exceptions, if any, will not constitute an approval of dimensions, connections, quantities, and details of the material, equipment, device, or item shown.

B. The review of drawings and schedules will be general, and shall not be construed:

1. As permitting any departure from the Contract Documents
2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
3. As approving departures from details furnished by the Engineer, except as otherwise provided herein

C. If the drawings or schedules as submitted describe variations and show a departure from the Contract Documents which the Engineer finds to be in the interest of the County and to be so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.

D. "Approved As Noted": Contractor shall incorporate Engineer's comments into the submittal before release to manufacturer. The Contractor shall send a letter to the Engineer acknowledging the comments and their incorporation into the Shop Drawing.

E. "Revise and Resubmit": Contractor shall resubmit the Shop Drawing to the Engineer. The resubmittal shall incorporate the Engineer's comments highlighted on the Shop Drawing.

F. "Disapproved": Contractor shall correct, revise and resubmit Shop Drawing for review by Engineer.

G. Resubmittals will be handled in the same manner as first submittals. For resubmittals the Contractor shall direct specific attention, in writing or on resubmitted Shop

Drawings, to revisions other than the corrections requested by Engineer on previous submissions. The Contractor shall make any corrections required by the Engineer.

H. If the Contractor considers any correction indicated on the Drawings to constitute a change to the Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.

I. When the Shop Drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the Construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

J. No partial submittals will be reviewed. Submittals not deemed complete will be stamped "Rejected" and returned to the Contractor for resubmittal. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items for:

1. Systems
2. Processes
3. As indicated in specific Specifications Sections

K. All drawings, schematics, manufacturer's product data, certifications, and other Shop Drawing submittals required by a system specification shall be submitted at one time as a package to facilitate interfaces checking.

L. Only the Engineer shall utilize the color "red" in marking Shop Drawing submittals.

M. Failure to comply with any of the above may result in the rejection of Shop Drawings.

1.03 PRODUCT DATA

A. Submit not less than 6-copies, unless approved by the Engineer. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information unique to the Work.

1.04 MANUFACTURERS' INSTRUCTIONS

A. When required in an individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing, in quantities specified for product data.

1.05 SAMPLES

A. Submit full range of manufacturers' standard colors, textures and patterns for the County's selection. Submit samples for selection of finishes within 30-days after

Award of Contract. All color and finish selections must be submitted by the Contractor in a single submission, properly labeled and identified.

B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.

C. Submit the number of samples specified in the respective Specification section, but no less than two (2). After review one (1) will be retained by the County. Reviewed samples that may be used in the Work are indicated in the Specification Section.

D. Samples shall be delivered to the County as directed. The Contractor shall prepay shipping charges on samples. Materials or equipment for which samples are required shall not be used in the Work until approved by the Engineer.

E. Samples shall be of sufficient size to clearly illustrate:

1. Functional characteristics of the product, with integrally related parts and attachment devices
2. Full range of color, texture and pattern
3. Each sample shall have a label indicating:
    a. Name of Project
    b. Name of Contractor and Subcontractor
    c. Material or equipment represented
    d. Place of origin
    e. Name of product and brand (if any)
    f. Location in Project
    g. Specification title and number
    h. Submittal number
    i. Note: Samples of finished materials shall have additional marking that will identify them under the finished schedules.

F. The Contractor shall prepare a transmittal letter, in triplicate (3) for each shipment of samples containing the information required in paragraph herein. The Contractor shall enclose a copy of this letter with the shipment and send a copy of this letter to the Engineer. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Contract requirements.

G. Approved samples not destroyed in testing shall be sent to the County or stored at the site of the Work. Approved samples of the hardware in good condition may be incorporated in the Work if requested in writing by the Contractor and approved in writing by the Engineer. Samples that failed testing or were not approved will be returned to the Contractor at the Contractor's expense, if so requested at time of submission.

1.06 FIELD SAMPLES

A. Provide field samples of finishes as required by individual Specifications sections. Install the sample completely and finished. Acceptable samples in place may be retained in completed Work.

1.07 DRAWINGS, PRODUCT DATA AND CERTIFICATES

A. Each letter of transmittal shall identify each and every item transmitted by title, drawing number, revision number and date.

B. The County generally will not check dimensions, quantities or schedules, except in cases where the information is lacking in the Specifications.

C. The following is applicable to submitted drawings, data and certificates:

1. Show relation to adjacent structures or materials.
2. Clearly identify field dimensions.
3. Show required dimensions and clearances.
4. Performance characteristic and capabilities shall accompany original Shop Drawing submittals.
5. Wiring diagrams and controls shall accompany original Shop Drawing submittals.
6. Installation instructions shall accompany original Shop Drawing submittals.
7. Each submittal shall identify applicable Standards, such as ASTM number or Federal Specification number.
8. All information not pertinent shall be removed from the submittal, or shall be crossed out.

D. When resubmission is required, the Engineer will return only two (2) marked up copies. A third submission from the same manufacturer will not be accepted.

1.08 SUBSTITUTIONS

A. The substitution requirements of this Section are in addition to the requirements of the General Conditions and Supplementary Conditions.

B. When a particular product is specified or called for, it is intended and shall be understood that the proposal tendered by the Bidder includes those products in his Bid. Substitutions will only be considered in cases where original materials are unavailable or in an instance where substitute can be proven superior in its planned application.

C. The intent of these specifications is to provide the County with a quality facility without discouraging competitive bidding. For products specified only by reference standards, performance and descriptive methods, without naming manufacturer's products, the Contractor may provide the products of any manufacturer complying with the Contract Documents, subject to the review of product data by the Engineer as specified herein.

D. The Engineer's approval is required for substitutions.

E. The Contract is based on the materials, equipment and methods described in the Contract Documents.

F. The Engineer will consider proposals for substitution of materials equipment and methods only when such proposals are accompanied by full and complete technical data and all other information required by the Engineer to evaluate the proposed substitution.

G. Do not substitute materials, equipment or methods unless such substitution has been specifically approved for this Work by the Engineer in writing. The Contractor must provide a submittal per this Section specifically requesting approval of the substitution. Failure to specifically identify the requested substitution may invalidate approval of a submittal.

1.09 AVAILABILITY OF SPECIFIED ITEMS

A. Verify prior to bidding that all specified items will be available in time for installation during Construction for orderly and timely progress of the Work.

B. In the event that specified items will not be available, notify the Engineer prior to receipt of proposals.

1.10 OPERATING MANUALS

A. Submit all manuals in accordance with requirements of Divisions 2 through 16 of the Contract Specifications and Section 01700 "Contract Closeout."

1.11 WARRANTIES, GUARANTEES AND BONDS

A. Provide as required by Technical Sections of the Specifications and Sections 01700 "Contract Closeout" and Section 01740 "Warranties and Bonds."

1.12 CADD FILES

A. The Professional's CADD files will be available on a limited basis to qualified firms at the County’s prerogative. The procedure for requesting such files is noted elsewhere in these documents and there is a cost associated with handling and

reproduction. Recipients are cautioned that these files may not accurately show actual conditions as constructed. Users are responsible to verify actual field conditions.

B. The Professional's Drawings are to be used only for background information. If the Professional's Drawings are just reproduced and resubmitted (e.g. for ductwork drawings) they will be rejected.

C. Copies of data furnished by the Engineer to Contractor or Contractor to Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

D. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60-days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

E. When transferring documents in electronic media format, the transferring party makes no representations as to long-term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

1.13 PROGRESS PHOTOGRAPHS

A. Photographs and digital pictures shall be in color. Provide 1 copy of each digital picture on each of three (3) CDs and provide 1 print of each photograph in two (2) separate albums.

B. Photographs shall be from locations to illustrate the condition of Construction and state of progress adequately.

C. Provide up to 30 digital photographs of views randomly selected by the County, taken prior to any construction and prior to each scheduled Application for Payment.

D. Deliver electronic images, prints, and negatives to the County.

E. Each print shall be single weight paper with glossy finish and the overall dimension shall be 7-1/2-inch x 10-inches (19.05 x 25.4 cm). The print shall be clear, sharp and free of distortion after the enlargement from the negative.

F. Provide loose-leaf albums for each set of photographs to hold prints with a maximum of 50-leaves per binder.

G. Each print shall be protected by flexible, transparent acetate or plastic sheet protector leaves with metal reinforced holes. Two (2) extra leaves shall be provided in each binder.

H. The Contractor shall provide before and after photographs of each portion of the site. The below ground facilities shall include all equipment, walls, floor, piping, supports and entrance. At major locations, photographs shall include before, during, and after prints and all prints shall be placed in binders in ascending date order to show the Work as it progresses.

I. Descriptive Information:

1. Each photograph shall have a permanent title block on the back and shall contain the typed information and arrangement as follows:

a. ORANGE COUNTY, FLORIDA
b. (ENTER PROJECT NAME)
c. BID No. (Enter Bid Number)
d. CONTRACTOR: (Name of Contractor)
e. DATE: (When photo was taken)
f. PHOTO NO.: (Consecutive Numbers)
g. PHOTO BY: (Firm Name of Photographer)
h. LOCATION: (Description of Location and View)

2. The Contractor shall provide the Professional with a written description of each photograph. This description shall be included in the binders and a copy shall be submitted with the CDs.

1.14 PROJECT RECORD DOCUMENTS

A. Project Record Documents shall be submitted in accordance with Section 01720 "Project Record Documents" of these specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SUBMITTAL PROCEDURES

A. Article 9 of the General Conditions contains additional provisions regarding submittals.

B. Preliminary Shop Drawing Data: Within 20-days after the Award of the Contract or before the Pre-Construction Meeting, the Contractor shall submit to the Engineer a

complete listing of manufacturers for all items for which Shop Drawings are to be submitted.

C. Shop Drawing Submittal Schedule: Within 30-days after the Notice to Proceed, the Contractor shall submit to the Engineer a complete schedule of Shop Drawings submittals with the respective dates for submission, the beginning of manufacture, testing and installation of materials, supplies and equipment, noting those submittals critical to the progress schedule.

D. Submittal Log: An accurate updated log of submittals will be maintained by the Contractor and subject to review by the Engineer at each scheduled progress meeting.

E. If the Contractor considers any correction indicated on the Drawings to constitute a change to the Contract Drawings or specifications, the Contractor shall give written notice thereof to the Engineer. This does not constitute a change order until accepted by the County.

F. Shop Drawing and submittal data shall be reviewed by the Engineer for each original submittal and first resubmittal; thereafter review time for subsequent resubmittals shall be charged to the Contractor. The Contractor shall reimburse the County for services rendered by the Engineer at the rate multiplied by the County's Professional multiplier based on the fee schedule provided to the County for this Project. If a County engineer is performing any portion of the review, this fee is based upon the hourly rate of the engineer times the County's multiplier for overhead, benefits, and expenses. The Contractor agrees that the County shall deduct such charges from the Contract Amount by a deductive Change Order.

G. Contractor Shop Drawing and Sample submittals shall include 5 copies in addition to any other copies that the Contractor wants returned. The County will retain 5 copies of approved submittals. In addition to the hard copies, the Contractor shall submit at the same time electronic (PDF) files of transmittals, shop drawings, equipment or product data information, and O&M manuals.

H. Identify Project, Project Number, date, dates of previous submittals, Contractor, Sub-Contractors, suppliers with their addresses, pertinent Drawings by sheet and detail number, and Specification Section number, as appropriate. Identify all deviations from the Contract Documents. Provide space for Contractor and Professional review stamps.

I. Contractor's delivery of Shop Drawings for review shall follow a reasonable sequence, as is necessary to support the dates on the Progress Schedule and avoid an overload of Shop Drawings awaiting review at any one time. Coordinate submittal of related items.

J. Submit Shop Drawings per the schedule of Shop Drawing submittals, inserted in 1 loose-leaf binder, with tabs and index to the Engineer. All individual submittal sheets inserted in said binder must be clearly marked and referenced to proper paragraph

and subparagraph of specifications. Cross out any items on sheets which constitute information not pertaining to equipment specified. Clearly mark all components that are provided as "optional" by manufacturer. Shop Drawings shall be approved by the Contractor prior to submittal to the Engineer. Shop Drawings will be reviewed by the Engineer. After Engineer approval, reproduce and distribute in accordance with requirements herein.

K. All submissions of Shop Drawings, brochures and catalog cuts shall be accompanied by a transmittal letter listing the Drawings submitted by number and title.

L. When engineering calculations and/or professional certification of performance criteria of materials, systems, and/or equipment are required, the County is entitled to rely upon the accuracy and completeness of such calculations and certifications submitted by the Contractor. Calculations, when required, shall be submitted in a neat, clear and in an easy to follow format. Such calculations and/or certifications shall be signed and sealed by a Professional Engineer registered in the State of Florida.

M. Distribute copies of reviewed submittals to concerned parties. Instruct recipients to promptly report any inability to comply with provisions.

N. Prior to submission of Shop Drawings and samples, the Contractor shall stamp and sign the submittals. Any submission which, upon examination by the County, shows evidence of not having been thoroughly checked, or is not in compliance with the provisions of this Section will be returned to the Contractor for completion before it will be considered for review.

O. Notify the County of the need for making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the material or equipment Contactor proposes to supply.

P. On resubmittals, direct specific attention in writing or on the revised Drawings or sample to revisions other than the corrections required by County on previous submissions.

Q. All drawings, schematics, manufacturer’s product data, certifications and other drawing submittals required for a system specification shall be submitted at one time as a package to facilitate interface checking.

R. The County will distribute Shop Drawings as follows for the indicated action taken:

SHOP DRAWING SUBMITTAL DISTRIBUTION

Representative Party	No Exception Taken or Make Correction Noted			Rejected or Revise & Resubmit		
	Submittal Transmittal	Shop Drawing	Review Comment Sheet	Submittal Transmittal	Shop Drawing	Review Comment Sheet
Engineer	2 Copies	File Copy	1 Copy	Original	File Copy	1 Copy
Contractor (see Note 1)	2 Copies	1 Copy Each Submittal	1 Copy	1 Copy	All Copies Except Engineers	1 Copy
County	1 Copy	1 Copy Each Submittal	1 Copy	1 Copy	None	1 Copy
Inspector	2 Copies	1 Copy Each Submittal	1 Copy	1 Copy	None	1 Copy
Project Record Data (see Note 2)	1 Copy	1 Copy Each Submittal	1 Copy	1 Copy	None	1 Copy

NOTES:
1. Contractor shall distribute additional copies to Subcontractors as required.
2. Stored by Contractor to be furnished to County upon closeout.

S. All Shop Drawings shall be accompanied with a transmittal letter providing the following information:

1. Project Title and Contract Number
2. Date
3. Contractor's name and address
4. The number of each Shop Drawing, project data, and sample required
5. Notification of Deviations from Contract Documents
6. Submittal Log Number conforming to specification section numbers
   a. Submit each specification section separately.
   b. Identify each Shop Drawing item required under respective specification section.
   c. Identify resubmittal using specification section followed by A (first resubmittal), B (second resubmittal)…etc.

3.02 CONTRACTOR'S REVIEW

A. Contractor's Responsibility for Coordination: Where the dimension, size, shape, location, capacity or other characteristic affects another item, and where the

Contractor selects, fabricates or installs related or adjacent products to be used, the Contractor shall be responsible for coordination of related items. The Contractor shall insure that a proper exchange of information takes place prior to or during preparation of each submittal and that submittals reflect such coordination. The notation "verify" or "coordinate" on the Drawings indicates the necessity for Contractor coordination in the particular instances used.

B. Contractor's Checking: When checking submittals from Subcontractors and suppliers, the Contractor shall mark all sets, indicating his corrections and comments in blue or green. Copies marked in red may be returned for revision.

C. The Contractor is responsible to deliver and pick-up all submittals in a timely manner at the Engineer's designated office. The Contractor is responsible for all related costs and expenses for the transmittal of such submittals.

3.03 COUNTY'S / PROFESSIONAL'S REVIEW

A. Corrections or comments made on Shop Drawings during review do not relieve the Contractor from compliance with the requirements of Drawings and Specifications. This check is only for review of general conformance with the design concept of this Project and general compliance with information given in Contract Documents. Any substitutions or changes shall be properly noted.

B. No action will be taken on "rough-in" Shop Drawings for plumbing and electrical connections when the items of equipment are not included in the same submittal.

C. Review Time:

1. On a normal basis, each submittal will be returned to the Contractor within 21 working days of the date it is received. Some submittals may require additional time.

2. If, for any reason, the above schedule cannot be met, the Contractor will be so informed within a reasonable period and the Schedule of Submittals revised. If the specific submittal affects the critical path, the Contractor shall immediately notify the Engineer in writing. In the event of separate submittals of individual components of a system, these submittals may be held until all components of the system are submitted, and the Contractor will be so notified.

END OF SECTION

SECTION 01310
PROGRESS SCHEDULES

PART 1 - GENERAL

1.01 REQUIREMENT

A. The Contractor will submit precedence method cost loaded Critical Path Method (CPM) Progress Schedules to the County depicting the approach to prosecution and completion of the Work. This requirement includes, but is not limited to the Contractor's approach to Activity cost loading, recovering schedule and managing the effect of changes, substitutions and Delays on Work sequencing.

B. The Progress Schedule shall show how the Contractor's priorities and sequencing for the Work (or Work remaining) conform to the Contract requirements and the sequences of Work indicated in or required by the Contract Documents; reflect how the Contractor anticipates foreseeable events, site conditions and all other general, local and prevailing conditions that may affect cost, progress, schedule, furnishing and performance of the Work; and show how the Contractor's Means and Methods translate into Activities and logic.

C. The Progress Schedule will consist of the Initial Submittal, Payment Submittals and Revision Submittals. Upon acceptance by the County and/or the Engineer, the Initial Submittal will become the As-Planned Schedule for the Work. Revision submittals upon acceptance will become the As-Planned Schedule for the Work remaining to be completed as of the submittal date for that Revision.

D. References to the Critical Path Method (CPM) are to CPM construction industry standards that are consistent with the requirements of this Section.

1.02 GLOSSARY OF TERMS

A. The following terms, whether or not already defined elsewhere in the Contract Documents, have the following intent and meanings within this Section:

1. Activity Value (Value): That portion of the Contract Price representing an appropriate level of payment for the part of the Work designated by the Activity.
2. As-Planned Schedule: The first, complete Initial Progress Schedule submitted by the Contractor with the intent to depict the entire Work as awarded and accepted by the County or returned as no resubmittal required.

3. Contract Float: Days between the Contractors anticipated date for completion of the Work, or of a specified portion of the Work, if any, and the corresponding Contract Time.

4. CPM Schedule: The Progress Schedule based on the Critical Path Method (CPM) of scheduling. The term Critical Path means any continuous sequence of Activities in the Progress Schedule controlling, because of their sum duration, the Early Date of a pertinent, specified Contract Time.

5. Early/Late Dates: Early/late times of performance, based on CPM calculations, for an Activity in the Progress Schedule. Early Dates will be based on proceeding with all or part of the Work on the date when the corresponding Contract Time commences to run. Late Dates will be based on completing all or part of the Work on the corresponding Contract Time, even if the Contractor plans early completion.

6. Milestones: Key, pre-determined points of progress in the completion of a facility, denoting interim targets in support of the Contract Times. Milestones may pinpoint targets for key excavation and substructure events, significant deliveries, critical path transition from superstructure to piping and electrical rough in and building enclosure. Also, hook-up of mechanical and electrical equipment, availability of power for testing, equipment shakedown, training of County personnel, start□-up, Substantial Completion and other events of like import.

7. Official Schedule: The Initial or most recent Revision Submittal accepted by the County or returned as no resubmittal required and the basis for Payment Submittals until another Revision Submittal is submitted and accepted. The accepted Initial Submittal is also the As-Planned Schedule.

8. Payment Submittal: A monthly Progress Schedule update reflecting progress and minor adjustments on the Activities, sequencing and restraints for Work remaining.

9. Total Float: Days by which an activity may slip from its Early Dates without necessarily extending a pertinent Contract Time. Total Float at least equals Contract Float. Total Float may also be calculated and reported in working Days. When an activity is delayed beyond Early Dates by its Total Float it becomes a Critical Path activity and if delayed further will impact a Contract Time.

1.03 QUALITY ASSURANCE

A. The Contractor may self-perform the Work covered by this Section or employ a Subcontractor, subject to the County's consent. Employment of a scheduling Subcontractor shall not in any way alter or reduce the Contractor's obligations under the Contract Documents.

B. The Contractor will obtain a written interpretation from the County, if the Contractor believes that the selection of activities, logic ties and/or restraints requires a written

interpretation of the Contract Documents. With each submission, the Contractor will point out by specific, written notation, any Progress Schedule feature that may reflect variations from any requirements of the Contract Documents.

C. It is the Contractor's responsibility to obtain information directly from each Subcontractor and Supplier when scoping their respective Activities, Values, logic ties and restraints.

D. Neither Acceptance nor Review of any Progress Schedule will relieve the Contractor from the obligation to comply with the Contract Times and any sequence of Work indicated in or required by the Contract Documents and to complete, within the Contract Times, any Work omitted from that Progress Schedule.

E. Neither Acceptance nor Review of any Progress Schedule will imply approval of any interpretation of or variation from the Contract Documents, unless expressly approved by the County through a written interpretation or by a separate, written notation on the returned Progress Schedule Submittal.

1.04 MILESTONES AND SCHEDULE RECOVERY

A. The County will select Milestones and Milestone Dates on the basis of the As-Planned Schedule. As the Official Schedule is revised, Milestone Dates will be revised accordingly. Milestone Dates will serve as target dates.

B. Whenever any Activity slips by 14 or more Days from the Late Date for an activity in the Official Schedule, Milestone Dates selected by the County, or a pertinent Contract Time, the Contractor will deliver a Revision Submittal documenting the Contractor’s schedule recovery plan and/or a properly supported request for an extension in the Contract Time. The narrative will identify the Delay and actions taken by the Contractor to recover schedule, whether by adding labor, Subcontractors or construction equipment, activity re-sequencing, expediting of submittals and/or deliveries, overtime or shift Work, and so forth. Activity shortening and overlapping shall be explained as to their basis (and be supported by increases in resources).

C. Upon evaluation of that Revision Submittal, if the County determines there is sufficient cause, the County may withhold liquidated damages or provide a notice of intent to do so, if schedule is indeed not recovered, and/or may give a notice of default.

1.05 PROGRESS SCHEDULE SOFTWARE

A. The scheduling software employed by the Contractor to process the Progress Schedule will be the current version of Primavera P6.0®, or Primavera® Contractor 5.0 CPM scheduling software.

B. If the Contractor intends to use companion schedule reporting, analysis or graphics software tools, the Contractor will furnish to the County descriptive materials and samples describing such software tools.

1.06 NON-PERFORMANCE

A. The County may refuse to recommend all or any part of any payment, if the Contractor fails, refuses or neglects to provide the required Progress Schedule information on a timely basis. Partial payments without a properly updated Progress Schedule shall be returned to the Contractor as non-conforming.

B. If justified under the circumstances, the County also may prepare alternate Progress Schedules, as appropriate, and deduct from the Contract Amount all related costs by Change Order and/or take other action commensurate with the breach.

1.07 REPORTS, SCHEDULES AND PLOTS

A. Schedule Reports will include Activity (ID) code and description, duration, calendar, Early Dates, Late Dates and Total Float. Separate Schedule Reports will tabulate, for each Activity, all preceding and succeeding logic types and lead times, whether CPM Plots displaying logic ties are appended or not.

B. CPM Schedule Plots will be plotted on a suitable time scale and identify the Contract Times, Critical Paths, phases and work areas on 24-inch x 36-inch or smaller sheets. Activities will be shown on the Early Dates with Total Floats noted by Late Date flags. For Payment and Revision Submittals plot a target comparison based on the current Official Schedule.

C. The Activity Value report will tabulate Activity code and description and Activity Value, percent complete and earned value as calculated by the scheduling software. Cash flow plots shall be provided showing the monthly and cumulative actual and planned earned values with curves shown for Early and Late Dates in the schedules. For Payment and Revision Schedule submittals, the cash flow curves shall also plot the most current Official Schedule planned earnings curves.

D. Each submittal shall include listings of all added and deleted activities, logic, constraints, Activity Value changes and update information vs. the previous Progress Schedule submittal. This list may be manually prepared or generated by accessory software that will generate such listings.

1.08 NARRATIVE REQUIREMENTS

A. The Initial Submittal narrative will describe the Contractor’s approach to prosecution of the Work and the basis for determination of activity durations, sequence and logic, including the Contractor's management of the site, e.g., lay down, staging, parking, etc.; Contractor’s phasing of the Work; use of crewing and construction equipment;

identification of non-work County/Professional's, shifts, weekend Work and multiple calendars applied to activities and an explanation of the basis for restraint dates.

B. Revision and Payment Submittal narratives will explain any changes to the approach or planning referred to in Paragraph A above on account of any change, delay, schedule recovery, substitution and/or Contractor-initiated revision occurring since the previous submittal.

C. Each narrative will list the Critical Path Activities and compare Early and Late Dates against Contract Times and Milestone Dates. Narratives shall also recap progress and Days gained or lost vs. the current Official Schedule, and identify delays, their extent and causes.

D. The Initial Submittal narrative will describe all delays occurring since Contract Award and all pending and anticipated "or equal" and substitution proposals. Payment and Revision Submittal narratives will describe any new delays and shall certify that the Contractor has not been delayed, as of the cut off date, by any acts or omissions of the County, except as otherwise specifically stated.

1.09 ACTIVITY REQUIREMENTS

A. Separate activities will identify permits, design when included in the Work, construction, Submittal preparation and review (and resubmission and re-review), deliveries (site or storage), testing, start-up, commissioning and Punch List.

B. Activities will be detailed to the extent required to show the transition of trade Work. Activities will delineate the progression of the Work.

C. Activities will not combine separate or non-concurrent items of Unit Price or lump sum Work.

D. Activity durations will equal the Work Days required to sufficiently complete the Work designated by the Activity, (i.e., when finish-to-start successors could start, even if the Activity is not quite 100% complete). Installation Activities will last from 10 to 40 workdays. Submittal review activity durations shall conform to specified timeframes.

E. Activities will be assigned consistent descriptions and identification codes. Sort codes will group Activities by meaningful schemes.

F. Activities will be assigned Activity Values as appropriate and needed to reasonably allocate the Contract Amount to the time periods that they will be earned and eligible for payment based on the Progress Schedule and Schedule of Values. Separate pay activities may be used to simplify cost loading of the Progress Schedule. When used, pay activities shall be loaded with the cost of Work that is included, at no cost, in related (generally, concurrent) CPM activities. Pay activities shall not control the rate of progress; however, their start and finish dates shall be consistent with those of

their related CPM activities to ensure accurate Early Date and Late Date cash-flow plots.

1.10 FLOAT TOLERANCES AND FLOAT OWNERSHIP

A. Any Progress Schedule with Early Dates after a Contract Time will yield negative Total and Contract Floats, whether shown/calculated or not. Any Revision Submittal with less than negative 20-days of Float will be returned as "Revise and Resubmit," unless a time extension is requested or the County assesses liquidated damages or gives notice of intent to do so, in the event schedule is not recovered.

B. Float calculated from the definitions given in this Section supersede any conflicting Float values in any early completion Progress Schedule.

C. Neither the County nor the Contractor own the Float time, the Project owns the Float time. Neither the County nor the Contractor use of positive Total Float will impact a Contract Completion Date or justify an extension of Contract Time.

1.11 SUBMITTALS

A. Each Progress Schedule Submittal will consist of a narrative, 5 copies of the required reports and plots and an optical ROM data disk with the Contractor's corresponding schedule and schedule layout files in Primavera ".XER" format.

B. The County will review Progress Schedule Submittals and return a review copy within 14-days after receipt and the Contractor shall, if required, resubmit within 7-days after return of the review copy.

C. Requirements for the Initial Submittal:

1. Within 20-days after receipt of Notice to Proceed and prior to commencing Work on the Project, prepare and submit to the County the Initial Submittal of the Progress Schedule for the Work. The Initial Submittal will show the Work as awarded, without delays, Change Orders or substitutions.

    a. Activity Values will prorate Schedule of Values costs and/or pay items through to Activities. Provide a cross-reference listing with two parts; a part that will list each activity with the respective amounts allocated from each Schedule of Values and Unit Price Item making up the total value of each activity and a second part that will list the Schedule of Values and Unit Price Items with the respective amounts allocated from each activity that make up the total value of each item.

2. After the As-Planned Schedule is established, the County will select Milestones and record the Milestone Early and Late Dates. As the Official Schedule evolves, Milestone Dates will be revised accordingly.

3. If the County refuses to endorse the Initial Submittal (or a resubmission) as "Resubmittal Not Required," the As-Planned Schedule will not be established. In that event, the Contractor will continue to submit Payment and Revision Submittals reflecting progress and the Contractor's approach to remaining Work. The County will rely on the available Payment and Revision Submittals, subject to whatever adjustments it determines appropriate.

D. Requirements for Payment Submittals:

1. Payment Submittals with progress up to the closing date and updated Early Dates and Late Dates for progress and remaining Activities will be due with each Progress Payment. As-built data will consist of actual dates, percent complete, earned payment, changes, Delays and other significant events occurring before the closing date.

2. Activity percent complete and earned value should indicate a level of completion that corresponds to the Application for Progress Payment for the same period. The earned value should be calculated by the scheduling software as Activity Value times percent complete. Explanation should be provided whenever the cumulative earned value of activities in a Payment Submittal is not within 10% of the value of Work completed as represented in the corresponding Application for Progress for Payment.

3. At the Contractor’s option, a Payment Submittal may overlay minor adjustments on activities and sequencing for Work remaining. This excludes Activity re-scoping to reflect Delays, changes, schedule recovery or substitutions.

E. Requirements for Revision Submittals:

1. Revision Submittals will be submitted when necessary because of major changes or delays affecting activities, sequencing or restraints for Work remaining and/or to put forth a schedule recovery plan. Revision Submittals may also be required because of Contractor-initiated re-planning, or when Contractor plans to perform Work ahead or out-of-sequence that will require additional testing or inspection personnel, or when requested by the County when Work is performed out-of-sequence from the current Official Schedule such that the number of Days gained or lost can not be determined or the scheduled dates of completion of the Work in a Payment Submittal are not viewed as reliable.

2. If requesting a time extension, the Revision Submittal should show the impact of the delay after incorporating reasonable mitigation to minimize the impact and illustrate how the number of Days requested time extension was determined. The delay should be determined as the change in the forecast Contract Completion Date(s) resulting solely from delays that entitle the Contractor to a time extension as provided in the General Conditions. Any and all Contractor slippage and delay occurring prior to and concurrent with the delay potentially entitling the Contractor to a time extension shall be

incorporated in the Revision and explained such that the concurrent and non-concurrent periods of delay are indicated. If the Contractor does not follow the procedures contained in this Section or, if the Contractor's analysis is not verifiable by an independent, objective evaluation by the County using the electronic files and data furnished by the Contractor, any such extension in Contract Time will not be granted.

F. Retrospective Delay Analysis.

1. If the County/Professional refuses to endorse any Revision Submittal as "Resubmittal Not Required," the Contractor and County will use the latest Official Schedule when evaluating the effect of Delays on Contract Time and/or Contract Price. The procedure to be used will consist of progressively updating the latest Official Schedule at key closing dates corresponding to starting and finishing dates of the delays and/or dates the delays became critical or dates the Critical Path may have changed for other reasons. For each Progress Schedule iteration, slippage between actual Milestone Dates and Initial Milestone Dates will be correlated to Delays occurring solely in that iteration.

2. For each iteration, revisions in Activities, logic ties and restraints affecting Work after the closing date will be included in that Progress Schedule only if they meet any of the following conditions. First, they are Progress Schedule revisions that the County consented to contemporaneously (i.e., before the closing date) in writing. Second, they reflect comments or objections raised by or on behalf of the County and that were actually confirmed by the as-built progress. Lastly, they represent Contractor’s schedule recovery plans or other Progress Schedule revisions that were actually confirmed by the as-built progress.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01323
SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 PRELIMIARY SCHEDULE OF VALUES

A. The Preliminary schedule of values listing shall include, at a minimum, the proposed value for the following major work components:

1. General Requirements/Mobilization/Demobilization. General Requirement Mobilization/Demobilization costs on the Schedule of Values shall not exceed 5% of the total Contract Amount. Refer to specification Section 01505 for additional information on Mobilization requirements.

2. The total value of miscellaneous site improvements inclusive of clearing and grubbing, stripping, excavation, fill construction, paving, road removal, site restoration, and all incidental work associated with miscellaneous site improvements. This total value shall be itemized into separate values for each item.

3. The total value of yard piping construction work inclusive of fabrication, excavation, pipe installation, pipe structures (air-release valves, blowoff valves, and vents), backfilling, testing, site restoration, and all incidental work associated with yard piping construction. The total value shall be broken down into separate values for each pipe section.

4. The total value of reinforced concrete work by structure and building inclusive of all excavation, dewatering, subgrade preparation, backfill, and incidental work for all new structures. Additionally, this total value shall be broken down into separate values for each new structure constructed as a part of the work. Miscellaneous and minor concrete work may be listed as one item in this breakdown.

5. The total values of all mechanical work (HVAC and plumbing), including piping, valves, and equipment.

6. The total value of process piping, valves, and mechanical equipment (such as pumps).

7. The total value of electrical work.

8. The total value of instrumentation and control work including fiber-optic cable system.

9. The total value of all other work not specifically included in the above items.

10. The contractor and Engineer shall meet and jointly review the preliminary schedule of values and make any adjustments in value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major work components. Front-end loading will not be permitted. The Engineer may require reallocation of major work

components from items in the above listing if, in the opinion of the Engineer, such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of the notification of the required reallocation.

1.02 DETAILED SCHEDULE OF VALUES

A. Base the detailed schedule of values on the accepted preliminary schedule of values for major work components. Because the ultimate requirement is to develop a detailed schedule of values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM schedule activities, provide sufficient detailed breakdown to meet this requirement. Provide breakdown of line item quantities when applicable: cubic yards, linear feet, pounds, etc. The Engineer shall be the sole judge of acceptable numbers, details, and description of values established. If, in the opinion of the Engineer, a greater number of schedule of values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the Engineer as a condition to processing the payment requests.

B. At a minimum the schedule of values shall be separated by unit process area and/or by building and the following general work elements. The minimum detail of breakdown of the major work components is indicated below.

1. General Requirements/Mobilization/Demobilization. General Requirement Mobilization/Demobilization costs on the Schedule of Values shall not exceed 5% of the total Contract Amount. All Work included in the Schedule of Values that falls under this heading as described in this paragraph (including such Work by Subcontractors) will be added and checked for compliance with the 5% limitation. Any actual cost in excess of this amount shall be distributed proportionately to Schedule of Values items for direct Work items not covered by this heading. Work under this heading may be detailed on Schedule of Value line items identifying each as to whether it is mobilization or initial costs, maintenance or overhead cost or finalization or demobilization cost. The subdivision of this Work into Schedule of Values line items shall be done to support the payment process that shall be distributed as follows: 50% for the first progress payment, 10% for the final payment following demobilization and restoration, and 40% spread evenly over payments, made in between.

2. Miscellaneous site construction shall be broken down by clearing and grubbing, stripping, excavation, full construction, erosion control, paving, paving removal, site restoration, and any other items determined to be necessary for the establishment of pay and schedule activity items.

3. Yard piping construction work shall be broken down separately by pipeline segment, which shall not exceed 500-foot-long sections of the pipeline. Each pipeline segment shall be broken down into excavation, pipe fabrication (by wall thickness), pipe installation, pipe structures (air-release valves, blowoff valves, and vents), backfilling, testing, site restoration, and any other items

determined to be necessary for the establishment of pay and schedule activity items.

4. Concrete structures and building shall be broken down by structure into excavation, subgrade preparation, and appurtenant prefoundation work; concrete foundation construction; slabs on grade; walls/columns; miscellaneous metalwork; and backfill.

5. Mechanical (HVAC and plumbing) work shall be broken down to identify individual piping and ductwork and equipment installation and equipment testing.

6. Piping, valve, and equipment work shall be broken down to identify individual piping systems, equipment installation by equipment (including valves, actuators, etc.), name and number, and equipment testing and checkout.

7. Electrical work shall be broken down by structure into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations, and lighting. Yard facilities shall be broken down by duct bank designation and substations.

8. Instrumentation and control work shall be broken down by pull boxes, duct, fiber-optic cable, and installation and testing.

9. Equipment testing and start-up broken down for completion milestones and substantial completions for each.

C. Other work not specifically included in the above items shall be broken down as necessary for establishment of pay and schedule activity items.

D. The Contractor, Engineer, and Resident Project Representative shall meet and jointly review the detailed schedule of values within 40 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to provide cost loading of the CPM schedule activities. Make any adjustments deemed necessary to the value allocation or level of detail, and submit a revised detailed schedule of values within 10 days from the date of the review meeting.

E. Following acceptance of the detailed schedule of values, incorporate the values into the cost loading portion of the CPM schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed schedule of values; however, it shall be necessary to adjust the detailed schedule of values to correlate to individual schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the schedule of values and the CPM schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the CPM schedule activities. Where such instances arise, the Contractor shall propose changes to the schedule of values and to the CPM schedule activities to satisfy the CPM schedule cost loading requirements.

1.03 INCORPORATION OF SCHEDULE OF VALUES INTO CPM SCHEDULE

A. In conjunction with each submittal of the construction schedule, submit a cash flow projection indicating estimated earning by month during the entire contract period and a schedule of values of work using the "Schedule of Values" described above, including quantities and prices. The aggregate of these extended prices shall equal the contract price. Costs shall include all materials, labor, equipment, and appurtenant items necessary to accomplish the work in accordance with the contract documents. This schedule shall be satisfactory in form and substance to the Engineer and shall subdivide the work into the specified component parts. Upon review by the Engineer, incorporate the schedule into the form for Application for Payment. The Owner reserves the right to delete (or add) items of work from the contract and the total contract amount shall be reduced (or increased) by the total amount shown in the schedule of values.

B. Develop the schedule of values (lump-sum price breakdown) and incorporate into the cost loading function of the CPM schedule. Determine monthly progress payment amounts from the monthly progress updates of the CPM schedule activities. Develop the schedule of values independent but simultaneous with the development of the CPM schedule activities and logic.

1.04 CROSS-REFERENCE LISTING

A. To assist in the correlation of the schedule of values and the CPM schedule, provide a cross-reference listing, furnished in two parts. The first part shall list each scheduled activity with breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective schedule activity or activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the schedule of values), the total cost for each scheduled item should be indicated.

B. Update and submit these listings in conjunction with each CPM monthly submittal.

C. Incorporate executed change orders reflected in the CPM schedule into the schedule of values as a single unit identified by the change order number.

1.05 CHANGES TO SCHEDULE OF VALUES

A. Changes to the CPM schedule which add activities not included in the original schedule but are included in the original work (schedule omissions) shall have values assigned as reviewed by the Engineer. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer.

B. In the event that the Contractor and Engineer agree to make adjustments to the original schedule of values because of inequities discovered in the original accepted detailed schedule of values, increases and equal decreases to values for activities may be made.

END OF SECTION

SECTION 01340
WEB BASED PROJECT CONTROLS SYSTEM

PART 1 - GENERAL

1.01 PROJECT CONTROLS

A. The Project Controls on this project shall be performed through the use of web-based project controls software. In fulfilling this requirement the Contractor shall provide the following:

1. Utilization of Primavera Contract Management (BCM), Business Intelligence Publisher Edition Version 14.2 or version as required by the County of Primavera Contract Management web-based software hosted and managed by a third party provider. No other software shall be acceptable. The intended users on the individual license shall include the Owner (seven (7) users), Engineer and sub-consultants (twelve (12) users), and Contractor (minimum of two (2) users). The software, owner's manuals, licensing and database shall be owned and retained by the County. If the Contractor requires additional users, additional user licenses shall be provided to the County by the Contractor at no cost to the County and those additional licenses may be retained by the Contractor at project final completion.

2. OCU reserves the right to migrate to another software during the course of the project, the contractor will be properly notified and may be required to attend a training session for the new system.

3. A maintenance agreement including but not limited to technical support, training, maintenance and software upgrades shall be provided from the software supplier on the software for the duration of the project.

B. A web-based hosting service to provide individual user access for a minimum of twenty one (21) named PCM licenses, including sequel server database software, BI Publisher as the report engine, email functionality, minimum of 100 gigabytes of memory shall be provided for the duration of the contract. Contract Management shall be hosted by Load Spring Solutions Inc.

1. Contractor shall provide and attend a one day joint training session for the Owner, owner construction consultant, Engineer and Contractor, for all components of the software in the manner detailed in section 3.01 of this specification.

2. Contract Management and the Load Spring Solutions access portal shall be operational within 14 calendar days after issuance of Notice to Proceed and once the County approves Version 14.2 software.

3. The Contractor shall be responsible for providing all the necessary connections at the temporary office facility including but not limited to, patch panels, switches routers, etcetera, at both ends of the fiber optic cables, also, installing a single mode fiber optic cable exterior and Multi-Mode interior, from the existing Administration Building to the temporary Contractor's and Owner's field offices to be located in the general vicinity of the Existing Pump Station.

4. Contractor shall provide two fiber optic patch panels with four fiber adapters PN# FAP6WST2. Contractor shall terminate fiber optic cable to patch panel at each end.

5. The Contractor shall be responsible for providing internet connection averaging download speeds of 45 Mbps. The download speed shall be no less than specified elsewhere in the contract specifications. The contractor is to provide internet connectivity for the duration of the project and until no longer necessary as determined by the RPR.

6. The Primavera Contract Management 14.2 application (PCM) utilizes BI Publisher to allow users to run pre-defined reports. The user may select filters or parameters to only view data of interest, and report access is permission based making for a secure environment. The contractor will also be required to purchase two Business Intelligence Publisher for Oracle Applications licenses.

7. At least 8 custom reports and forms are to be provided under this contract. OCU will determine and identify the required reports/forms. These reports/forms will be created and tested in the OCU environment on the LoadSpring cloud. The contractor shall budget at least 5 hours per report/form for LoadSpring to create, test and implement each report/form.

8. All project correspondence and documentation including but not limited to Requests for information, Notices, Change Orders / Change Management, noncompliance notices, Notice of claims, requests for clarification, updates, meeting minutes, shop drawing transmittals, shop drawings in PDF format, shop drawing comments, letters, memos, etc. shall be created and managed in Contract

9. Management. The use of emails as project correspondence and documentation is unacceptable and shall be considered to be noncompliance with this specification.

10. Statement of capability and cooperation - The Contractor shall have the capability of preparing and utilizing the specified document control software, critical path scheduling techniques and specified software packages. A statement of capability shall be submitted in writing to the Engineer with the return of the executed Agreement to the Owner and will verify that either the Contractor's organization has in-house capability qualified to use the technique or that the Contractor employs a consultant who is so qualified. The statement shall include the name of the individual

on the Contractor's staff or qualified Consultant who will be responsible for the use of Contract Management and associated reports and for providing the required updating information of same.

1.02 SUBMITTALS

A. Provide a statement of Capability and Cooperation per 1.01.

B. Provide for approval a minimum of twenty one (21) user licenses in Orange County Utilities' name for the latest version (at the Notice to Proceed preconstruction meeting) of Contract Management.

C. Provide for approval two Business Intelligence Publisher for Oracle Applications licenses

D. Maintenance Agreement – Provide proof of maintenance agreement with

E. Oracle/Primavera Systems that will last for the duration of the project. E. Provide proof of web hosting services for the duration of the project.

PART 2 - PRODUCTS

A. Web-based Project Controls Software – Primavera Contract Management 14.2 or latest edition. Software. Collaboration by all parties on a single project database storing all project documentation during construction and through project final completion.

B. Web based hosting services to be provided by.

LoadSpring Solutions, Inc.
15 Union Street, #401
Lawrence, MA 01840
Scott D Harrison
Account Executive | LoadSpring Solutions, Inc.

Mobile: +1 781.820.0704
Office: +1 978.685.9715 x125
Web: www.loadspring.com

PART 3 - EXECUTION

3.01 REQUIREMENTS FOR OPERATION OF CONTRACT MANAGEMENT

A. The Contractor, Owner and Engineer shall use the following functions of the Contract Management Software:

A. Project Information Modules

1. Companies – All contact information for parties involved in this project will be entered by the County. Contractor shall provide a digital list of all contact information (Full Name with middle initial, Company Name, address, phone number, cell phone, email address, title, etc).

2. Issues – Issues shall be created as necessary to monitor potential problems on the project. Issues shall be assigned from items in requests for information, meeting minutes, or independently generated items. The project team shall be responsible for entering data and maintaining this list.

B. Communication Modules

1. Transmittal – All transmittals between the Contractor, Owner and Engineer shall be generated in the Contract Management software including but not limited to shop drawing transmittal cover letters, submittals and other project related packages or documentation.

2. Requests for Information – All requests for information shall be generated and performed through Contract Management. Requests for Information shall be performed completely electronically. All requests shall be complete. If necessary, the Contractor shall attach electronic attachments of all sketches, photographs or other documentation as necessary to provide full details of the issue or concern. References to all pertinent details, drawings, schedule activities, and issues shall be noted in each request for information. All project participants shall be responsible for electronic updates for their action items. Contractor shall submit all RFI's with a ball in court (BIC) to the Engineer. The Engineer shall provide a response and submit the RFI with a ball in court to the County. RFI's shall not be considered answered and shall not be acted upon by the Contractor until the County has officially CLOSED the RFI.

3. Notices – All notices be performed in this module. Notices shall be comprised of all documentation previously written in the form of letters, memo's, emails, test requests, Notice of claim, general correspondence, clarification, schedule update, bulletin, etc and shall be created in Contract Management with the appropriate attachments as required.

4. Notices of Non-compliance – All notices of non-compliance shall be generated and performed through Contract Management. Both the original notice from the Owner/Engineer and the proposed corrective action by the Contractor shall be completed in web-based software. Owner/Engineer shall submit all notices of non compliance with a ball in court (BIC) to the Contractor. The Contractor shall provide a response and submit the NCN with a ball in court to the Engineer. NCN's shall not be considered answered and shall not be acted upon by the Contractor until the County has officially CLOSED the NCN.

5. Meeting Minutes – All meetings shall be documented in Contract Management. Business Items and Attendees will be documented, and attachments will be attached as appropriate. Recurring meetings shall be

generated using delivered functionality within Contract Management, and will be updated by the meeting organizer. Logs presented at the meetings including but not limited to Shop drawing logs, RFI logs, Change Order Logs, Test Request & Results logs, and correspondence logs shall be generated from Contract Management, dispersed and attached to the meeting minutes module. Logs shall be downloaded as of the date of the meeting to provide the most current status of all logs.

C. Contract Information Modules

1. Change Management – Change Management shall be used to organize all related documents for each change to scope of work, schedule, or budget. Related documents shall be linked via Issues and included in the CPM schedule. Estimates, proposals, and final change orders shall be linked as Attachments. The contractor shall input data and maintain this module. The Change Management process shall only be initiated from a request for information in the RFI module.

2. Payment Requisition – The Contractor shall utilize the Payment Requisition module for the purpose of inputting the monthly pay applications into Contract. Management for the project record as well as for the required approval of the "pencil copy" or preliminary submittal for approval by the County inspector prior to submitting each month's printed copy through normal means.

D. Logs Modules

1. Submittal Packages – Submittals will be combined into Submittal Packages as appropriate, when workflow is similar and using Packages increase efficiency.

2. Submittals – Contract Management shall be used to create all transmittals between the Engineer, Owner and Contractor for all submittals. The printed copy of the submittals will be transmitted through normal means. Contractor shall enter a complete list of all known submittals for the project at the start of the project. Submittals shall include required by dates so that all parties are aware of upcoming submittals, and will use industry standard specification codes to categorize the submittals and shall be included in the Primavera CPM schedule. Contractor shall provide and attach a digital copy of the shop drawing submittal including all revisions, in PDF format for a complete project record and access for all users. However, only hard copy shop drawings submittals shall be reviewed and approved by the Engineer.

3. Contractor Daily Reports – Daily Reports shall be inputted daily through Contract Management by the Contractor. Daily Reports shall be complete and include electronic attachments, photographs, or other documentation as appropriate. Daily Reports shall be documented in accordance with the Standard Specifications for the project.

E. Other

1. Correspondence Sent – All correspondence sent shall be logged within Contract Management by the originating party in the appropriate module. Documents generated within Contract Management shall be recorded via delivered functionality within Contract Management. Documents generated external to Contract Management shall be kept to an absolute minimum and shall be manually added to appropriate contract Management module. Digitally Attach applicable documents as appropriate to Contract Management.

2. Correspondence Received – All correspondence received from outside parties pertinent to the project shall be logged within Contract Management by the receiving party. Receipt of submittals or other documents that originated out of Contract Management shall be recorded by the contractor via delivered functionality within Contract Management in the appropriate module. Digitally Attach applicable documents as appropriate to Contract Management.

END OF SECTION

SECTION 01380
AUDIO-VISUAL DOCUMENTATION

PART 1 - GENERAL

1.01 PURPOSE AND DESCRIPTION OF WORK

A. The purpose of the audio-visual documentation is to provide the County with regularly documented audio-visual records of the Construction process from the existing conditions through final completion.

1.02 PRE-CONSTRUCTION VIDEO REQUIREMENTS INCLUDED

A. The Contractor shall employ a professional videographer to take a Pre-Construction video of the entire site including the areas of adjacent properties within 100-feet of the limits of Work and shall be made within 30-days of Work beginning. Special attention shall be made to show the existing paved roads, shoulders, signs, and other existing features.

B. The Contractor shall submit a quality audio-video recording documenting Pre-Construction field conditions for the entire project. When the Work includes construction of water, wastewater, reuse, or other lines in the vicinity of any street or road, the Contractor shall take digital audio-video recordings of existing conditions at the Project Site and along both sides of the adjacent road. The Pre-Construction video shall be submitted to the County and accepted prior to commencing any Work or using any Contractor laydown areas.

C. Electronic digital photography shall also be used to record and facilitate resolution of on-site issues through the transmission of electronic photographs by e-mail from the site to the Professional's and County's offices.

1.03 COST OF VIDEOGRAPHY AND PHOTOGRAPHY

A. The Contractor shall pay costs for specified videography, photography and prints. Parties requiring additional photography or prints will pay the photographer directly.

PART 2 - PRODUCTS

2.01 AUDIO-VIDEO RECORDING

A. Each audio-video recording shall be saved on appropriate DVD media viewable on standard DVD players or computer.

B. Each DVD shall contain the following information and arrangement at the beginning as a title screen:

Orange County, Florida
PROJECT NAME
PROJECT NUMBER

CONTRACTOR:	(Name of Contractor)
DATE:	(When photo was taken)
VIDEO BY:	(Firm Name of Videographer)
LOCATION:	(Description of Location(s) and View(s))

C. Each DVD recording section shall begin with an audio description of the County's name, Contract name and number, Contractor's name, date and location information such as street name, direction of travel, viewing side, etc.

D. Information appearing on the video recording must be continuous and run simultaneously by computer generated transparent digital information. No editing or overlaying of information at a later date will be acceptable.

E. Digital information to appear in the upper left corner shall be as follows:

1. Name of Contractor
2. Day, date and time
3. Name of Project & Specification Number

F. Time must be accurate and continuously displayed on the video record

G. Written documentation must coincide with the information on the DVD so as to make easy retrieval of locations at a later date.

H. The video system shall have the capability to transfer individual frames of video electronically into hard copy prints or photographic negatives.

I. Audio shall be recorded at the same time as the video recording and shall have the same information as on the viewing screen. Special commentary shall be given for unusual conditions of buildings, sidewalks and curbing, foundations, trees and shrubbery, structures, equipment, pavement, etc.

J. All DVDs and boxes shall bear labels with the following information:

1. DVD Number
2. County's Name
3. Date of Recording
4. Project Name and Number
5. Location and Standing Limit of Video

2.02 CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall employ a competent photographer to take photographs when necessary to addresses construction issues.

B. Prints: Date imprinted 8-inch x 10-inch high resolution glossy single weight color print paper; two (2) sets, bound in 3-ring binders to be provided to the County and distributed by the County as follows:

1. Contractor (1 set)
2. Project Record Data (1 set stored by Contractor to be furnished to County upon Closeout)

C. Provide a CD with electronic photo files. Furnish a file index that lists photo no. or file name and description of view.

2.03 IDENTIFICATION

A. Identify each print on back.

1. Name of project.
2. Phase.
3. Name of Contractor.
4. Description of view/orientation.
5. Time and date of exposure.
6. Name and address of photographer.
7. Photographer's numbered identification of exposure.

PART 3 - EXECUTION

3.01 VIDEO VIEWS REQUIRED

A. Complete coverage shall include all surface features in all accessible areas on the site to be used by the Contractor and shall be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culverts, headwalls, and retaining walls, equipment, structures, pavements, manholes, vaults, handrails, etc. located within the work zone. Video coverage shall extend to the maximum height of all structures within this zone.

B. The video recorder shall take special efforts to point out and provide audio commentary on cracking, breakage, damage, and other defects in existing features.

C. All video recording shall be done during times of good visibility. No video recording shall be done during periods of visible precipitation, or when more than 10% of the ground area is covered with standing water, unless otherwise authorized by County.

D. Prior to commencement of audio-video recording, the Contractor shall notify the County in writing within 48-hours of the audio-video recording. The County may provide a designated representative to accompany and observe all video recording operations. Audio-video recording completed without a County Representative present will be unacceptable unless specifically authorized by the County.

3.02 AUDIO-VIDEO REQUIREMENTS

A. Major Locations:

1. The Contractor shall provide color digital video of each major facility and structures and facilities adjacent to the Construction before construction starts.

2. All videos shall be recorded with character generator operating with date, time, and location on screen. During video recording, the Contractor shall narrate video explaining what is being shown. All master videos shall be delivered to the County.

3. The audio and video portions of the recording shall maintain viewer orientation. To this end, overall establishing views of all visible structures shall be used. In areas where the proposed construction location will not be readily apparent to the video recording viewer, highly visible yellow flags shall be placed, by the Contractor, in such a fashion as to clearly indicate the proposed centerline of Construction. When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed 10-feet. The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.

4. All video recording shall be done during time of good visibility. No video recording shall be done during precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recording and to produce bright, sharp video recordings of those subjects.

5. The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size and value of the surface features within that construction area's zone of influence. The rate of speed in the general direction of travel of the vehicle used during taping shall not exceed 44-feet per minute.

END OF SECTION

SECTION 01400
QUALITY OF MATERIALS AND TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. It is the intent of the Specifications that material and equipment incorporated into the Work shall be as specified or if not specified, shall meet the intent of the Project and are suitable for heavy duty, severe service, suitable for use in wastewater treatment. The material used shall be incorporated in such a manner as to produce completed construction which is workmanlike and acceptable in every detail. Only materials which conform to the intent and requirements of these Specifications shall be incorporated in the WORK.

B. All materials and equipment used in the performance of the Work under this Contract are subject to inspection and testing at the point of manufacture, fabrication, or installation. Standard specifications for quality and workmanship are indicated in the Contract Documents. The Engineer may require the Contractor to provide statements or certificates from the MANUFACTURES, FABRICATORS, or TESTING LABORATORY that the materials and equipment provided by them or tested by them are in full accordance with the standard Specifications for quality and workmanship indicated in the Contract Documents.

C. All costs of testing and providing statements and certificates shall be paid by the Contractor, and NO EXTRA CHARGE to the Owner shall be allowed on account of such testing and certification.

1.02 REQUIREMENTS INCLUDE

A. Qualifications of the testing laboratory employed by the Contractor shall meet the "Recommended Requirements for Independent Laboratory Qualifications", latest edition, published by the American Council of Independent Laboratories, meet the basic requirements of ASTM E329-(latest) "Standard Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction."

B. The testing laboratory shall meet all other standards as required and recognized by the industry and be authorized to provide testing services in Kentucky.

C. The Contractor shall cooperate with the testing laboratory to facilitate the execution of its required services and provide sufficient notice and access to allow the testing laboratory to collect samples and perform the testing.

D. Employment of the testing laboratory shall in no way relieve Contractor's obligations for quality control to perform the Work of the Contract.

E. The Owner reserves the right to require the Contractor to use another testing laboratory at any point in the Project. The Owner's request to use another testing laboratory does not relieve the Contractor from conducting the required tests or from the quality control requirements of the Project.

1.03 SUBMITTALS

A. The Contractor shall deliver to the testing laboratory adequate quantities of representational samples of materials proposed to be used and which require testing. The Contractor shall provide the testing laboratory, the preliminary design mix proposed to be used for all concrete mixer services, asphalt concrete, soil cement, and other material mixes which require control by testing laboratory.

B. Four (4) copies of the reports shall be submitted and authoritative certification thereof must be furnished to the Engineer as a prerequisite for the acceptance of any material or equipment.

1.04 QUALITY ASSURANCE

A. All materials not conforming to the requirements of the Specifications shall be considered as defective and shall be removed from the WORK: if in place, they shall be removed by the Contractor at his expense and replaced with acceptable materials. No defective materials, the defects of which have been subsequently corrected, shall be used until approval has been given. Upon failure of the Contractor to comply forthwith with any written order of the Engineer pursuant to the provisions of this article, the Owner shall have authority to remove and replace defective materials and to deduct the cost of removal and replacement from any moneys due or to become due the Contractor.

B. Regardless of any tests of materials made at the source, the Contractor shall carefully inspect all materials before installation and reject any materials which have been damaged or have visible flaws. The Engineer also reserves the right to make such an inspection, but failure to detect irregularities does not relieve the Contractor of responsibility to remove and replace materials which are found to be defective after installation.

C. Except where the manufacturer is specified, all products installed in the work shall be manufactured in the United States of America. If the products and/or materials needed to complete the work are not produced in the USA, then foreign made items may be submitted for shop drawing review.

1.05 SCHEDULING

A. The Contractor shall notify the testing laboratory sufficiently in advance of operations to allow for the testing laboratory to assign personnel and scheduling of tests.

B. The Contractor shall provide incidental labor and facilities to provide the testing laboratory access to the Work to be tested, obtain and handle samples at the Project Site or at the source of the product to be tested, facilitate inspections and tests, and for storage and curing of test samples.

PART 2 - PRODUCTS NOT USED.

PART 3 - EXECUTION NOT USED.

END OF SECTION

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SECTION 01410
TESTING AND TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. County will employ and pay for services of an Independent Testing Laboratory to perform Testing specifically indicated on the Contract Documents or specified in the Specifications and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents.
2. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
3. Employment of laboratory by County shall in no way relieve Contractor's obligations to perform the Work.

B. Related Requirements Described Elsewhere:

1. Conditions of the Contract.
2. Respective section of Specifications: Certification of products.
3. Each Specification section listed: Laboratory tests required and standards for testing.

1.02 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with County's personnel; provide access to work and manufacturer's operations.

B. Secure and deliver to the County adequate representational samples of materials proposed to be used and which require testing.

C. Provide to the County the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.

D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. The County may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no

extra charge to the County shall be allowed on account of such testing and certification.

E. Contractor shall not have direct contact with laboratory or laboratory personnel. All testing shall be coordinated through County.

F. Furnish incidental labor and facilities:

1. To provide access to work to be tested.
2. To obtain and handle samples at the Project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

G. Notify County sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspections cannot be performed after such notice, reimburse County for laboratory personnel and travel expenses incurred.. The following field testing schedule summarizes the responsibilities of various tests that may be required by the Contract Documents.

TEST	**NOTES**	**PAID FOR**
Soil Compaction	A. Pipe Work: Every 300 ft. at each lift of compaction B. Structures: As a minimum one test per 2000 SF of fill area per lift, or at least 2 tests per structure, per lift. As specified in material specifications sections	County
Low Pressure Air Exfiltration	Each section of gravity sewer pipe between manholes or lift station	Contractor
Hydrostatic Pressure	All segments of pressure piping (24-hour test).	Contractor
Hydrostatic Leakage	All segments of pressure piping (2-hour test).	Contractor
Bacteriological	As required by local and state agencies	County
Asphaltic Concrete Paving	As required by County	County
LBR	Each 600 SY of pavement	County
Concrete	Slump test each delivery, cylinders every 20 CY per Section 03300	County
Asbestos	Environmental testing of materials	County
All Other Testing	As specified in various sections of the Project Manual	As Indicated

H. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience.

I. If the test results indicate the material or equipment complies with the Contract Documents, the County shall pay for the cost of the testing laboratory. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the Contractor shall pay for the laboratory

costs directly to the County or the total costs shall be deducted from any payments due to the Contractor.

J. Contractor is required to provide safe concrete testing of sample areas. Contractor shall provide adequate field control cylinder storage bins and add ice to maintain temperatures when necessary.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01500
TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 GENERAL

A. During the performance of this Contract, Contractor shall maintain a suitable office at the project site, which shall be the headquarters of its representative authorized to receive drawings, instructions, or other communication or articles. Any communication given to the said representative or delivered at Contractor's office at the Site in the representative's absence shall be deemed to have been delivered to Contractor. The minimum requirements for the Contractor's field office are provided below

B. Copies of the Drawings, Specifications, and other Contract Documents shall be kept at Contractor's office at the Site and available for use at all times.

C. Contractor cannot establish an address at the site for receiving non-project mailings. The Contractor must also be present to accept deliveries. The County will not accept deliveries on the Contractor's behalf.

D. WATER

1. All water required for and in connection with the Work to be performed shall be furnished by and at the expense of Contractor through meters installed on hydrants or existing piping. Contractor shall supply all necessary tools, hose, and pipe, or otherwise transport the water to the point of use, and shall make its own arrangements with O.C.U. as to the amount of water required and the time when the water will be needed. Indiscriminate use of water so furnished will not be permitted. Special hydrant wrenches shall be used for opening and closing fire hydrants. In no case shall pipe wrenches be used for this purpose.

2. The Contractor may use plant reuse water for filling basins and testing as approved by the Owner.

3. Furnish potable drinking water in suitable dispensers and with cups for use of all employees at the job site during the entire construction period.

E. POWER

1. Purchase electric power for the construction of the project. Provide for the extension of utility lines to the point of usage. The Contractor is responsible for the permitting and the provisions required in order to provide temporary power for construction facilities. There is no excess electrical power available at plant site.

F. SANITARY FACILITIES

1. Contractor shall furnish temporary sanitary facilities at the Site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project.

2. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 persons. Contractor shall enforce the use of such sanitary facilities by all personnel at the Site.

G. MAINTENANCE OF TRAFFIC

1. Contractor shall conduct its work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point.

2. In making open-cut street crossings, Contractor shall not block more than one-half of the street at a time. Whenever possible, Contractor shall widen the shoulder on the opposite side to facilitate traffic flow. Temporary surfacing shall be provided as necessary on shoulders.

H. FENCES

1. All existing fences affected by the Work shall be maintained by Contractor until completion of the Work. Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates shall be kept closed and locked at all times when not in use.

2. On completion of the Work across any tract of land, Contractor shall restore all fences to their original or to a better condition and to their original locations.

I. DAMAGE TO EXISTING PROPERTY

1. Contractor will be held responsible for any damage to existing structures, Work, materials, or equipment because of his operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to, County.

2. Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.

J. DUST CONTROL

1. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water. When practicable, dusty materials in piles or in transit shall be covered to prevent blowing dust.

2. Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Existing or new machinery, motors, instrument panels, or similar equipment shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.

K. TEMPORARY DRAINAGE PROVISIONS

1. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on the Site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the Site, and adjacent property.

2. Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect County's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.

L. POLLUTION CONTROL

1. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes shall be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance shall be permitted to enter sanitary sewers, and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

M. EROSION CONTROL

1. Contractor shall prevent erosion of soil on the Site and adjacent property resulting from its construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

2. Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation shall be preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing

vegetation or other suitable ground cover shall be provided as necessary to control runoff.

N. TREE AND PLANT PROTECTION

1. All trees and other vegetation which must be removed to perform the Work shall be removed and disposed of by Contractor; however, no trees or cultured plants shall be unnecessarily removed unless their removal is indicated on the Drawings.

2. All trees and plants not removed shall be protected against injury from construction operations.

O. SECURITY

1. Contractor shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

2. No Claim shall be made against County by reason of any act of an employee or trespasser, and Contractor shall make good all damage to County's property resulting from Contractor's failure to provide security measures as specified.

3. All personnel, contractor employees and or subcontractors and suppliers that pass through the gates shall wear picture identification badges. All personnel passing through the gates shall be subject to background checks to identify any historical crimes dealing with terrorism, sabotage, or other government related illegal activities. Background checks shall be provided by the Contractor. The background checks shall include running fingerprints through FDLE to determine nationwide arrest history. Background check information for each personnel shall be submitted to the County prior to access to the facility.

4. All deliveries entering the site shall be escorted by Contractor for the duration of the time on site.

P. LOCATION OF STORAGE AREAS

1. Areas where the Contractor may store materials used in his operations shall be approved by the County.

2. Offsite storage arrangements, if allowed, require pre-approval by County for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such offsite storage arrangements shall be presented in writing and shall afford security and protection that is satisfactory to the County. Offsite storage facilities shall be accessible to County and Engineer.

Q. PROJECT CONSTRUCTION SIGN

1. Contractor shall provide two (2) project construction signs as described below. The Contractor shall submit a drawing of the proposed signs for

review and approval prior to sign production. Signs shall be 4' high x 8' wide x 3/4" MDO plywood. Signs shall be painted dark blue on both sides. Front face shall be trimmed with 1" orange border and shall have two horizontal 3/4" white lines dividing the face into three sect ions. The upper section shall include the Orange County logo in orange, green, and dark blue, and the project name in white. The middle section shall include the names of the County Commissioners, the County Administrator, and the Utility Director. The lower section shown shall include the name and logo of the engineer and name and logo of the Contractor. Signs shall have 2"x4" wood stops on the top and bottom of both sides and shall be painted white. Signs shall be mounted on 4"x4" pressure treated wood posts, painted white, with the bottom of the sign 4' above grade. Posts shall be embedded a minimum of 4 ft. The sign shall be installed within 30 days following the Notice to Proceed and shall be maintained in good condition during the course of the work.

R. REMOVAL OF TEMPORARY CONSTRUCTION WHEN NO LONGER NEEDED

1. When temporary facilities, services, and controls are no longer needed and before the Work is completed, remove the various temporary facilities, services, and controls and legally dispose of them. Portions of the site used for temporary facilities shall be reconditioned and restored to their previous condition.

PART 2 - MATERIAL AND EQUIPMENT

2.01 COUNTY INSPECTOR'S FIELD OFFICE TRAILER

A. In addition to the Contractor's field office, Contractor shall provide a suitable field office for the County's inspector and/or Resident Project Representative (RPR) separate from the Contractor's office at the site until removal is approved by the County but not longer than 1 month following the final completion date.. Contractor shall provide office space in accordance with the following:

1. The office space provided shall be either a building or a double wide office trailer in new condition (approx. 1,500 sq ft) for the exclusive use of the County's project manager, RPR, the Engineer, and the CQA Consultant throughout the period of construction as specified above.

2. The floor plan for the trailer shall be divided into rooms with doors and locks, with a minimum of four (4) offices with a minimum of 120 SF per office, a 600 SF conference/main room, and the remainder configured for comfort facilities and storage room. The proposed floor plan shall be submitted for approval by the County.

3. The office trailer shall be weather tight and have a tight floor at least 18 inches off the ground, leveled properly and securely attached with hurricane straps. The office shall be insulated, air-conditioned, have suitable screened

ventilation and a solid door provided with a cylinder lock, deadbolt and five sets of keys.

4. The exterior doors shall be lighted and provided with a level connection deck at least three-fourths the length of the trailer by 6-feet wide with stairs at each end.

5. The office shall be provided with professional janitorial service twice per week. The schedule for janitorial service shall be coordinated with the RPR. The trailer is required to be clean and maintained in good working conditions throughout the construction and any necessary repairs are to be performed immediately. Cleaning of floors will be done in a manner as not to cause dust to rise and drift onto upper surfaces. The use of Dust down or other product may be used to prevent dust from rising.

6. The office shall be provided with heating equipment, air conditioning equipment, electrical wiring, outlets, and light fixtures suitable to light the tables and desk adequately, and window blinds. Contractor shall supply all fuel for heating and pay all electrical bills for the office.

7. Toilet facilities in the office (Men and Women) trailer shall be connected to an approved septic system or to the plant sewer as approved by the County. Provide potable water for office services. It is the Contractor's responsibility to provide the services, determine suitability and workability and obtain building permit from Orange County for this project. Toilet facilities provided in the trailer shall be for exclusive use of County and their representatives.

B. The field office will be fully outfitted and in service prior to any construction. All furniture and equipment supplied by the Contractor for the County inspector’s office trailer shall be new. Contractor shall provide the following items:

1. Two (2) plan tables, 4 feet by 6 feet, and two (2) new adjustable stools.

2. A new wooden desk for each of the four offices in the trailer, approximately 4 feet by 6 feet, with a new swivel chair for each desk. Provide one new wooden desk for the reception area and a new swivel chair.

3. A conference table(s) 4ea – 4 feet by 12 feet, sixteen (16) new chairs with integrated cushions.

4. A plan rack, minimum capacity 6 sets of prints.

5. Shelves, three (3) eight foot high by 4-foot wide wooden shelves.

6. Five wastebaskets and one large garbage can.

7. Coat rack and hooks

8. Dry erase boards one (1) 36” by 72”

9. Dry erase boards two (2) 24” by 36”

10. Tack board one (1) 36” by 30”

11. Outside digital thermometer and digital rain gauge

12. Four (ea) 4-drawer, legal size filing cabinet with locks and key.

13. One, 72-inch steel storage cabinet with 4 adjustable shelves, 72”H X 36”W X 18”D

14. Air conditioning/heating suitable for the office space

15. Hot and cold bottled water cooler.

16. One (1) Microwave oven, 1.5 CUFT

17. One (1) Top-freezer refrigerator 18 CUFT. R. Six (6) Surge protectors power strips.

18. One (1) shredder Ativa model CX14W.

19. Color Printers – Two (2) ea. Brother Wireless Inkjet All-In-One Printer, Copier, Scanner, Fax, MFC-J6920DW or approved equal capable of printing 11x17.

20. An office size photocopy/color printer/scanner machine network wired to each of the four offices' computer line capable of copying letter, legal and ledger size paper at a minimum of 60 PPM with maintenance and service throughout construction period, Kyocera KM-6030 or approved equal.

21. Provide Intranet connection in each of the four offices in the field trailer.

22. Internet connection (and Wireless Router) with minimum download speed of 60 Mbps and upload speed of 5 Mbps.

23. A first aid kit suitable for ten (10) people fully stocked with proper manuals for the trailer.

24. Provide and maintain on-site adequate firefighting equipment capable of extinguishing incipient fires, and comply with NFPA No.241

C. Maintenance. Contractor to maintain Temporary Field Offices for duration of Work. Maintenance by the Contractor shall include the following:

1. Heat/air conditioning.

2. Janitorial service (2x per week).

3. Utility service including electricity, telephone (fax, voice, alarm, computer), water and sewer.

4. Security.

5. Weather-tightness.

6. Supply of hot/cold drinking water.

7. Paper cups, paper towels, liquid soaps and toilet paper.

8. Photocopy machine with all supplies, including toner and paper and service contract. I. Computer and service contract.

9. Laser printer with supply of paper and ink cartridges.

10. Repair of all furnishings and equipment supplied as part of the County Inspector's

11. Field Office Trailer.

2.02 CONTRACTOR'S FIELD OFFICE AND FACILITIES

A. Specific Requirements:

1. The Contractor's and any subcontractor's office trailers shall be located in an area approved by the Owner.

2. Provide either a separate pre-manufactured building or a single wide or double wide trailer of adequate floor space for Contractor's use at Contractor's option.

3. The Contractor shall provide the following temporary utilities for the office trailers:

   a. Potable water.
   b. Sanitary sewer.
   c. Electrical.
   d. Telephone.
   e. High speed Internet connection.

4. The Contractor shall be responsible for costs of installing the utilities from the points of connection, maintenance, and removal of all materials for all temporary utilities. The Contractor shall also be responsible for installation, maintenance and removal of the electrical power, telephone, high-speed internet, exterior lighting, potable water and sanitary sewer utilities for the Engineer's/Owner's field office and the Contractor's and subcontractors field offices. Additionally, the Contractor shall be responsible for maintenance and removal of parking areas around the and Contractor's office and Engineer's/Owner's office trailers. This shall include policing the area of litter and debris, and weed control.

5. The offices shall be weather-tight, have a tight level floor at least 12 inches off the ground, and shall be insulated, have suitable screened ventilation and a solid door.

6. The office shall be provided with janitor service, HVAC equipment, water, electrical wiring, outlets, and fixtures suitable to light the tables and desk adequately. Toilet facilities are to be included with a holding tank to be pumped clean daily by the Contractor or a sanitary sewer connection. Garbage shall be collected daily and clean-up of the trailer shall be provided at least once per week or more often as required to maintain general cleanliness.

7. Lighting and Temperature Control: HVAC unit capable of maintaining the trailer at 70 to 78°F, but a minimum of 12,000 BTU (1 ton) rating.

B. Furniture and Equipment: The Contractor's office shall have the following minimum furniture and equipment:

1. Telephone: One (1) direct land line and phone instrument.
2. Plan racks and file cabinets for Project Record Documents.
3. Facsimile machine on a dedicated line.
4. Copy/scanner machine capable of producing 60 sheets per minute and capable of producing copies for 8-1/2"x11", 8-1/2"x14" and 11"x17". The copy machine shall be capable of providing reduced and enlarged copies. The scanner shall produce Adobe PDF files for electronic files of hard copy documents and transfer to a desktop computer for forwarding by e-mail.
5. Desktop or laptop computer connected to the high speed Internet and capable of sending and receiving e-mails. High speed internet connection shall have a minimum download speed of 60 Mbps and upload speed of 5 Mbps.
6. Other furniture and furnishings: At Contractor's option.

C. Within ten (10) days after Notice to Proceed, submit a sketch showing proposed number of office trailers and locations; including storage sheds and subcontractors trailers. The Contractor shall locate all temporary construction offices and storage trailers where approved by the Owner.

2.03 TEMPORARY FIRE PROTECTION

A. Provide and maintain a temporary fire protection system as construction progresses for control of fires that may occur during construction. Temporary fire protection shall be provided for the Contractor's field office and the Engineer's/Owner's field office in accordance with Orange County Building and Fire Code requirements.

B. Provide a minimum of one (1), 20-pound, all purpose (ABC) dry chemical type fire extinguisher with a UL rating as required by County Codes, for each construction crew and each trailer, including equipment storage trailers.

2.04 CONTRACTOR AND OWNER TEMPORARY EMPLOYEE PARKING

A. Contractor employee parking shall be allowed in only those areas approved by the Owner. The Contractor is to submit a plan of intended parking areas for approval 30 days prior to mobilizing on site. The plan shall include the proposed design and construction of the employee parking areas, if required. The parking area shall be designed for the maximum number of Contractor's and subcontractor's employees on-site at any one time, with a 10% contingency allowance for additional spaces.

B. The Contractor is to maintain strict supervision of use of the parking areas. The Contractor is to maintain, service and clean the areas acceptable to the Owner.

C. Provide a location, approved by the Owner, for a gravel or other suitable surface for Contractor's employees, Engineer representatives and visitor parking. Personal vehicles will be restricted from the work area.

D. Provide gravel parking spaces at the Contractor's field office trailer for a minimum of five (5) vehicles. Provide gravel parking spaces at the Engineer's/Owner's field office trailers for a minimum of five (5) vehicles.

2.05 SECURITY LIGHTING

A. Contactor shall provide adequate pole mounted flood lights at the Contractor and Engineer's/Owner's trailer offices parking areas and the Contractor's Employee parking area. Maintain all exterior lighting on photocells or timers.

PART 3 - EXECUTION

3.01 PREPARATION

A. The site shall be properly prepared for the setting of all temporary structures and the installation of all temporary facilities.

3.02 INSTALLATION

A. Locate water piping and outlets convenient to work stations and avoid interference with traffic and work areas, materials handling equipment, and storage areas. When necessary to maintain pressure, provide temporary pumps, tanks, etc.

B. Electrical service and distribution may be overhead or underground. Locate to avoid interference with traffic and work areas, cranes, material handling equipment, and storage areas.

C. Set portable toilets, if used, level and anchor to prevent dislocation or tipping over. Service as often as necessary to prevent accumulation of wastes, and creation of unsanitary conditions.

3.03 REMOVAL OF TEMPORARY FACILITIES

A. Completely remove temporary structures, facilities, materials and equipment upon completion of construction.

B. Clean, and repair damage caused by installation and restore areas to specified or original condition.

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SECTION 01505
MOBILIZATION

PART 1 - GENERAL

1.01 DEFINITION AND SCOPE

A. Mobilization shall include the obtaining of all permits, insurance, and bonds; moving onto the site of all equipment; temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to the following:

1. Move onto the site all Contractor's equipment required for the first month's operations.
2. Install temporary construction power, wiring and lighting facilities.
3. Establish fire protection plan and safety program.
4. Secure construction water supply.
5. Provide on-site sanitary facilities and potable water facilities as specified.
6. Arrange for and erect Contractor's work and storage yard and employee's parking facilities.
7. Submit all required insurance certificates and bonds.
8. Obtain all required permits.
9. Post all OSHA, EPA, Department of Labor and all other required notices.
10. Have Contractor's superintendent at the job site full time.
11. Submit a detailed construction CPM schedule acceptable to the Engineer as specified.
12. Submit a schedule of values of the work.
13. Submit a schedule of submittals.

1.02 DEMOBILIZATION

A. Demobilization is the timely and proper removal of all Contractor owned material, or equipment, from the jobsite and the proper restoration or completion of work necessary to bring the site into full compliance with the contract documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01516
WASTEWATER SYSTEM BYPASS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Work covered by this section consists of providing all temporary bypassing to perform all operations in connection with the flow of wastewater around pipe segment(s), manholes or pump stations at the influent area of a major wastewater reclamation facility. The purpose of bypassing is to make areas of the site available for construction activity, provide continuous service to all wastewater customers and prevent any wastewater surcharge, overflow or spills. The Contractor will maintain by-pass operations of wastewater flow in the construction area continuously in order to prevent backup and/or overflow and allow reliable wastewater service to the users of the wastewater system at all times.

1.02 SUBMITTALS

A. Prior to implementation of any bypass, the Contractor will submit and receive County acceptance of a bypass plan. The Contractor will submit to the County a comprehensive written plan for approval and acceptance that describes the intended bypass for the maintenance of flows during construction. The Contractor will also provide a sketch showing the location of bypass pumping equipment for each pump station, manhole or line segment(s) around which flows are being bypassed. The plan will include proposed pump unit(s), bypass piping, backup plan and equipment, work schedule, monitoring log for bypass pumping, monitoring plan of the bypass pumping operation, and maintenance of traffic plan. The Contractor shall identify fuel storage and fuel supply arrangements if required to support pump units. The Engineer shall have 30-days to review this submittal. The Contractor shall respond to all questions and request for additional information by the County and Engineer. The approved by-pass plan will be coordinated with OCU-SWRF operations staff prior to implementation. The Contractor shall provide a 24-hour around the clock personnel to monitor all bypass activities with emergency phone numbers for immediate response as needed if a failure should arise. The Contractor shall plan accordingly to allow 30 days of review of the submittals by the Owner and/or the Engineer.

B. Procedures and specialty subcontractors for linestopping and pipe tapping shall be submitted and approved in accordance with Section 02282 – Connections to Existing Buried Pipelines.

C. Specialty fittings and valves for wastewater bypassing such as linestops, tapping sleeves and tapping valves shall be submitted and approved in accordance with Section 02550 – Piping, Fittings, Valves, and Accessories for Underground Utilities.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Contractor will provide and maintain adequate equipment, piping, and other necessary appurtenances in order to maintain continuous and reliable wastewater service in all wastewater lines as required during construction. The Contractor will have secondary backup pump(s), piping, emergency power generators and appurtenances ready to deploy immediately if needed.

B. All temporary piping will be designed to withstand at least twice the maximum system pressure or a minimum of 50-psi, whichever is greater, and designated flow (GPD) as indicated on contractual drawings.

C. Linestops, tapping sleeves and tapping valves installed for wastewater bypassing shall be in accordance with Section 02550 – Piping, Fittings, Valves, and Accessories for Underground Utilities.

D. When bypassing a pump station, manhole or pipe section, a minimum of one (1) back-up pump equal to the primary unit(s) will be provided by the Contractor to prevent downtime while removing primary pumps. Where the Contractor is using multiple pumps to by-pass at one location, there shall be back-up pumps for a minimum of 100% of the pumped flow. Fuel storage shall be equal to twice the needed fuel volume needed between regular fuel deliveries. All motorized systems, pump units, etc. shall be monitored continuously to prevent discontinuation of by-pass flow. Manual and electronic monitoring is required for Influent Flow locations at the SWRF. Bypass pumps must comply with the maximum sound requirements as required by Orange County ordinances.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall have all materials, equipment and labor necessary to complete the repair, replacement, or rehabilitation on the job site prior to isolating the gravity main segment, manhole, or pump station. The Contractor will demonstrate that the temporary bypass pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 72-hours prior to beginning the Work.

3.02 TRAFFIC CONSIDERATIONS

A. The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways, and alleys, to include the possible temporary trenching of piping at critical intersections. Temporary piping shall be buried underground and protected from wheel loading where indicated on the plans to allow normal vehicle traffic to pass through the construction area. Additional traffic maintenance requirements are found in Section 01570 "Maintenance of Traffic".

3.03 BYPASS OPERATION

A. The County shall accept the bypass plan prior to implementation of the bypass operation. Contractor will plug off and pump down the sewer manhole or line segment in the immediate work area and will maintain the wastewater system so that surcharging does not occur. A successful 3-day test period shall be performed during normal County workdays (no weekend).

B. Where Work requires the line to be blocked after normal working hours and bypass pumping is being used, the Contractor shall be responsible for monitoring the bypass operation 24-hours per day, 7-days per week. Electronic monitoring, with SCADA systems, shall be included along with on-site monitoring and must be detailed in the comprehensive written plan and approved by the County.

C. The Contractor shall ensure that no damage will be caused to private property as a result of bypass pumping operations. The Contractor will complete the Work as quickly as possible and satisfactorily pass all tests, inspections, repair all deficiencies prior to discontinuing bypassing operations, and returning flow to the sewer manhole or line segment.

D. Since the flows are prior to the bar screens, the Contractor shall also provide screening for the flow, with means of cleaning and maintaining these screens.

E. During bypassing, no wastewater will be leaked, dumped, or spilled in or onto, any area outside of the existing wastewater system.

F. The Contractor shall immediately notify the County should a sanitary sewer overflow occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the County or other governmental agency. If sewage is spilled onto public or private property, the Contractor will wash down, clean up and disinfect the spillage to the satisfaction of the County and or other governmental agencies.

G. When bypassing a pump station, at least one (2) back-up pumps equal to the primary unit shall be required at all bypass locations. Bypass pumps shall have a maximum rating for sound attenuation in accordance with Orange County sound ordinances.

H. The Contractor shall cease bypass operations and return flows to the new and/or existing sewer when permanent work is completed and accepted by the County. Following the County's acceptance, all bypass piping shall be drained into the wastewater system prior to disassembly. All by-pass equipment, piping, plugs and other appurtenances shall then be removed from the site by the Contractor.

3.04 CONTRACTOR LIABILITY

A. The Contractor shall be responsible for all required pumping, equipment, piping, electrical and appurtenances to accomplish the bypass and for any and all damage that results directly or indirectly from the bypass pumping equipment, piping and/or appurtenances. The Contractor shall also be liable for all County personnel labor and equipment costs, penalties and fines resulting from sanitary sewer overflows. It is the intent of these specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

END OF SECTION

SECTION 01570
MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: This section includes identifying safety hazards and then furnishing all necessary labor, materials, tools, and equipment including, but not limited, to signs, barricades, traffic drums, cones, flashers, construction fencing, flag persons, variable message boards, uniformed police officers, warning devices, temporary pavement markings, temporary sidewalk, delineators, etc., to maintain vehicular and pedestrian traffic through and adjacent to the project area. These measures and actions shall be taken to safely maintain the accessibility of public and construction traffic by preventing potential construction hazards. All materials, work and incidental costs related to Maintenance of Traffic will be paid for at the contract lump sum price.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."

1.02 REQUIREMENTS

A. The Traffic Control Plan shall conform to the following standards:

1. Standard Specifications for Road and Bridge Construction, latest edition including all subsequent supplements issued by the Florida Department of Transportation, (FDOT).
2. Manual on Uniform Traffic Control Devices for Streets and Highways by U.S. Department of Transportation, Federal Highway Administration.
3. Right-of-Way Utilization Regulations, Orange County, Florida, latest edition.

B. All references to the respective agencies in the above referenced standards shall be construed to also include the municipality as applicable for this Work.

C. Sequence the Work in a manner that will minimize disruption of vehicular and pedestrian access through and around the construction area.

D. Traffic planning and control for the maintenance and protection of pedestrian and vehicular traffic affected by the Contractor’s Work includes, but is not limited to:

1. Construction and maintenance of any necessary detour equipment and facilities.
2. Providing necessary facilities for access to residences and businesses.
3. Furnishing, installing, and maintenance of traffic control and safety devices (e.g. signage, barricades, barriers, message boards, etc.), and flag persons as appropriate during Construction.

4. Control of water runoff, dust and any other special requirements for safe and expeditious movement of traffic.

E. Planning, maintenance and control of traffic shall be provided at the Contractor's expense. The Contractor will bear all expense of maintaining the vehicle and pedestrian traffic throughout the work area.

F. The Contractor will ensure all personnel involved in traffic control are and capable of communicating with the public. The Contractor may be required to hire off-duty uniformed police officers, in addition to flag persons, to direct and maintain traffic. Locations and conditions requiring such uniformed police officers shall be as directed by the County. The Contractor shall be required to utilize uniformed police officers for work within FDOT maintained ROW, road closures affecting school traffic and during all night work involving a road closure or crossing on nonresidential roads.

G. The Contractor will remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.03 SUBMITTALS

A. Submit at Contractor's own expense a Traffic Control Plan for approval by the controlling roadway agency (FDOT, Orange County Public Works or other local government) having jurisdiction over the road for approval.

1. The Traffic Control Plan will detail procedures and protective measures proposed by the Contractor to provide for protection and control of traffic affected by the Work consistent with the following applicable standards:

a. Standard Specifications for Road and Bridge Construction, latest edition including all subsequent supplements issued by the Florida Department of Transportation, (FDOT Spec.).
b. Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations, FDOT.
c. Right-of-Way Utilization Regulations, Orange County, Florida, latest edition.

B. All references to the respective agencies in the above referenced standards shall be construed to also include the municipality as applicable for this Work.

C. The Traffic Control Plan will be signed and sealed by a Professional Engineer registered in the state of Florida and shall include proposed locations and time durations of the following, as applicable:

1. Pedestrian and public vehicular traffic routing.

2. Lane and sidewalk closures, other traffic blockage and lane restrictions and reductions anticipated to be caused by construction operations. Show and describe the proposed location, dates, hours and duration of closure, vehicular and pedestrian traffic routing and management, traffic control devices for implementing pedestrian and vehicular movement around the closures, and details of barricades.

3. Location, type and method of shoring to provide lateral support to the side of an excavation or embankment parallel to an open travel-way.

4. Allowable on-street parking within the immediate vicinity of worksite.

5. Access to buildings immediately adjacent to worksite.

6. Driveways blocked by construction operations.

7. Temporary traffic control devices, temporary pavement striping and marking of streets and sidewalks affected by construction

8. Temporary commercial and industrial loading and unloading zones.

9. Construction vehicle reroutes, travel times, staging locations, and number and size of vehicles involved.

D. Obtain and submit prior to erection, or otherwise impacting traffic, all required permits from all authorities having jurisdiction, including Orange County Public Works, if applicable.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. The Contractor shall furnish, erect, and maintain all necessary traffic control devices, including flag person, in accordance with the Manual of Uniform Traffic Control Devices for Streets and Highways published by the U.S. Department of Transportation, Federal Highway Administration.

1. FLAG PERSONS

a. All flag persons used on this Project will adhere to the following requirements:

b. Any person acting as a flag person on this Project will have attended a training session taught by a Contractor’s qualified trainer before the start date of this Contract.

c. The Contractor’s qualified trainer will have completed a "Flag person Train the Trainer Session" in the 5-years previous or before the start date of this Contract and will be on file as a qualified flag person trainer.

d. The flag person trainer’s name and Qualification Number will be furnished by the Contractor at the Pre-Construction meeting. The Contractor will provide all flag persons with the Flag Person Handbook and will observe the rules and regulations contained therein. This handbook will be in the possession of all flag person while flagging on the Project.

e. Flag persons will not be assigned other duties while working as authorized flag persons.

f. Any person replacing flag person for break shall have the same training.

PART 3 - EXECUTION

3.01 NOTIFICATIONS

A. The Contractor will notify individual owners, owner's agents, and tenants of buildings affected by the construction, with copies to the county, 72-hours in advance of any construction activities.

B. The Contractor shall notify residents and pedestrians via variable message boards no later than 10 days prior to the closure of any road, lane or pedestrian thoroughfare.

C. The Contractor shall notify Emergency Management Services agencies, Lynx and OCPS no less than 7 days prior to such closures or whenever roads are impassable.

D. Implement closing of vehicle or pedestrian thoroughfare in accordance with the construction drawings and the approved Traffic Control Plan.

E. The Contractor will immediately notify the County of any vehicular or pedestrian safety or efficiency problems incurred as a result of the construction of the Project.

3.02 GENERAL TRAFFIC CONTROL

A. The Contractor will sequence and plan construction operations and will generally conduct Work in such a manner as not to unduly or unnecessarily restrict or impede normal traffic.

B. Unless otherwise provided, all roads within the limits of the Work will be kept open to all traffic by the Contractor. The Contractor will keep the portion of the project being used by public traffic, whether it is through or local traffic, in such condition that traffic will be adequately accommodated.

C. The Contractor will be responsible for installation and maintenance of all traffic control devices and requirements for the duration of the construction period. Necessary precautions for traffic control will include, but not be limited to, warning signs, signals, lighting devices, markings, barricades, canalizations, and hand signaling devices.

D. The Contractor will provide and maintain in a safe condition temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, residences, garages and farms.

E. The Contractor will provide emergency access to all residences and businesses at all times. Residential and business access will be restored and maintained at all times outside of the Contractor's normal working hours.

F. Traffic is to be maintained on one section of existing pavement, proposed pavement, or a combination thereof. Alternating one-way traffic may be utilized and limited to a maximum length of 500-feet during construction hours. Lane width for alternating one-way traffic will be kept to a minimum width of 10-feet, or as directed by the County.

G. Travel lanes and pedestrian access will be kept reasonably smooth, dry, and in a suitable condition at all times.

H. The Contractor will make provisions at all "open cut" street crossings to allow for free passage of vehicles and pedestrians, either by bridging or other temporary crossing structures. Such structures will be of adequate strength and proper construction and will be maintained by the Contractor in such a manner as not to constitute an undue traffic hazard.

I. The Contractor will keep all signs in proper position, clean, and legible at all times. Care will be taken so that weeds, shrubbery, construction materials, equipment, and soil are not allowed to obscure any sign, light, or barricade. Signs that do not apply to construction conditions should be removed or adjusted so that the legend is not visible to approaching traffic.

J. The County may determine the need for, and extent of, additional striping removal and restriping.

K. Excavated material, spoil banks, construction materials, equipment and supplies will not be located in such a manner as to obstruct traffic, as practicable. The Contractor will immediately remove from the site all demolition material, exercising such precaution as may be directed by the County. All material excavated shall be disposed of so as to minimize traffic and pedestrian inconvenience and to prevent damage to adjacent property.

L. During any suspension, the Contractor will make passable and open to traffic such portions of the Project and/or temporally roadways as directed by the County for accommodation of traffic during the anticipated period of suspension. Passable conditions will be maintained until issuance of an order for the resumption of construction operations. When Work is resumed, the Contractor will replace or renew any Work or materials lost or damaged because of such temporary use in every respect as though its prosecution had been continuous and without interferences.

3.03 TEMPORARY SHORING

A. Use shoring to maintain traffic when it is necessary to provide lateral support to the side of an excavation or embankment parallel to an open travel-way. Provide shoring when a theoretical 2:1 or steeper slope from the bottom of the excavation or embankment intersects the existing ground line closer than 5-feet (1.5 m) from the edge of pavement of the open travel-way.

B. The Contractor will furnish, install, and remove sheeting, shoring, and bracing necessary to maintain traffic at locations shown on the Traffic Control Plan and other locations determined during construction.

END OF SECTION

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SECTION 01580
PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall furnish, install, and maintain all sign materials including sign posts, weighted stands, brackets, any required mounting hardware, and miscellaneous materials required for temporary signs for the purpose of:

1. Project Identification.
2. Informational signs to direct traffic
3. On-site safety signs as appropriate for the Work

B. Remove temporary signs on completion of Construction prior to obtaining Certificate of Occupancy and Substantial Completion.

C. Allow no other signs to be displayed without written approval of the County.

1.02 SUBMITTALS

A. Submit complete Shop Drawings identifying locations, material, layout, sign content, font type and size, and sample colors. Make sign and lettering to scale, clearly indicating condensed lettering if used. The sign details will be submitted to the County for approval prior to fabrication.

B. Submit method of erection to include materials, fasteners, and other items to assure compliance with the requirements for wind pressures as required by the authorities having jurisdiction.

C. Submit signs in accordance with any details provided in the Drawings.

D. Prior to erection obtain and submit all required permits from the authorities having jurisdiction at appropriate locations to provide required information.

1.03 PROJECT IDENTIFICATION SIGN

A. Provide 1 painted sign at the site, or at each end of the Work if a linear project, or at each of the separate sites of Work, if applicable. The sign will be not less than 32-square feet area, with a minimum dimension of 4-feet and painted graphics with content to include:

1. Title of Project

2. Orange County Government name and logo

3. Names and titles of the Board of County Commissioners, County Administrator, Director of Orange County Utilities Department, the Consulting Engineer, and the Contractor

B. Erect on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by the County. The sign must be located 5-feet from all rights-of-way and 20-feet from all property lines.

1.04 INFORMATIONAL SIGNS

A. All signs and other traffic control devices shall conform to the requirements for shape, color, size, and location as specified in the latest Manual on Uniform Traffic Control and Safe Streets and Highways and the Florida Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations. Information as to the above may be obtained from FDOT Division engineers.

PART 2 - PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: New construction grade lumber, structurally adequate and suitable for exterior application and specified finish.

B. New construction grade lumber, structurally adequate and suitable for exterior application and specified finish.

1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles, minimum ¾-inch.

C. Rough Hardware: Galvanized steel, of sizes and types to enable sign assemblies to resist wind pressures as required by the authorities having jurisdiction but not less than a wind velocity of 50-mph.

1. Use minimum 1/2-inch diameter button head carriage bolts to fasten sign panels to supporting structures. Bolt heads to be painted to match sign face.

D. Paint: Exterior quality, as specified in Division 9 or as a minimum as specified herein.

1. Primer and finish coat: exterior, semi-gloss, alkyd enamel.

2. Colors for structure, framing, sign surfaces, and graphics: As shown on the Drawings or as selected by the County.

PART 3 - EXECUTION

3.01 PROJECT IDENTIFICATION SIGN

A. Install project identification signs within 10-days of the Notice to Proceed date. Failure to erect the signs may be reason to delay approval of the initial Application for Payment.

B. Paint exposed surfaces of supports, framing, and surface material; one (1) coat of primer and two (2) coats of finish paint.

C. Set signs plumb and level and solidly brace as required to prevent displacement during the Construction period. If mounted on posts, sink posts 3-feet to 4-feet below grade, leaving a minimum of 8-feet of each post above grade for mounting the sign.

D. Install informational signs at a height for optimum visibility, on ground mounted poles or attached to temporary structural surfaces.

3.02 MAINTENANCE

A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing, or sign.

B. Relocate informational signs as required by the progress of the Work.

C. Poorly maintained, defaced, damaged, or dirty signs shall be replaced, repaired, or cleaned without delay.

D. Special care must be taken to ensure that construction materials and dust are not allowed to obscure the face of a sign.

E. Signs not in effect shall be covered or removed.

3.03 REMOVAL

A. Remove signs, framing, supports, and foundations at Substantial Completion of the Work.

B. Leave areas clean and patch as required to remove any traces of temporary signs.

END OF SECTION

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SECTION 01600
MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Material and equipment incorporated into the Work:

1. Conform to applicable specifications and standards.
2. Comply with size, make, type and quality specified, or as specifically approved in writing by Engineer.
3. Manufactured and fabricated products:
    a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
    b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
    c. Two or more items of the same kind shall be identical, by the same manufacturer.
    d. Products shall be suitable for service conditions.
    e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

B. Related Work Described Elsewhere:

1. General Conditions and Requirements of the Contract
2. Submittals: Section 01300

1.02 APPROVAL OF MATERIALS

A. Only new materials and equipment shall be incorporated in the work. All materials and equipment furnished by Contractor shall be subject to the inspection and approval of Engineer. No material shall be delivered to the site without prior approval of Engineer.

B. The Contractor shall submit to Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable Engineer to identify the particular product to form an opinion as to its conformity to the specifications.

C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by Contractor. If Engineer requires, either prior to beginning or during progress of the work, Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples shall be furnished, stored, packed and shipped as directed at Contractor's expense. Except as otherwise noted, Contractor will make arrangements for and pay for the tests.

D. Contractor shall submit data and samples sufficiently early to permit consideration and approval before materials are necessary for incorporation in the work. Any delay of approval resulting from Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against Owner or Engineer.

E. In order to demonstrate the proficiency of workers or to facilitate the choice among several textures, types, finishes and surfaces, Contractor shall provide such samples of workmanship or finish as may be required.

F. The materials and equipment used on the work shall correspond to the approved samples or other data.

1.03 SUBSTITUTIONS AND PRODUCT OPTIONS

A. The substitution requirements of this Section are in addition to the requirements of the General Conditions and Special Conditions.

B. The intent of these Specifications is to provide Owner with a quality facility without discouraging competitive bidding. Substitutions may be submitted and will be evaluated as specified herein.

C. For products specified only by reference standards, performance and descriptive methods, without naming manufacturer's products, the Contractor may provide the products of any manufacturer complying with the Contract Documents, subject to the review of product data by Engineer as specified herein.

D. For products specified by naming a manufacturer's product followed by the words "or equal" or "or approved equal", the Contractor may provide any of the named products. He may substitute a product by another manufacturer as an equal only after review by the Engineer and Owner’s Representative as specified herein. In all cases, any product provided must comply with all of the specified requirements.

1.04 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including five copies to Engineer.

B. Maintain one set of complete instructions at the job site during installation and until completion.

C. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

2. Do not proceed with work without clear instructions.

D. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.05 SPARE PARTS

A. Spare parts shall be packaged in sealed, rotationally molded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Contractor shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

B. Pertaining to general inventory of all containers, the Contractor shall provide a general ascending alpha-numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

C. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum: Process description and Process number, equipment description, equipment tag, Manufacturer’s information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

D. The Contractor shall provide an electronic log in MS Excel of all containers that include the following at a minimum: container alpha-numerical designation, content description, site storage location, O&M Manual volume subsection reference.

E. A copy of all inventory and manufacturers’ product information data sheets shall be provided within a file pocket attached within the container.

F. Containers shall be positioned on site as designated by the Owner’s Representative.

1.06 TRANSPORTATION AND HANDLING

A. Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at the site.

1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.07 STORAGE AND PROTECTION

A. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.

1. Store products subject to damage by the elements in weather tight enclosures.

2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

3. Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.

4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

B. All materials and equipment to be incorporated in the work shall be handled and stored by Contractor before, during and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage of any kind whatsoever to the material or equipment.

C. Cement, sand and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural and miscellaneous steel, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical.

D. All materials which, in the opinion of Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the work, and Contractor shall receive no compensation for the damaged material or its removal.

E. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.

F. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.

G. The Contractor shall be responsible for all material, equipment and supplies sold and delivered to Owner under this Contract until final inspection of the work and acceptance thereof by Owner. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, Contractor shall replace same without additional cost to Owner.

H. Should Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice to do so has been given, Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering and any other costs associated with making the necessary corrections.

I. Store mechanical equipment with moving parts (pumps, valves, operators, etc.) in weathertight sheds on elevated floors.

J. Store electrical and electronic control equipment (motor control centers, panelboards, switchgear, wiring devices, etc.) in weathertight sheds on elevated floors and in an environment similar to the one in their final locations (ventilated, air-conditioned, etc.). Store all other electrical material in a manner to prevent contact with the ground and from being damaged by its own weight or by other loads.

1.08 STORAGE AND HANDLING OF EQUIPMENT ON SITE

A. Special attention shall be given to the storage and handling of materials on site. As a minimum, the procedure outlined below shall be followed:

1. Materials shall not be shipped until approved by the Engineer. The intent of this requirement is to avoid unnecessary delivery of unapproved materials and to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall materials be delivered to the site more than one month prior to installation without written authorization from the Engineer. Materials shipped to the site shall be stored in accordance with Paragraph 1.06, herein.

2. Manufacturer's storage instructions shall be carefully studied by Contractor and reviewed with Engineer by him. These instructions shall be carefully followed and a written record of this kept by the Contractor.

1.09 WARRANTY

A. For the submersible pumps, variable frequency drives, metering manholes, switchgears, and other major pieces of material, submit a warranty from the material manufacturer as specified in Section 01740. The manufacturer's warranty period shall start concurrent with the Contractor's and continue for a minimum of five (5) years after the date of Substantial Completion.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01650
START-UP AND TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide material, personnel, and equipment as needed and as specified herein to perform the required start-up and demonstration tests.

B. Start-up of the Work and associated facility will require cooperation between completion of remaining structures and connection to existing system or (system by others).

C. All equipment and systems shall be tested, ready for continuous operations and approved by the Owner prior to placing the Work into operation.

D. All lubricants, fuel and power necessary for initial operation and tests shall be furnished by the Contractor.

E. In addition to furnishing, delivering, installing, and testing equipment, the Contractor shall provide the services of competent manufacturing representatives for the periods indicated in this specification and other specifications included in the Contract Documents. These representatives shall be specially trained and qualified for installation, adjustment, start-up, and testing work and shall not be sales representatives only. The cost of such representation, including subsistence and travel, shall be included under this Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS:

A. Prepare and submit to the Engineer for approval and successfully execute the step-by-step procedure of start-up and performance demonstration specified hereinafter.

B. Demonstration tests and start up procedures personnel and vendors shall be on site for mechanical and electrical components.

C. The start-up and performance demonstration shall be successfully executed prior to approval of the completion milestone established in the Construction Contract.

D. Manufacturer or Field acceptance tests may be witnessed by the Owner and Engineer. At least 30 calendar days prior to scheduled testing, Contractor shall submit details of all test procedures to the Engineer for review, including but not limited to electrical and instrumentation testings.

E. All tests and inspections shall be scheduled at least 10 working days in advance or as otherwise specified with the Owner and Engineer. All performance tests and inspections shall be conducted during the normal work week of Monday through Friday, unless otherwise specified.

F. The Contractor shall be fully responsible for the proper operation of equipment during tests and demonstration periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner takes over the operation thereof.

3.02 PREPARATION FOR START-UP:

A. Upon completion of the Work, all channels shall be flushed with water. All process systems and pipe lines shall be filled and flushed with water and hydraulically checked for leaks, cracks, and defects. All sumps, tanks, basins, chambers, and wet wells which under normal operating conditions will contain water or process liquids shall also be checked using water for leaks, cracks, and defects.

B. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the various pumps, compressors, and other remaining equipment shall be made. All systems shall be purged as required. All sumps, tanks, basins, chambers, wet wells, and pipe lines which are hydraulically checked shall be drained and returned to their original condition once the water testing is complete.

C. All instruments and controls shall be calibrated through their full range. Any other adjustments required for proper operation of all instrumentation and control equipment shall be made.

D. The Contractor shall perform all other tasks needed for preparing and conditioning the Work for proper operation.

E. No testing or equipment operation shall take place until it has been verified by the Contractor and approved by the Engineer that all specified safety equipment has been installed and is in good working order.

F. No testing or equipment operation shall take place until it has been verified by the Contractor and approved by the Engineer that all lubricants, tools, maintenance equipment, spare parts, and approved equipment operation and maintenance data manuals have been furnished as specified.

3.03 PRELIMINARY FIELD TESTS

A. Prior to field testing of equipment of systems, Contractor shall provide to Owner the certificates required under Section 01820 Manufacturers' Field Services.

B. Hydrostatic and Leakage Testing – Potable and Reuse Water Lines, Plant Water Lines and Sewer Forcemains

1. All pipes shall be inspected and cleaned of debris. Potable, reuse and irrigation lines shall be flushed of all visible debris.

2. Pressure and leakage tests shall be performed in accordance with OCU standards and these specifications.

3. All exposed pipes, fittings and valves shall be carefully examined during the test and all leaks shall be made tight. All defective pipe, fittings, valves, hydrants or accessories shall be removed and replaced by the Contractor.

C. All potable, reuse and irrigation lines shall be disinfected in accordance with OCU Standards and these specifications.

D. Infiltration /Leakage Tests – Gravity Sewers

1. All pipelines shall be inspected for debris and cleaned.

2. All pipelines shall be tested for infiltration or leakage per OCU standards and these specifications.

E. The Contractor shall demonstrate to the Owner's Representative that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their own controls as designated.

F. Coordinate start up activities with the Owner's operating personnel and with the Engineer prior to commencing system start-up of the Works. Provide all Owner training and O&M Manuals prior to system start-up in accordance with their respective specifications.

3.04 DEMONSTRATION TESTS

A. Contractor shall furnish all labor, fuel, energy, lubrication, reclaimed water and all other materials, equipment, tools, and instruments necessary for all testing and inspections.

B. Contractor shall coordinate activities with the County, the manufacturer's representatives and Subcontractors. A factory representative knowledgeable in the mechanical and electrical equipment furnished shall inspect and supervise a start-up of their respective equipment. A minimum of 1 full business day shall be provided for the testing.

C. Initiate start-up of each system in accordance with the operation and maintenance manual. Demonstrate that all of the components of a system are operating under their own controls as designated without overheating or overloading any parts and without objectionable vibration as determined by the County.

D. Observe the system operation and make adjustments as necessary to optimize the system performance.

E. All functions of the pump station mechanical and electrical equipment shall be tested and inspected for operation and workmanship. All equipment shall be properly installed and meet the design performance requirements

F. The pumps shall be tested at the pump station start-up to verify their performance meets the design requirements.

G. After all Work components have been constructed, field tested and started up in accordance with the individual specifications and manufacturer requirements, perform Demonstration Tests in the presence of the Engineer and the Owner. The demonstration shall be held upon completion of all systems at a date to be agreed upon in writing by the Owner or his representative.

1. The Tests shall demonstrate the essential features of the systems as it applies to the Work, including the mechanical equipment, piping, structures, finishes, controls, instrumentation, and power distribution. Use the approved procedures and circumstances to demonstrate the system. Any minor deficiencies found shall be noted and included on a punch list attached to the Certificate of Completed Demonstration. The system shall be demonstrated only once, after completion of start-up tests.

2. Certificate of Completed Demonstration: Submit one (1) electronic copy of the Facility Performance Demonstration Certification Form for each system, signed by the Contractor and the Engineer and insert one copy in each Operation and Maintenance Manual. A sample Facility Performance Demonstration Certification Form is provided at the end of this section.

H. Start-up with Raw Sewage and Final Performance Demonstration

1. After the satisfactory completion and certification of the Demonstration Tests, the facilities shall be prepared to accept raw sewage and the Contractor shall divert raw sewage to the Works. The existing IPS shall be maintained in operations throughout the performance testing period until the Partial Completion milestone is approved in writing by the Owner.

2. The Contractor shall demonstrate 30 continuous, 24 hour days of successful operation of the Works with raw sewage, as a prerequisite of Partial completion and acceptance. During the demonstration test, operate the Work and cause various operational circumstances to occur. As a minimum, these circumstances will include average and peak flows, random equipment

failures, drawdown tests and alarm conditions. Demonstrate the essential features of the equipment and its relationship to other equipment. Some of the tests may be repeated multiple times during the testing period.

3. If circumstances arise that interrupt the test procedures (such as weather, unforeseen process problems, or problems caused by the Contractor whether or not the problems are the fault of the Contractor, etc.), then the test shall be terminated and rescheduled to a later date after the problem is corrected. The test shall be run in its entirety if so directed by the Engineer.

4. Prior to the demonstration test, the Contractor shall submit two (2) copies of a detailed schedule of operational circumstances to describe the proposed test procedures for approval of completeness. These approved procedures will then be used as the agenda at the demonstration. Coordination of the test schedule will be accomplished through the Engineer.

    a. This test is for the purpose of demonstrating that all performance and efficiency guarantees of the equipment and other requirements in compliance with these specifications have been met, that the operation of all equipment is coordinated, and that all controls operate satisfactorily in accordance with the equipment installed.
    b. During the testing period, each of the pump station wetwells will have to be isolated and operated independently for a minimum of 5 days.
    c. Operations of the controls for the self-cleaning cycle controls flow control via gates (modulated) will be tested a minimum of once each 7 days on each of the two wet wells.
    d. Pumping and Flow Measurement
    e. Screen Channel, Outlet Box, Isolation Box, and Yard Piping Valves
    f. Flow control via gates (open/close)
    g. Flow control via valves.
    h. The Owner may define other anticipated operating modes for the Works throughout the duration of the performance tests.

5. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempts, all necessary alterations, adjustments, repairs, and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the Owner and Engineer for the specified duration.

6. Contractor shall maintain a crew onsite to make repairs or adjust the equipment as necessary. The Contractor shall ensure all fuel, lubrication, and all other materials for operation are replenished.

7. The Owner will furnish all operating personnel (other than vendor's or subcontractor's service personnel) needed to operate equipment during the performance test period but will not be responsible for correcting or maintaining the equipment during the testing period.

8. At no time during performance tests shall the Contractor allow the facility to be operated in a manner which subjects any equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

I. In the event the initial or final guarantee testing and demonstration of equipment and controls does not meet the guarantee conditions or is not demonstrated to the satisfaction of the Engineer, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which is deemed necessary and shall conduct further tests until full satisfaction is received thereof.

J. The Owner will pay the salaries of the personnel selected by the Owner for operation of the equipment. Payment of all other salaries, public utility services, and operating expenses shall be borne by the Contractor for the test period and any additional test period required.

K. Re-testing:

1. If the start-up testing does not meet the requirements, the deficiencies shall be corrected and the testing procedure will be rescheduled.

L. Acceptance

1. The intent of the demonstration tests is for the Contractor to demonstrate to the Owner and the Engineer that the Work will function as complete and operable systems under normal, as well as emergency operating conditions and is ready for acceptance.

2. Acceptability of the Work's performance will be based on the Work functioning as a complete and operable system, performing as specified under actual and simulated operating conditions, and that construction of the Works has been completed in accordance with the contract documents and any deficiencies that were observed and noted have been corrected.

3.05 OTHER SYSTEM START-UP TESTS

A. Confirm that all equipment is properly energized, that the valves are set to their normal operating condition and that the flow path through the new work is unobstructed.

B. The start-up tests will be conducted for the screen channels, outlet box, and isolation box as they become ready for substantial completion. Both systems shall be tested as indicated in the specifications and as necessary to demonstrate full functioning of all alarms, signals, equipment, and components as complete systems. The Contractor shall submit a preliminary testing plan prior to testing. If the systems fail to operate successfully, or if the start-up is interrupted, the problems will be corrected and the test will start over. During the start-up tests, instruct designated operating personnel in the function and operation of the systems.

C. The Contractor shall coordinate with the Owner for any adjustments desired or operational problems requiring debugging.

D. The Contractor shall make adjustments as necessary to correct any deficiencies.

FACILITY PERFORMANCE DEMONSTRATION CERTIFICATION FORM

OWNER:_____ **PROJECT:** _____

Unit Processes Description (List unit processes involved in facility startup):

_____
_____
_____
_____

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

_____
_____
_____
_____
_____

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____**, 20____**

Engineer: _____ **Date:** _____**, 20____**
(Authorized Signature)

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Comply with requirements stated in the General Conditions and Requirements of the Contract and in specifications for administrative procedures in closing out the Work.

1.02 SUBSTANTIAL COMPLETION

A. The work may not be considered substantially complete unless the punch list items that remain, as identified by the Engineer and Owner, can be completed within thirty (30) days. All painting, finishes, cleanup, final pavement restoration shall have been completed and ready for inspection before substantial completion is given. Also, all building occupancy certificates will need to have been obtained. After (or concurrent with) the Demonstration Tests, with any minor deficiencies noted, the Contractor wishing to consider the Work substantially complete, shall have work completed as follows and submit to the Engineer:

1. A written notice that the Work is substantially complete
2. A list of items to be completed or corrected and explanations thereof
3. All Operations and Maintenance manuals have been submitted and approved in accordance with the Contract Documents
4. All equipment has been checked-out by the equipment manufacturer and Certificates of Manufacturer's Check-Out have been submitted in accordance with the Contract Documents
5. All start-up and demonstration testing completed and Certificates of Completed Demonstration submitted are in accordance with the Contract Documents
6. Project Record Documents are complete and have been submitted and reviewed in accordance with the Contract Documents.
7. The systems are fully-operational and are able to handle the raw wastewater flow, as applicable. Additionally, the equipment can be started up and operated in manual mode.
8. All training of Owner's personnel is completed.

9. All areas to be used and occupied are safe, operable in automatic and complete.

10. All deficiencies noted on inspection reports or non-conformances are corrected or the correction plan is approved.

11. All building inspections shall have been performed and passed by the local code officials.

B. Within a reasonable time after receipt of such notice, the Engineer will make an inspection, if necessary, to determine the status of completion.

C. Should Engineer determine that the Work is not substantially complete:

1. The Engineer will promptly notify Contractor in writing, giving the reasons therefore.

2. Contractor shall remedy the deficiencies in the Work and send a second written notice of substantial completion to Engineer.

3. Engineer will re-inspect the Work.

D. When Engineer finds that the Work is substantially complete, he will:

1. Prepare a tentative Certificate of Substantial Completion, with a tentative list of items to be completed or corrected before final inspection.

2. After consideration of any objections made by the Owner as provided in the General Conditions of the Contract, the Engineer will execute the Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.03 FINAL INSPECTION AFTER COMPLETION

A. When Contractor considers the Work is complete with all minor deficiencies completed or corrected, he shall submit written certification that:

1. Contract Document requirements have been met.

2. Work has been inspected for compliance with Contract Documents.

3. Work has been completed in accordance with Contract Documents.

4. Equipment and systems have been tested in the presence of Owner's representative and are operational.

5. All minor deficiencies have been corrected or completed and the Work is ready for final inspection.

6. All operation and maintenance manuals have been submitted.

7. Project record documents are complete and submitted.

8. Transfer of all spares and expendables has been made to the Owner with a full accounting of the quantities and amounts due.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should Engineer consider that the Work is incomplete or defective:

1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.

2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.

3. Engineer will re-inspect the Work.

D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

A. Evidence of compliance with requirements of governing authorities

B. Project Record Documents and Survey: To requirements of Section 01720

C. Operating and Maintenance Data: To requirements of Section 01730

D. Spare Parts and Maintenance Materials: To requirements of Technical Sections of the Specifications

E. Final Pay Request with “Final Estimate #--“ typed on front page

F. Consent of Surety to Final Payment, Form Dated and Notarized

G. Power of Attorney, Dated and Notarized

H. Asbestos-Free Letter on Contractor’s letterhead, Notarized

I. Prime Notarized Contractor’s Final Release of Lien

J. Final Project Notarized Release from all Subcontractors

K. Final Project Notarized Release from all Suppliers

L. Other items are required in the General and Special Conditions

M. Certificate of Insurance for Products and Completed Operations

N. Evidence of all Certifications of Warranties and Bonds

1.05 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01710
CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Execute cleaning, during progress of the Work, and at completion of the Work, as required by this section and the General Conditions.

B. Related Work Described Elsewhere:

1. General Conditions and Requirements of the Contract.
2. Each Specification Section: Cleaning for specific Products or Work.

1.02 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use only those cleaning materials which will not create hazard to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION

A. Execute daily cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

B. Provide on-site containers for the collection of waste materials, debris and rubbish.

C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

A. Construction techniques that minimize the production and distribution of dust shall be used.

B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

A. The Contractor shall wash down and vacuum out the containment area.

B. Prior to final completion, or Owner occupancy, the Engineer shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire Work is clean.

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS AND SURVEY

PART 1 - GENERAL

1.01 PURPOSE AND DESCRIPTION OF WORK

A. The purpose of the Project Record Documents is to provide the County with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.

B. Provide professional surveying and mapping work required for the execution of the contract, including verification of existing survey data, construction layout, and production of the As-Built Drawings. This Work shall be performed by a Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.

C. The location of the constructed improvements as depicted in the contract drawings is required. To verify the As-Built Drawing accuracies and to insure the Work was constructed in conformance with the contract drawings, the following survey documents are required to be certified by the Surveyor.

1. As-Built Asset Attribute Data Table,
2. Gravity Main Table,
3. Pipe Deflection Table,
4. Boundary Survey of IPS and associated components (vault structures) and Survey Map Report and
5. Boundary Survey and Survey Map Report for any easements that have constructed pipes within and monuments that were replaced.

1.02 DEFINITIONS

A. Except where specific definitions are used within a specific section, the following terms, phrases, words and their derivation shall have the meaning given herein when consistent with the context in which they are used. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number. The word "shall" is mandatory, and the word "may" is permissive.

1. **As-Built Drawings:** Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed WORK in a full size hard copy and an electronic AutoCAD file (dwg) format.
2. **Record Drawings:** Drawings, prepared by prepared and certified by the County's Consultant Engineer, shall be a compiled representation of the constructed project, a listing of the sources and the basis of information used

in the preparation of the "record drawings", the constructed project meets the Engineer's design intent and note the material deviations from the design documents, and the accuracy of the location information is based upon the Contractor's surveyor data supplied in the tables (As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection).

3. **Boundary Survey:** Boundary survey, map and report certified by a Surveyor shall be provided that meets the requirements of Chapter 61G17-6 'Minimum Technical Standards', FAC.

4. **Surveyor:** Contractor's Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.

5. **Survey Map Report:** As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, IPS and associated structures boundary issues, and accuracies obtained.

1.03 QUALIFICATIONS OF THE SURVEYOR

A. The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the County. Prior to any services being performed, the Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the County prior to Notice to Proceed. It is recommended that the Surveyor attend the Preconstruction meeting. Any Surveyor, who has not previously performed work for the County in the past, shall attend the Preconstruction meeting.

1.04 RELATED REQUIREMENTS

A. All General Conditions, Supplements to the General Conditions, and any Addenda issued by the County are a part of this Section in the same manner as if fully written herein, and shall govern the Work of this Section, except where more stringent articles or requirements are stipulated, then they shall govern this Section.

B. The Contract Documents are complementary and what is required by anyone shall be as binding as if required by all.

C. Other requirements affecting Record Documents may appear in pertinent other sections of these specifications.

1.05 QUALITY ASSURANCE

A. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor's staff as approved by the County.

B. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications and each sheet of drawings and other documents where such entry is required to show progress and changes properly.

C. Make entries within 24-hours after receipt of information has occurred.

D. Survey documents shall comply with the minimum technical standards of Chapter 61G17-6 of the Florida Administrative Code (FAC) and Table 01720-1 Minimum Survey Accuracies specified in, whichever are more stringent. Asset attribute data shall be signed, sealed and dated by the Surveyor. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract drawings control points for horizontal and vertical controls.

Table 01720-1
Minimum Survey Accuracies

Asset/Location	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: horizontal center and vertical top, unless otherwise specified
Bench Marks	N/A	0.01	Point
Horizontal Control	0.01	N/A	Point
Easements and Tracts	*	N/A	Survey Monuments
Civil Site, Topo and Foundation Drawings	0.1	0.01	All
Hydrants	0.01	N/A	Operating Nut
Blow off Valves	0.01	N/A	Valve Enclosure
Air Release Valves	0.01	N/A	Valve Enclosure
Master Meters	0.01	N/A	Register
Meter Box	0.01	N/A	Top of Meter Box
Clean-out	0.01	N/A	Top of Clean-out
Pump skids	0.01	0.01	Top Center of pump and Pipe Inverts
Manholes (Includes Electrical)	0.01	0.1	Top Center of Cover
Manhole	N/A	0.01	Pipe Inverts
System Valves	0.01	0.1	Operating Nut and Valve Body
Fittings	0.01	0.1	Top of Fitting and Ground
Piping at 100' max intervals (Includes Conduits)	0.01	0.1	Top of Pipe and Ground Top and Bottom of Conduits/Ductbanks
Restrained Pipe	0.01	N/A	Limits
Connections	0.01	0.1	Pipe Invert
Bore & Jack Casing	0.01	0.1	Top of Casing at Limits of Casing

Existing Utilities**	0.01	0.1	Conflicts

* Shall conform to the requirements of the "Chapter 61G17-6, 'Minimum Technical Standards', FAC", certified by a Surveyor.

** Existing utilities including but not limited to water, wastewater, reclaimed water, storm, fiber optic cable, electric, gas and structures within the limits of construction.

1.06 SUBMITTALS

A. Comply with pertinent provisions for the timely submittal requirements under this article and specification section.

B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings and tables (As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection) shall be acceptable to the County.

C. Progressive As-Built Drawings which will indicate the horizontal and vertical locations of all current constructed improvements with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The progressive As-Built Drawings shall include a Surveyor's certified statement regarding the constructed improvements being within the specified accuracies or if not indicating the variances, as described in Table 01720-1 Minimum Survey Accuracies. The Contractor shall also submit the following updated monthly tables certified by the Surveyor:

D. Prior to submitting a request for final payment or the County issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the County for approval. Retainage funds will be withheld at the County's discretion based on the quality and accuracy of the final Record Documents.

1.07 RECORD DOCUMENTS AT SITE

A. Maintain at the site and always available for County's use one record copy of:

1. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.

2. Change Orders, Verbal Orders, and other modifications to Contract.

3. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).

4. Accepted Shop Drawings, Samples, product data, substitution and "or-equal" requests.

5. Field test records, inspection certificates, manufacturer certificates and construction photographs.

6. Progressive As-Built Drawings

7. Current Surveyor's tables for the As-Built Assets Attribute Data, pipe deflection data, and gravity main data.

B. Maintain the documents in an organized, clean, dry, legible condition and completely protected from deterioration and from loss and damage until completion of the Work, transfer of all record data to the final Record Documents and for submittal to the County.

PART 2 - PRODUCTS

2.01 AS-BUILT DRAWINGS

A. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.

B. Date all entries. Enter RFI No., Change Order No., etc. when applicable.

C. Call attention to the entry by highlighting with a "cloud" drawn around the area affected.

D. In the event of overlapping changes, use different colors for entries of the overlapping changes.

E. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated "AB") and be shown in a bolder text that is completely legible.

F. Make entries in the pertinent other documents while coordinating with the Engineer and the County for validity.

G. Entries shall consist of graphical representations, plan view and profiles, written comments, dimensions, State Plane Coordinates, details and any other information as required to document field and other changes of the actual Work completed. As a minimum, make entries to also record:

1. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.

2. Plan view and profile drawings: State Plane coordinates and elevations or depths for all assets shown in the Asset Attribute Data Table on each drawing if the fittings, valves, appurtenances, etc. are shown on that drawing sheet.

3. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record true elevations and locations, dimensions between boxes.

4. Actually installed pipe or other Work materials, class, pressure rating, diameter, size, specifications, etc. Similar information for other encountered underground utilities, not installed by Contractor, their owner and actual location if different than shown in the Contract Documents.

5. Details, not on original contract Drawings, as needed to show the actual location of the Work completed in a manner that allows the County to find it in the future.

6. The Contractor shall mark all arrangements of conduits, circuits, piping, ducts and similar items shown schematically on the construction documents and show on the As-Built Drawings the actual horizontal and vertical alignments and locations.

7. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to contractor's records and shop drawings.

2.02 RECORD DOCUMENTS

A. A full size, two (2) hard copy set of the final Record Documents and shall include all of the documents described below under this subsection 2.02.

B. The following documents shall be signed and sealed by the Surveyor:

1. As-Built Asset Attribute Data Table (see Table 1720-2 for an example).

2. Boundary Survey of IPS and associated structures and Survey Map Report

3. Survey and Survey Map Report for the location of constructed pipes within any easements and right-of-way. As a minimum the Survey Map Report shall identify or describe the locations where the pipe centerline was constructed within three feet of the easement or right-of-way boundary, where the pipe was constructed outside the easement or right-of-way boundary, any corners that had to be reset, measurements and computations made, IPS and associated structures and improvements boundary issues, and accuracies obtained. Survey map report shall be dated after the Work within the right-of-ways or easements have been completed.

4. Gravity Main Table

5. Pipe Deflection Table (see Table 1720-3 for an example). *An electronic blank table will be supplied by the County.*

C. Digital Set of the final Record Documents including but not limited to:

1. Scanned digital copies of the final As-Built Drawings.

2. Electronic Survey documents electronically sealed by the Surveyor.

3. Final Record Documents information.

4. Digital As-Built Drawing in the Engineer's current version of AutoCAD file (dwg) format for the Contract Drawings, updated to match the final Record Drawing information.

D. IPS and associated structures site Boundary Survey and Map Report.

E. New Boundary Survey to re-establish easement corners, right-of-way monuments, or IPS and associated structures site corners with monuments if destroyed by the Work.

F. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.

G. The scanned As-Built drawing sets shall be complete and include the title sheet, plan/profile sheets, cross-sections, and details. Each individual sheet contained in the printed set of the As-Built Drawings shall be included in the electronic drawings, with each sheet being converted into an individual tif (tagged image file). The plan sheets shall be scanned in tif format Group 4 at 400 dpi resolution to maintain legibility of each drawing. Then, the tif images shall be embedded into a single pdf (Adobe Acrobat) file representing the complete plan set. Review all Record Documents to ensure a complete record of the project.

H. Provide an encompassing digital AutoCAD file that includes all the information of the As-Built Drawings and any other graphical information in the As-Built Drawings. It shall include the overall Work, utility system layout and associated parcel boundaries and easements. Feature point, line and polygon information for new or altered Work and all accompanying geodetic control and survey data shall be included. The surveyor's certified as-built asset attribute data shall be added to the As-Built Drawings and Surveyor shall electronically seal the data in a comma-delineated ASCII format (txt).

TABLE 1720-2

Asset Attribute Data Form Examples

General Information Worksheet

	A	B	C
1	**Date of submittal**	3/3/2009	
2			
3	**Collection Date**	3/3/2009	
4			
5	**Project Number**	123456	
6			
7	**Project Name**	ABC	
8			
9	**Contractor Name**	Joe Contractor	
10			
11	**Company**	Your Company	
12			

General Info | Hydrants | Valve | Manhole | Meter | Fitting | Cleanout | Pipes | Structures | Easements

Hydrants Worksheet

	A	B	C	D	E	F	H	I
1	**ID Number**	**Utilities Asset Number**	**Easting**	**Northing**	**Elevation**	**Service Type**		
2	1	H001	535896.7840	1491359.5830	99.78	Water		
3	2	H002	536062.0800	1491360.9250	99.20	Water		
4	3	H002	509643.9000	1481344.6000	99.20	Water		

General Info | **Hydrants** | Valve | Manhole | Meter | Fitting | Cleanout | Pipes | Structures | Easements

Valves Worksheet

	B	C	D	E	F	G
1	Utilities Asset Number	Easting	Northing	Elevation	Valve Type	Service Type
2	V001	535887.9950	1491394.7730	96.74	Gate	Water
3	V002	535884.7480	1491396.1010	91.27	Gate	Water
4	V003	535883.6870	1491393.4900	92.18	Gate	Water

General Info / Hydrants / **Valve** / Manhole / Meter / Fitting / Cleanout / Pipes / Structures / Easements

Manhole Worksheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID Number	Utilities Asset Number	Easting	Northing	Elevation	Invert Elv N	Invert Elv NE	Invert Elv E	Invert Elv SE	Invert Elv S	Invert Elv SW	Invert Elv W	Invert Elv NW	Service Type
2	15	15	535898.3040	1491144.0450	96.31	91.56	88.81			88.71		88.61		Water Reclamation
3	277	277	505962.0207	1474906.7832	92.76		86.83				86.85			Water Reclamation
4	278	278	506130.5461	1475093.6656	91.00				85.95		86.17		87.2	Water Reclamation
5	279	279	505993.3960	1475243.3448	92.36				88.8					Water Reclamation

General Info / Hydrants / Valve / **Manhole** / Meter / Fitting / Cleanout / Pipes / Structures / Easements / Lookup / Relation

Meter Worksheet

	A	B	C	D	E	F	G
1	ID Number	Utilities Asset Number	Easting	Northing	Elevation	Meter Type	Service Type
2	7	7	535887.9950	1491394.7730	96.74	Flow	Water

General Info / Hydrants / Valve / Manhole / **Meter** / Fitting / Cleanout / Pipes / Structures / Easements

Fitting Worksheet

	A	B	C	D	E	F	G
1	ID Number	Utilities Asset Number	Easting	Northing	Elevation	Fitting Type	Service Type
2	20008	F0001	538549.20	1475457.69	78.94	Tee	Water Reclamation
3	20010	F0002	538544.73	1475457.74	78.94	Tee	Water Reclamation
4	20013	F0003	538544.36	1475467.92	79.02	Tee	Water Reclamation

General Info / Hydrants / Valve / Manhole / Meter / **Fitting** / Cleanout / Pipes / Structures / Easements

Cleanout Worksheet

	A	B	C	D	E	F	H
1	ID Number	Utilities Asset Number	Easting	Northing	Elevation	Service Type	
2	15	15	535898.3040	1491144.0450	96.31	Water Reclamation	
3	277	277	505962.0207	1474906.7832	92.76	Water Reclamation	

General Info / Hydrants / Valve / Manhole / Meter / Fitting / **Cleanout** / Pipes / Structures / Easements

Pipes Worksheet

	A	B	C	D	E	F	G	H	I
1	ID Number	Utilities Asset Number	Easting	Northing	Elevation	W Pipe Type	WW Pipe Type	RW Pipe Type	Service Type
2	20001	P00001	1475448.92	538024.96	81.5	Distribution	Pressurized		Water Reclamation
3	20002	P00002	1475487.58	538055.74	79.74	Distribution	Pressurized		Water Reclamation
4	20004	P00003	1475470.75	538166.01	79.46	Distribution	Pressurized		Water Reclamation

General Info / Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / **Pipes** / Structures / Easements

Structures Worksheet

	A	B	C	D	E	F	G
1	ID Number	Utilities Asset Number	Easting	Northing	Elevation	Structure Type	Service Type
2	20	3980	535886.9150	1491144.3200	96.17	PumpStation	Water Reclamation

General Info / Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / Pipes / **Structures** / Easements

Easements Worksheet

	A	B	C	D	E	F	G
1	**ID Number**	**Utilities Asset Number**	**Easting**	**Northing**	**Elevation**		
2	1721	1721	468066.6800	1515018.8300			
3	1722	1722	468066.9400	1514983.8300			
4	1723	1723	468041.9400	1514983.6500			
5	1724	1724	468041.9400	1515018.6400			

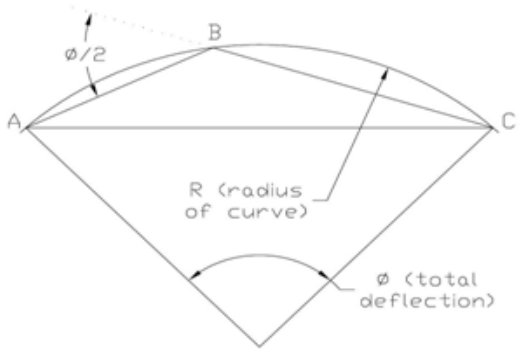
Hydrants / Valve / Manhole / Meter / Fitting / Cleanout / Pipes / Structures / **Easements**

Note: Do not fill out Utilities Asset Number (grey) column.

TABLE 01720-3

PIPE DEFLECTION TABLE EXAMPLE

Project:		
Contractor:		
Progress Mtg Date:		
Contract #		
Dwg Sheet #		
Utility Type	FM	
Pipe Manufacturer	National Pipe	
Pipe size & material	16" PVC C905	
PVC Manufacturer Deflection	6	inches
County Allowable Deflection 75%	4.5	inches
Allowable Angle of Offset	1.5	degrees
Allowable Radius of Curvature	764	feet
Laying Length of Pipe	20	feet



ID	Size and Type	Northing	Easting	Elev.	Calculations Including Elevation (XYZ)						
					Distance between points AB	**Distance between points BC**	**Distance between points AC**	**Total Deflection Ø'**	**Radius of Curve''**	**Average Offset Angle'''**	**Average Offset''''**
					Length AB	Length BC	Length AC	XYZ (w/ elevation)	XYZ (w/ elevation)	per laying length	per laying length
					ft	ft	ft	degrees	ft	degrees	inches
14041	16" FM	1505131.50	468948.53	107.68	-	-	-	-	-	-	-
7000	16" FM	1505059.60	468932.08	108.15	73.76	38.93	112.66	5.48	1,178.35	0.97	4.07
2128	16" FM	1505022.11	468921.60	108.55	38.93	39.61	78.54	2.29	1,961.65	0.58	2.45
2127	16" FM	1504983.85	468911.35	108.29	39.61	38.35	77.96	1.78	2,505.50	0.46	1.92
2126	16" FM	1504946.67	468901.96	107.81	38.35	39.13	77.42	8.79	505.16	2.27	9.51
2125	16" FM	1504908.11	468895.31	107.48							

Data that has be inputted Values in yelloware over spec

*Uses lawof cosines to determine angle ABC and Ø.
angle ABC = arccos((AB²+BC²-AC²)/(2*AB*BC))
180-Ø/2 = angle ABC
Calculate the total deflection Ø.
to the outer point (A or C) is equal in angle to
the approach from the next point along the

** Uses lawof sines, using the chord length AC and radius R.
Since sin((Ø/2)*(PI/180))=(Chord/2)/R and length AC=Chord
R=AC/(2*sin(Ø*PI/360)
This calculation assumes an average radius over the bend between three points.

*** Adds the lengths of AB + BC /20ft to get an approximate number of bends over the span.
This value is divided by the total deflection
angle to calculate the average bend angle of
This assumes that the bend angle consistent across the entire length.

**** Uses average offset angle and laying length of pipe.

PART 3 - EXECUTION

3.01 SURVEY FIELD WORK

A. Locate, reference, and preserve existing horizontal and vertical control points and property corners shown on the Drawings prior to starting any construction Work. If the Surveyor performing the Work discovers any discrepancies that will affect the Project, the Contractor must immediately report these findings to the County. All survey work shall meet the requirements as defined in Florida Administrative Code 61G17-6. Reference and preserve all survey points during construction. If survey points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes and/or electronic files for point replacement shall be provided to the County.

1. The Surveyor shall locate all improvements for the project As-Built Asset Attribute Data using State Plane Coordinates as the horizontal datum and the benchmark referenced on the Drawings as the vertical datum. The County's Engineer will provide electronic files of the Drawings to be used by the Surveyor in complying with these specifications.

2. The construction layout shall be established from the reference points shown or listed on the Drawings. The accuracy of any method of staking shall be the responsibility of the Contractor. All construction layout staking shall be done such as to provide for easy verification of the Work by the County.

B. Use survey control points to layout such work tasks as the following:

1. Clearing, grubbing, work limits, right-of-way lines and easements

2. Locations for pipelines and all associated structures and appurtenances

C. The Surveyor shall reference and replace any project control points, boundary corners, benchmarks, section corners, and right-of-way monuments that may be lost or destroyed, at no additional cost to the County. Establish replacement points based on the original survey control. Copies of all reference field notes and/or electronic files for point replacement shall be submitted to the County.

3.02 CONSTRUCTION PROGRESS MEETINGS

A. Contractor shall provide progressive and a final version of the Record Documents both as paper copies and electronic format described below.

1. Construction Contract, As-Built Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.

2. Specifications and Addenda: Record manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed as well as any changes made by Field Order, Change Order or other.

3. Change orders, verbal orders, and other modifications to Contract.

4. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).

5. 5. Accepted Shop Drawings, samples, product data, substitution and "or-equal" requests.

6. 6. Field test records, inspection certificates, manufacturer certificates and construction photographs.

B. Progressive record documents shall include the following updated monthly tables certified by the Surveyor:

1. As-Built Asset Attribute Data Table: Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements. The monthly submittal shall include the Surveyor's statement regarding the constructed improvements being within the specified accuracies as described in Table 01720-1 Minimum Survey Accuracies or if not, indicating the variances.

2. Gravity Main Table: Surveyor shall prepare and update a Gravity Main Table to include as a minimum the pipe segment identification, pipe lengths, manhole inverts and tops, and slopes for gravity mains. Surveyor shall certify the data entered are correct and indicate if the minimum slopes have not been met.

3. Pipe Deflection Table: Surveyor shall input the type of pipe, pipe manufacturer, PVC manufacturer deflection allowance, allowable angle of offset and radius of curvature, laying length of pipe, and coordinates.

Surveyor shall certify the data entered are correct and indicate if the deflection allowance, offset or radius of curvature exceeds the manufacturer's recommendations. *County will provide an electronic version of a blank table that shall be used to input the data.*

3.03 FINAL RECORD DOCUMENTS SUBMITTAL

A. Submit the Final Record Documents within 20 days after Substantial Completion.

1. Participate in review meetings as required and make required changes and promptly deliver the Final Record Documents to the Engineer and County.

3.04 STORAGE AND PRESERVATION

A. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.

1. Provide files and racks for storage of documents

2. Provide locked cabinet or secure space for storage of samples.

B. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.

C. In the event of loss of recorded data, use means necessary to again secure the data to the County's approval.

1. Such means shall include, if necessary in the opinion of the County, removal and replacement of concealing materials.

2. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

END OF SECTION

SECTION 01730
OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. The Contractor shall compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
2. The Contractor shall prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.
3. The Contractor shall instruct Owner's personnel in maintenance of products and in operation of equipment and systems.

1.02 QUALITY ASSURANCE

A. Preparation of data shall be done by personnel:

1. Trained and experienced in maintenance and operation of described products.
2. Familiar with requirements of this Section.
3. Skilled as a technical writer to the extent required to communicate essential data.
4. Skilled as draftsman competent to prepare required drawings.

1.03 FORM OF SUBMITTALS

A. Prepare data in form of an instructional manual for use by Owner's personnel.

B. Format:

1. Size: 8 1/2-inches x 11 inches.
2. Paper: 20 pound minimum, white, for typed pages.
3. Text: Manufacturer's printed data, or neatly typewritten.
4. Drawings:
   a. Provide reinforced punched binder tab, bind in with text.
   b. Reduce larger drawings and fold to size of text pages but not larger than 11 inches x 17 inches.

5. Provide fly-leaf for each separate products, or each piece of operating equipment.
    a. Provide typed description of products and major component parts of equipment.
    b. Provide indexed tabs.
6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
    a. Title of Project.
    b. Identity of separate structure as applicable.
    c. Identity of general subject matter covered in the manual.

C. Binders:

1. Commercial quality three D-ring binders with durable and cleanable plastic covers.
2. Maximum post width: 2 inches.
3. When multiple binders are used, correlate the data into related consistent groupings.

D. Electronic Format:

1. In addition to hardcopies for the Owners personnel one (1) electronic copy (PDF) of all Operation and Maintenance Manuals shall be provided to the Owner and Engineer.

1.04 CONTENT OF MANUAL

A. Neatly typewritten table of contents for each volume, arranged in systematic order.

1. Contractor, name of responsible principal, address and telephone number.
2. A list of each product required to be included, indexed to content of the volume.
3. List, with each product, name, address and telephone number of:
    a. Subcontractor or installer, manufacturer and supplier name, address and telephone number.
    b. A list of each product required to be included, indexed to content of the volume.
    c. Identify area of responsibility of each.
    d. Local source of supply for parts and replacement name, address and telephone number.
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

B. Product Data:

1. Include only those sheets which are pertinent to the specific product.
2. Annotate each sheet to:
    a. Clearly identify specific product or part installed.
    b. Clearly identify data applicable to installation.
    c. Delete references to inapplicable information.
3. Operation and maintenance information as herein specified.
4. Record shop drawings as submitted and approved with all corrections made for each product.

C. Drawings:

1. Supplement product data with drawings as necessary to clearly illustrate:
    a. Relations of component parts of equipment and systems.
    b. Control and flow diagrams.
2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
3. Do not use Project Record Documents as maintenance drawings.

D. Written text, as required to supplement product data for the particular installation:

1. Organize in consistent format under separate headings for different procedures.
2. Provide logical sequence of instructions of each procedure.

E. Copy of each warranty, bond and service contract issued.

1. Provide information sheet for Owner's personnel, give:
    a. Proper procedures in event of failure.
    b. Instances which might affect validity of warranties or bonds.

1.05 MANUAL FOR MATERIALS AND FINISHES

A. Submit six (6) copies of complete manual in final form in addition to one (1) electronic copy (PDF).

B. Content: for applied materials and finishes:

1. Manufacturer's data, giving full information on products.
    a. Catalog number, size, and composition.
    b. Color and texture designations.
    c. Information required for reordering special manufactured products.

2. Instructions for care and maintenance.

    a. Manufacturer's recommendation for types of cleaning agents and methods.
    b. Cautions against cleaning agents and methods which are detrimental to product.
    c. Recommend schedule for cleaning and maintenance.

C. Content, for moisture protection and weather-exposed products:

1. Manufacturer's data, giving full information on products.

    a. Applicable standards.
    b. Chemical composition.
    c. Details of installation.

2. Instructions for inspection, maintenance and repair.

D. Additional requirements for maintenance data: Respective sections of Specifications.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit six (6) copies of complete manual in final form in addition to one (1) electronic copy (PDF).

B. Content, for each unit of equipment and system, as appropriate:

1. Description of unit and component parts.

    a. Function, normal operating characteristics, and limiting conditions.
    b. Performance curves, engineering data and tests.
    c. Complete nomenclature and commercial number of replaceable parts.
    d. Summary of information listed on equipment and motor data plates.

2. Operating procedures:

    a. Start-up, break-in, routine and normal operating instructions.
    b. Regulation, control, stopping, shut-down and emergency instructions.
    c. Summer and winter operating instructions.
    d. Special operating instructions.

3. Maintenance procedures:

    a. Routine operations.
    b. Guide to "trouble-shooting".
    c. Disassembly, repair and reassembly.
    d. Alignment, adjusting and checking.

4. Servicing and lubrication required.

5. Manufacturer's printed operating and maintenance instructions.

6. Description of sequence of operation by control manufacturer.

7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

    a. Predicted life of parts subject to wear.
    b. Items recommended to be stocked as spare parts.

8. As-installed control diagrams by controls manufacturer.

9. Each Contractor's coordination drawings.

10. Charts of valve tag numbers, with location and function of each valve.

11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.

12. Other data as required under pertinent sections of specifications.

13. Approved record shop drawings with all corrections made, and a copy of the warranty statement, check-out memo, and demonstration test procedures and certification.

C. Content, for each electric and electronic system, as appropriate:

1. Description of system and component parts.

    a. Function, normal operating characteristics, and limiting conditions.
    b. Performance curves, engineering data and tests.
    c. Complete nomenclature and commercial number of replaceable parts.

2. Circuit directories of panelboards.

    a. Electrical service
    b. Controls

3. As installed color coded wiring diagrams.

4. Operating procedures:

    a. Routine and normal operating instructions.
    b. Sequences required.
    c. Special operating instructions.

5. Maintenance procedures:

    a. Routine operations.
    b. Guide to "trouble-shooting.
    c. Disassembly, repair and reassembly.
    d. Adjustment and checking.

6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

8. Other data as required under pertinent sections of specifications.

D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

1.07 SUBMITTAL SCHEDULE

A. Submit two (2) copies of preliminary draft of proposed formats and outlines of contents of Operation and Maintenance Manuals within 90 days after Notice to Proceed. Sets of example O&M manuals are available for examination upon request.

B. Submit two (2) copies of completed data in preliminary form no later than 20 days following Engineer's review of the last shop drawing of a product and/or other submittal specified under Section 01340, but no later than delivery of equipment. One copy will be returned with comments to be incorporated into the final copies and the other copy will be retained on-site for use in any early training.

C. Submit six (6) copies of approved manual in final form directly to the offices of the Engineer within 10 days after the reviewed copy or last item of the reviewed copy is returned.

D. Provide six (6) copies of addenda to the operation and maintenance manuals as applicable and certificates as specified within 30 days after final inspection.

1.08 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to demonstration test, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.

B. Operating and maintenance manual shall constitute the basis of instruction. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

C. Instructors shall be fully qualified personnel as outlined within the individual equipment specifications. If no specific training specifications are listed with the equipment, the Contractor shall provide the instruction with qualified Contractor personnel.

D. The instructors shall provide for and prepare lesson scopes and handouts for up to five individuals designated by the Owner that outline the items to be covered. Separate sessions for operation and maintenance instruction shall be provided consecutively. Handouts shall be submitted to the Owner with at least one week's notice prior to the training sessions.

E. All instruction sessions shall be video taped with portable video cameras and tapes supplied by the Contractor. Video taping shall be made by the Contractor under the direction of the Owner with DVD compatible taping equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01740
WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Compile specified warranties and bonds, as in the General Conditions and as specified in these Specifications.
2. Submit to Engineer for review and transmittal to Owner.

B. Related Work Described Elsewhere: Contract Closeout 01700

1.02 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Number of original signed copies required: Two (2) each.

C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.

1. Product or work item
2. Firm, with name of principal, address and telephone number
3. Scope
4. Date of beginning of warranty, bond or service and maintenance contract
5. Duration of warranty, bond or service maintenance contract
6. Provide information for Owner's personnel: Instances which might affect the validity or warranty or bond
7. Contractor, name of responsible principal, address and telephone number

1.03 FORM OF SUBMITTALS

A. Prepare in duplicate packets

B. Format:

1. Size 8 1/2-inches x 11-inches, punch sheets for standard three-post binder. Fold larger sheets to fit into binders. The Contractor shall submit warranties in a separate/stand-alone binder.

2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS".

3. List:

   a. Title of Project
   b. Name of Contractor

C. Binders: Commercial quality, three (3) D-ring binder, with durable and cleanable plastic covers and maximum ring size of two inches.

1.04 WARRANTY SUBMITTALS REQUIREMENTS

A. For all material, with the exception of material listed in section 1.04.B below, submit a written warranty covering materials, and workmanship for the equipment provide for a period of one (1) year. The warranty period shall commence concurrent with the start of the Contractor's warranty period, i.e., at the time of Substantial Completion.

B. Refer to Section 01600 for manufacturer's 5-year warranty.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01784
FIELD INSPECTION AND ACCEPTANCE TESTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Perform electrical system tests to demonstrate that each component of each system is in proper working order and in accordance with applicable codes, manufacturer's instructions, drawings and specifications. Tests are in addition to, and no substitution for, factory tests of individual equipment.

1. Perform insulation and ground resistance tests before operating tests.

2. Determine proper rotation of motors before permanent connections are made.

B. Testing shall be performed to:

1. Provide initial acceptance tests and recorded data that can be used as a bench mark for future routine maintenance and trouble shooting by facility operating staff.

2. Ensure a successful start-up with a minimum of last minute interruptions and problems.

3. Determine the suitability of the equipment and systems for energization and placing into operating service.

4. Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform, its function in the system with reasonable reliability throughout the life of the facility.

C. Provide all supervision and labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation. Provide sufficient personnel to assist in any additional checks they may require for acceptance, start-up, run-in and placing the equipment and systems into continuous service.

D. The Contractor shall engage the services of a competent nationally recognized independent electrical equipment testing to perform specified field inspections, tests, and adjustments firm. The testing firm shall not be a subsidiary, division, nor department of either the installing Contractor or the manufacturer of the equipment materials or systems being inspected and tested. The testing firm shall be a fully accredited member of the International Electrical Testing Association, Incorporated (NETA) and have the specialized experience and skill in the supervision and performance of all inspection and testing specified herein.

E. The testing firm shall perform the specified activities prior to the start-up and completion of the work identified in the Contract Documents.

F. The tests and inspections performed shall in no way relieve the Contractor of the responsibility for the performance of the tests, check outs, and inspections specified under other sections of the specification during construction.

G. The listings and descriptions of the tests, and checks described herein shall not be considered as complete and all inclusive. Additional normal standard construction (and sometimes repetitive) checks and tests may be necessary throughout the job, prior to final acceptance by the Owner.

H. Pay all costs for tests including expenses incident to retests occasioned by defects and failures of equipment to meet specifications.

1. Replace wiring and equipment found defective, or failing to meet specified requirements, without charge, unless written acceptance for repair is given by Engineer.

2. Unless otherwise specified, the Owner will supply electric power necessary for tests.

1.02 REFERENCES:

A. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.

1. All Standard, Special and Supplemental Conditions of the Contract.

2. Association of Edison Illuminating Companies (AEIC).

3. American National Standards Institute (ANSI):

a. Z244-1: American National Standard for Personnel Protection

4. ASTM International (ASTM).

5. Insulated Cable Engineers Association (ICEA).

6. National Electrical Manufacturer's Association (NEMA).

7. International Electrical Testing Association (NETA):

a. ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

8. National Fire Protection Association (NFPA):

a. 70: National Electrical Code
b. 70B: Electrical Equipment Maintenance
c. 70E: Electrical Safety Requirements for Employer Workplaces
d. 101: Life Safety Code
e. 780: Lightning Protection Code

9. Occupational Safety and Health Administration (OSHA):

   a. Part 1926; Subpart V, 1926.950 through 1926.960

10. State and Local Codes and Ordinances.

B. All inspections and tests shall utilize the following references:

1. Project Design Specifications
2. Project Design Drawings
3. Project Electrical System Studies
4. Manufacturer's instruction manuals applicable to each particular apparatus

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Submit test plans and test data in accordance with the requirements of Section 16050.
2. Submit evidence of NETA membership, experience and staff qualifications of the independent testing firm.
3. Submit in 3-ring notebook, test plans for each system and piece of equipment to be inspected and tested. Provide sample test data sheets with blanks identified where test data will be recorded, test instrument identification, calibration date, and blanks provided to identify the person performing the test and the person witnessing the test.
4. Submit test results.

1.04 SCHEDULING:

A. The Contractor shall be responsible for the preparation of proposed procedures and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work shall be coordinated and to be compatible with both the work of other crafts and the project schedule. The above must be organized and submitted with all proposed testing and check out forms. The procedures shall provide specific instructions for the checking and testing of each component in addition to the system functional checks. Tests and inspections shall be scheduled as the job progresses and may require repetition in grater detail at a later stage of construction. All procedures submitted shall include job safety rules proposed.

B. Equipment shall be inspected and tested to determine its condition. See other applicable sections of the specifications and contract documents for required checks and responsibilities.

C. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring repairs shall be reported to the Engineer. Corrective action may require prior approval.

D. Prior to check out and testing for start-up, ensure that all equipment and wiring is properly and permanently identified with nameplates and other identification as specified elsewhere. Check and tighten all terminals and connection points, remove all shipping blocks and hardware, thoroughly clean all equipment, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for submittal to the Engineer. Make routine checks and tests as the job progresses and as necessary to insure that all wiring and equipment is properly installed and wired.

E. All testing and checkout work shall be performed with fully qualified personnel skilled in the particular tests being conducted. This is essential for obtaining and properly evaluating data while the tests are in progress and for insuring that important facts and questionable data are reported.

F. All inspections, tests, and calibrations shall be reported in writing on forms submitted for review under Submittals. The recorded data form shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall be designed to serve as the test and inspection checklist for inspection requirements. "As-found" and "as-left" test data shall be recorded and reported in writing.

G. The sequence of all tests and checks shall be such that the equipment can be energized immediately after the completion of the applicable tests.

H. When applicable electrical tests and inspections specified herein, or otherwise required are completed and results reported and reviewed then the Contractor may consider that portion of the electrical equipment system or installation electrically complete. The Contractor shall then affix appropriate dated completion or calibration labels to the tested equipment. The Contractor shall notify the Engineer and Owner of electrical completion. If the Engineer or Owner finds completed work unacceptable, the Contractor will be notified in writing of the unfinished or deficient work which shall be corrected by the Contractor. The Contractor shall notify the Engineer in writing when all exceptions have been corrected. If later in-service operation or further testing determines problems attributable to the Contractor, these shall be corrected by the Contractor or suitable arrangements shall be made to suit operating circumstances.

PART 2 - PRODUCTS

2.01 TESTING EQUIPMENT:

A. Calibration:

1. Furnish all material, test equipment, and power sources required for testing, calibrating and check out. All calibration and setting checks by the independent testing laboratory shall be performed with laboratory calibrated test instruments of appropriate accuracy. This test equipment shall have calibrations traceable to the National Bureau of Standards. Testing laboratory dated calibration labels shall be visible on all test equipment. Calibrations over 6 months old will not be acceptable on field test instruments. The accuracy of all test instruments shall be at least twice that of the accuracy of the equipment, device, relay or meter under test. All testing instruments shall be checked to insure satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used shall be recorded on the test forms.

2. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.

2.02 TESTING:

A. Coordination:

1. Coordinate activities, and cooperate with others on project, to ensure that systems are energized when required, loads applied, and other requirements of Section are carried out on timely, coordinated basis.

2. Conduct tests in presence of Engineer. Notify Engineer seven calendar days or more in advance when any test to be performed, and do not start tests without Engineer's permission.

3. Other Sections of specifications require services of one or more manufacturer's representatives, to ensure that equipment supplied has been installed properly and adjusted to proper working order. Advise representative of all applicable tests in this Section, so that work will be coordinated, and tests combined where feasible.

4. It is important that equipment warranties or guarantees not be voided by testing and checkout work. The checks and tests to normally be supplemental to and compatible with the manufacturer's installation instruction leaflets and literature. Where deviations are apparent, the manufacturer's review shall be obtained prior to testing. Reasonable cooperation shall be extended to permit witnessing by the manufacturer's representative if so requested. Where any questionable repairs, modifications, significant adjustments, tests or checks are to be made, the Contractor shall contact the Engineer to determine if the work should be performed by or with the manufacturer's representative.

B. Preparation:

1. Make up no medium-voltage connections at service entrance transformers permanently until correct phase rotation of all equipment is determined.

Install and insulate these connections temporarily, if necessary, while determining proper rotation. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

PART 3 - EXECUTION

3.01 INSULATION TESTS OF EQUIPMENT, CABLE, AND CIRCUITS:

A. General:

1. Perform DC insulation tests of the type specified on electrical equipment, apparatus and cables under any one or more of the conditions described as follows: At the time equipment such as motors, transformers, power circuit breakers and switches, switchgear, motor control centers, and similar electrical equipment is:

   a. Delivered to the site for care, storage, and/or installation,
   b. Prior to energization and/or placing into service and acceptance by the Owner,
   c. When damage to the insulation is suspected or known to exist,
   d. After repairs or modifications to the equipment affecting the insulation,
   e. Routinely as necessary to determine or evaluate the condition of the insulation, especially moisture conditions, to determine the need for drying, cleaning or other maintenance work or protection,
   f. Where lightning or other surge conditions are known to have existed on the circuit.

2. Insulation tests are required to be performed by the testing firm at various stages of construction. The equipment, cable and systems that require testing, the maximum test voltages, and the type tests required shall be in accordance with the applicable paragraphs of NETA.

3. List each circuit and measured resistance as test data.

4. Maintain record of all insulation resistance values. Identify conductor, or equipment, date that value was taken and resistance value. Arrange information in suitable neat tabular form and submit to Engineer.

3.02 SPECIFIC TESTS AND INSPECTIONS BY THE CONTRACTOR:

A. General:

1. The following specific items of work shall be performed by the Contractor. The list is not all inclusive, nor does it define how the tests and checks are to be made. Refer to applicable sections of NETA and equipment specifications

for additional details. The equipment and cable shall be deenergized and isolated as necessary to perform the tests.

2. The engagement of the independent testing firm in no way relieves the Contractor of the responsibility for, or diminishes the importance of, performance tests, checkouts, and inspections during the various stages of construction. The specific work of the independent test firm is defined in Paragraph 3.03.

3. The Contractor shall perform all tests and inspections as defined in the other sections of this specification. Tests and inspections required by these sections are not necessarily repeated under specific equipment in Paragraph 3.02

4. All equipment received for the job and for which the Contractor is responsible to be stored and cared for per the manufacturer's instructions. It is the Contractor's responsibility to obtain such information even where the instructions are not shipped with the equipment.

5. The Contractor shall assist the independent test laboratory in performing its work.

B. Equipment Test and Inspection During Construction and Prior to Acceptance Testing:

1. Motors (5 Hp and larger):

a. At the time of motor receipt, each motor shall be visually inspected for any physical damage and the motor meggered as described in Paragraph 1.e below.

b. All voltage motors shall be provided with adequate heating during storage. See Paragraph 3.01 for additional insulation tests for all motors of different voltages.

c. Before energizing any machine, visually inspect for serviceability. Check manufacturer's instruction manual for correct lubrication and ventilation. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.

d. Test run all motors preferably uncoupled or unloaded, before placing into regular service. A check on the motor for rotation, speed, current and temperature rise to be made and results recorded. The proper color codes for phase identifications to be maintained. This may require lead swaps at the motor for proper rotation. A motor phase rotation meter shall be used prior to connection at motor to prevent later swaps.

e. Complete visual inspection and electrical test per NETA ATS. Section 7.15.1

2. Grounding Systems:

a. All grounding loops and major equipment grounds shall be tested to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground bench mark. Visual inspection of all systems, raceway and equipment grounds shall be

made to determine the adequacy and integrity of the grounding. All ground testing results shall be properly recorded, witnessed, and submitted.

b. Ground tests shall be performed in accordance with NETA ATS, Section 8.13 using a J. G. Biddle Company low resistance, Null balance type, ground testing with 'ohmmeter with test lead compensation in place. The test instrument shall be the type which compensates for potential and current rod resistances.

c. Test each ground rod and submit tabulation of results to Engineer. Include identification of electrode, date of reading and ground resistance value in results.

d. Test each entire grounding system for continuity of connections and for resistance. Ensure that ground resistance of conduits, equipment cases, and supporting frames does not vary appreciably from that of system as whole and does not exceed 5 Ohms.

e. Where ground test results indicate the need for additional grounding conductors or rods that are not indicated on drawings or specified, additional grounding provisions shall be initiated to obtain the acceptable values. The Contractor shall be responsible for the proper installation of the grounding shown on drawings or specified and for the correction of improper installations as determined by inspections and tests.

3. Power Transformers:

   a. At the time of equipment receipt, the exterior to be visually checked for any damage or any defects.

   b. Perform complete inspection and electrical tests in accordance with NETA ATS, Section 7.2.

4. Low Voltage Switchgear: Refer to NETA ATS, Section 7.2. Perform all applicable tests and checks as described in NETA ATS, Section 7.2.

5. Protective Relays and Metering:

   a. Prior to final check out as described in Paragraph 3.03, visually inspect and correct, where appropriate, all relays, meters, wiring and related circuitry for tightness of connections, physical damage, compliance with specifications and Vendor data, mechanical condition, freedom of movement, and presence of or possibility of moisture, dust, or other contaminants.

   b. Clean, check, and pre-set all protective relays. (Final calibration and adjustment, etc., shall be by the independent testing firm. Refer to Paragraph 3.03).

   c. Complete inspection and electrical tests per NETA ATS. Section 7.9.

6. Low Voltage Motor Control Centers:

a. At the time of equipment receipt, the motor control centers shall be visually checked for any damage.
b. Inspect and adjust compartment front doors, wireway doors, and side panels as necessary.
c. Megger incoming line terminals and busses.
d. Perform inspection checks and electrical tests in accordance with NETA ATS. Section 7.16.2.

C. Distribution Transformers:

1. All 480 volt primary, air-cooled, transformers shall be given an insulation test, by means of a megger, after connections with the primary cables are complete. The supply cable shall be meggered with the primary winding and to the open air circuit breaker. Secondary leads may be meggered with the secondary windings to the open load breakers.

2. Continuity and correctness of connections of all windings, and ratings shall be checked.

3. Perform inspection checks, and electrical tests in accordance with NETA ATS Section 7.2.3.

D. Wire and Cable:

1. Before energizing, the continuity and insulation resistance of every circuit external to equipment shall be measured with a megger from each wire to all others and ground and test results recorded on forms. Tests shall normally be conducted at voltages 500 volts or lower. High potential testing will normally be performed by the independent testing laboratory as described in Paragraph 3.03.

2. Insulation resistance measurements shall be taken of the following: (Refer to Paragraph 3.01 for additional information.)

a. Motor Feeders: With motors disconnected, measure and record insulation resistance from load side of contactors or circuit breakers. Repeat this test after motors are connected and just before energizing at lower voltage as limited by the maximum test voltage for the motor.
b. Motor Control Circuits (600 Volts): With push buttons and overcurrent devices connected, measure and record insulation resistance from phase to ground only. It will be necessary to lift the neutral ground on the control transformers to perform this test. Also, isolate any control elements that should not be meggered.
c. Lighting Panel Feeders: Measure and record insulation resistance with circuit breakers, lighting transformers and panelboards connected, but with lighting branch circuit breakers or switches open.
d. Lighting Branch Circuits: Measure and record insulation resistance after all lampholders, receptacles, fixtures, etc., are connected but before lamping.

e. Feeder Circuits: Measure and record insulation resistance with connections to circuit breakers made up but with breakers open and loads not connected.

3. All cables and wires shall be checked for proper identification numbering and/or color coding.

E. Overhead Conduit Systems:

1. The overhead conduit system shall be checked for proper installation by using the following check list: (This list not to be considered all inclusive but as a guide for inspection).

a. Conduits are supported on appropriate independent supports (i.e., not on process piping, pipe ways, or piping hangers).
b. Exposed conduits are run in a neat workmanlike manner, parallel or perpendicular to structural members.
c. Conduits are routed as far away from possible fire hazards and heat sources as practical.
d. Conduits are supported at the required intervals.
e. Pull boxes and fittings are installed so that covers are easily removable. Verify that all covers are installed and tightly bolted with gaskets provided where needed.
f. Number of bends in the conduit does not exceed 270 degrees without a pull box installed.
g. Circular cross sectional area is uniform at conduit bends. Single bends do not exceed 90 degrees.
h. Conduits are terminated in threaded hubs or bushings to prevent damage to wire.
i. Conduits joints have joint compound of the type specified and are tight and conduit ends are properly reamed and threaded not to engage less than 5 threads.
j. Pull fittings are of adequate size such that cable can be installed and replaced at a later date without the bending radius of the cable being less than code or manufacturer's requirements.
k. Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture into equipment and/or where shown on plans.
l. Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture.
m. Flexible conduit is installed at motors and other equipment as specified or required. Verify that all cabling and conduit runs are properly identified at each end.

F. Underground Conduit Systems:

1. Underground conduit systems shall be inspected and checked for compliance with standard practices, plans and specifications as the job progresses.

2. Upon construction completion of the underground conduit banks or runs and prior to backfill, the routing and the elevation and depth below grade shall be checked and any deviations from plans and/or specification to be recorded and in addition noted on record drawings.

G. Relay Panels, Operator and Instrument Control Panels, Programmable Controllers, Micro-Processors, and Other Miscellaneous Equipment:

1. Upon receipt of equipment, each item shall be inspected for damage, loose or missing parts.

2. Upon completion of equipment installation, all equipment and their control devices shall be visually and functionally tested for tightness of connections and for proper operation. In the case of operator, instrument, and relay panels and cabinets or devices used solely for control, each circuit, where possible, shall be functionally tested for proper operation and conformance with drawings. Where functional testing is deemed undesirable by the Owner's Representative from a safety or plant operational standpoint, then continuity and terminal connection verification checks will be adequate. The Contractor shall insure that instruments and associated components cannot be energized until instructed by the Owner's Representative. For functional, operational, and calibration checks of instrument loops, refer to the instrument installation specifications.

3. Panelboard electrical checks shall be as included in the Wire and Cable section of this specification, Paragraph 3.02.E. Panelboards to be checked for proper circuit identification on the door schedule.

H. Sealing of Openings: The Contractor shall inspect the entire job with the Engineer to insure that all openings are properly sealed as specified elsewhere.

I. Record Drawings: The Contractor shall maintain a master set of record drawings that shows changes and any other deviations from the base drawing. The markups shall be made as the changes are done. At the conclusions of the job, these master record drawings shall be complete and delivered to the Owner's Representative for forwarding to the design group.

3.03 SPECIFIC TESTS AND INSPECTIONS BY THE INDEPENDENT TESTING FIRM:

A. The following specific items of work shall be performed by the independent testing firm, (see paragraph 1.01.d.) The list is not all inclusive, nor does it define how the tests and checks are to be made. It is merely to define the minimum and type of tests that are required.

B. Protective Relays and Metering:

1. Check, clean, set, calibrate and adjust all protective relays. Settings will be provided by the contractor and reviewed by the engineer prior to setting.

Determine pickups, timing, seal-in and target operations. Check several points on the curves.

2. Check, calibrate and adjust all meters.

3. Visually inspect and correct where appropriate, all relays, meters, wiring and related circuitry for physical damage, shipping blocks, compliance with specification and vendor data, mechanical condition, freedom of movement, and presence or possibility of moisture, dust, or other contaminants.

4. Insulation resistance tests shall be made on this circuitry only where recommended by the manufacturer.

5. Simulated fault or other conditions at current transformers and voltage transformers, or initiating contacts shall be made where appropriate or necessary to assure the protective device function or characteristic and operation in the circuitry. Functional tests in the circuitry to verify tripping and operation shall be made in virtually all cases.

6. At the conclusion of tests and after placing into operating service under load conditions, measure and record all currents, voltages and phase angles at the terminals of all protective relays in medium and low voltage switchgear. Verify that all shorts are removed from current transformers where appropriate.

C. Medium Voltage Switchgear:

1. Check, set, calibrate and adjust all relays and meters as previously specified in Paragraph B.2, Protective Relays and Metering, and in addition, all power circuit breakers.

2. A ratio and polarity test shall be made of all current transformers (cts) and potential transformers (pts). Remove any ct shorts at the units or on terminal blocks. Perform complete wire tracing and continuity checks of all ct and pt wiring within the gear. Relaying circuits shall be given special attention to assure proper connections, phasing and operations.

D. Low Voltage Switchgear:

1. Check, set, calibrate and adjust all relays and meters as previously specified in Paragraph B.2, Protective Relays and Metering, and in addition, all power circuit breakers.

2. Perform DC insulation overpotential proof tests on low voltage components of the system such as bus and breakers. This shall normally be done with the manufacturer's representative present. The DC overpotential proof tests shall be performed with a Biddle instrument at the maximum voltage specified elsewhere for 480-volt equipment. Breaker tests shall be performed with the breaker open and also closed.

3. Inspect switchgear and breaker for physical damage, tightness of connections, contact resistance, mechanical conditions, anchorage and alignment, shipping

blocks, freedom of movement and operation, cleanliness and other installation and maintenance checks called for in manufacturer's instructions.

4. Bolted bus joints shall be inspected and tested by calibrated torque wrench methods in accordance with manufacturer's instructions.

5. Functionally and operationally test all devices, equipment and circuitry.

6. Physically and functionally check all key, electrical, mechanical or other interlock systems.

7. A ratio and polarity test shall be made of all current transformers (CTs) and potential transformers (PTs). Remove any CT shorts at the units or on terminal blocks. Perform complete wire tracing and continuity checks of all CT and PT wiring within the gear. Relaying and synchronizing circuits shall be given special attention to assure proper connections, phasing and operations.

E. Low Voltage Motor Control Centers:

1. No work by the independent testing firm is required on low voltage (600 volts and less) motor controls.

F. Molded Case Breakers:

1. No testing or checks of molded case circuit breakers is required by the independent testing firm.

G. Medium Voltage Cables

1. Inspect and test the installed medium voltage cables prior to energizing, as detailed in Section 16124. Testing of the cable shall be performed in the presence of the Engineer.

H. Thermographic (Infrared) Surveys:

1. After the equipment has been placed in service, infrared surveys shall be performed on all designated electrical system apparatus specified below. The survey shall be performed with all apparatus energized and under full or normal load conditions. The survey shall include all connections and joints. Access covers and doors shall be removed or opened from all apparatus for the purpose of the survey. The survey shall consist of an on-site inspection performed by certified field engineering personnel using portable, imaging-display infrared camera equipment to locate and recommend corrective measures for overheated electrical connections, splices, taps, conductors and other abnormally hot items of apparatus, or portions thereof, that are a part of the designated apparatus.

2. The infrared survey documentation shall include a survey summary as well as detailed inspection reports containing photographic records of significant problems found, problem cause(s), required corrective action(s) and recommendations as to how promptly corrective action(s) should be taken.

3. The infrared camera equipment used shall be of the fully portable, image display type with photographic camera attached unit, and be capable of measuring apparatus temperatures with an accuracy of plus or minus 0.25 degrees C. at 30 degree object temperature. The testing firm and its assigned field engineer shall be regularly engaged in this type of work, to have prior experience in the use of the infrared camera equipment for this kind of application and to also be experienced in the normal inspection and test, of the electrical apparatus to be surveyed.

I. Electrical system apparatus to be surveyed to include:

1. 480-volt switchgear and breakers and disconnects.
2. 480-volt motor control centers.
3. Small service transformers, and power transformers.
4. Power distribution panels.
5. Variable speed drive controls and equipment.
6. Surge protective devices.
7. Rotating equipment.

3.04 LOSS OF AC POWER TEST:

A. After the satisfactory completion of all electrical system testing, perform a loss of AC power test. The main circuit breaker at the facility shall be placed in the "OPEN" position by the Contractor using all required safety and personal protective equipment in accordance with NFPA 70E.

B. During this test the representatives from the following organizations shall be present:

1. Contractor
2. Division 40 SCADA System Supplier
3. Main Electrical Distribution Equipment Supplier
4. Variable Frequency Drive Equipment Supplier
5. Engineer

C. The test shall verify that all electrical equipment in the system can withstand the loss of utility AC power. Under standby generator power, all automatically started equipment shall be witnessed to start and accept load without tripping offline or initiating false alarms.

D. The test shall be performed with the facility operated at near or full load.

E. All alarms associated with the loss of utility power and startup of the standby generator system shall be recorded.

1. Any nuisance type alarms associated with microprocessor faults or troubles shall be investigated and action taken to prevent reoccurrence.

2. When all nuisance type alarms have been resolved, the test shall be repeated to verify acceptable operation of the facility electrical system upon loss of utility power.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 01800
MISCELLANEOUS WORK AND CLEANUP

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. This Section includes operations which cannot be specified in detail as separate items but can be sufficiently described as to the kind and extent to work involved. The Contractor shall furnish all labor, materials, equipment and incidentals to complete the work under this Section.

2. The work of this Section includes, but is not limited to, the following:
1) Restoring of driveways, 2) Cleaning and Clean up 3) Incidental work

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials required for this Section shall be of the same quality as materials that are to be restored. Where possible, the Contractor shall reuse existing materials that are removed and then replaced.

B. Use only those cleaning materials which will not create hazard to health or property and which will not damage surfaces.

C. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

D. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

E. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 3 - EXECUTION

3.01 RESTORING OF DRIVEWAYS AND SIDEWALKS

A. Existing driveways and sidewalks disturbed by the Contractor shall be replaced. Paved drives and sidewalks shall be repaved to the limits and thickness existing prior to construction. Gravel drives shall be replaced and regraded.

3.02 CLEANING AND CLEAN UP

A. The Contractor shall removal all construction material, buildings, equipment and other debris remaining on the job as the result of construction operations and shall render the site of the Work in a neat and orderly condition. All suitable excess excavated material shall remain on site and be placed as directed by the RPR.

B. Execute daily cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

C. Provide on-site containers for the collection of waste materials, debris and rubbish.

D. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

E. The Contractor shall wash down and vacuum out the containment area.

F. Prior to final completion, or Owner occupancy, the Engineer shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire Work is clean.

G. Construction techniques that minimize the production and distribution of dust shall be used.

H. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 INCIDENTAL WORK

A. Do all incidental work not otherwise specified, but obviously necessary for the proper completion of the contract as specified and as shown on the Drawings.

END OF SECTION

SECTION 01820
MANUFACTURERS' FIELD SERVICES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

A. Contractor shall submit a list of all equipment and electrical installations for Owner to review and choose training.

B. Submit a construction submittal for each training event for review and acceptance by the Owner and Engineer. The submittal shall contain the format, trainers, and course material and specify whether the training will be hands-on or in a classroom setting.

C. Informational Submittals:

1. Training Schedule: Submit not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.

2. Lesson Plan: Submit proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified elsewhere.

B. Representative subject to acceptance by Owner and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services when required by an individual specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum services.

F. When specified in individual specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.

2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.

3. Providing, on a daily basis, copies of all manufacturers' representatives field notes and data to Engineer.

4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.

5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.

6. Assistance during functional and performance testing, and facility startup and evaluation.

7. Training of Owner's personnel in the operation and maintenance of respective product as required.

8. Additional requirements may be specified elsewhere.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. A Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be placed on the manufacturer's letterhead, completed in full, signed by the entity supplying the product, material, or service, and submitted prior to shipment of product or material or the execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. A Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be placed on the manufacturer's letterhead, completed, and signed by the equipment manufacturer's representative.

B. Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

3.04 TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) for all equipment and electrical work in these specifications.

2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information.

3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.

4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

5. Unless otherwise specified, a minimum of two (2) person-days of training shall be provided for each piece of equipment supplied, including all electrical installations and testing equipment. Contractor shall video and audio record to a DVD all training given to operations staff, and a copy of the DVD will be supplied to the Owner. Video equipment shall be accompanied with independent microphone for instructor to speak into for audio recording.

6. The Contractor shall submit a Construction Assistance Request (C.A.R.) form at least seven (7) days prior to beginning of training to coordinate training schedule with the Owner. The Owner shall approve training schedule to ensure that critical staff is available to attend the training.

B. Training Schedule:

1. List specified equipment and systems for training services and show:

   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.

2. Allow for multiple sessions when several shifts are involved.

3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.

4. Coordinate with Section 01310, Progress Schedules.

C. Lesson Plan: Provide the following minimum information:

1. Title and objectives.

2. Recommended types of attendees (for example, managers, engineers, operators, maintenance).

3. Course description and outline of course content.

4. Format (for example, lecture, self-study, demonstration, hands-on).

5. Instruction materials and equipment requirements.

6. Resumes of instructors providing the training.

D. Pre-startup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives.

2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

F. Contractor shall arrange for audio/video (A/V) recording of all training performed. A/V equipment will include a separate microphone to ensure proper audio reception.

3.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this Specification.

1. Form: Manufacturer's Certificate of Compliance.

2. Form: Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER:

PRODUCT, MATERIAL, OR SERVICE SUBMITTED:

PROJECT NAME:

PROJECT NO:

Comments:_____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the contract for the named project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer:_____

Manufacturer's Authorized Representative *(print)*: _____

_____

(Authorized Signature)

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MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO:_____

EQPT TAG NO:_ EQPT/SYSTEM:_____

PROJECT NO:__ SPEC. SECTION:_____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments:_____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer:_____

By Manufacturer's Authorized Representative: _____

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SECTION 02012
GEOTECHNICAL INSTRUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

A. The purpose of geotechnical instrumentation is to provide data to the Contractor to control operations, and to monitor ground movement in the vicinity of excavations, the control of water levels and pressures in aquifers affected by the work, and protection of adjacent property during trenchless utility construction operations. The instrumentation program specified herein is not intended to be used to ensure the safety of the work.

B. The Contractor shall be responsible for monitoring ground conditions as necessary to conform to the requirements of the Work.

C. Vibration producing activities (such as pile driving, vibratory compaction, pavement breaking or operation of heavy construction equipment may be required for construction of this Project. The Contractor is advised that structures are located close to the proposed work and that construction activities shall be conducted so as to preclude damage to same. The Contractor shall be responsible for any damage caused by his activities.

D. Scope of Work:

1. The work specified in this Section includes, but is not limited to, furnishing, installing, maintaining, reading and reporting the geotechnical instrumentation specified herein and protecting instrumentation from damage. Instruments damaged or destroyed during the Work shall be repaired or replaced.

2. Monitor ground and facility movements and groundwater conditions within, around, and above the trenchless utility alignment.

3. Monitor horizontal deflections of temporary excavation support wall systems for jacking shafts, receiving shafts, and open-cut excavations, as appropriate for the construction.

4. Perform a pre-construction survey and monitor ground vibrations as appropriate to the construction location and equipment.

E. At a minimum, the Contractor shall install the instrumentation as necessary to control operations, monitor ground conditions, and ground response to achieve specified Project requirements and to prevent damage to existing structures and facilities.

F. Unless otherwise noted or instructed by the Engineer, the Contractor shall abandon all instruments upon completion of the work and restore the ground surface to pre-existing conditions.

1.02 SYSTEM DESCRIPTION

A. The purpose of the geotechnical instrumentation program is to provide supplemental pre-construction baseline data for comparison with construction and post-construction data.

1. Monitor ground surface movement, and existing facilities during construction, to determine whether they have been affected by construction activity and forewarn of unforeseen conditions that may require remedial or precautionary measures.

1.03 SUBMITTALS

A. Geotechnical Instrumentation: Submittals listed below shall be prepared by a qualified instrumentation specialist.

1. Instrumentation shop drawings detailing locations, depths based on general information shown on the Drawings, type, details, and other pertinent information showing the installation details for each type of instrumentation required. Submittal shall include proposed locations of construction phase monitoring wells.

2. Drawing that indicates the locations of control points and benchmarks associated with surveys for monitoring geotechnical instrumentation. Location of monitoring points, settlement points, vibration monitoring points, and offset lines and other geotechnical instrumentation.

3. Description of methods for installing and protecting all instruments.

4. Construction details including materials, sizes, dimensions, connections and methods and sequence of installation and removal of geotechnical instrumentation.

5. Schedule of instrument installation related to significant activities or milestones in the overall Project.

6. At least 30 days prior to the start of such work, the Contractor shall provide a vibration monitoring plan to the Engineer, which shall include, but not be limited to the following: proposed construction method(s) that may induce vibrations, vibration monitoring plans (including the format for reporting the vibration readings), identify buildings or sensitive receptors within 400 feet of vibration creating construction activities, anticipated vibration levels at identified buildings, preconstruction Condition Survey format, and proposed public relations activities. A copy of all reports shall be provided to the Engineer.

7. Following installation of the instruments and prior to the start of underground construction, submit as-built Shop Drawings showing the exact installed location, the instrument identification number, the instrument type, the installation date and time, the heading station or shaft excavation depth on the installation date, when applicable, and the anchor or tip elevation and instrument length, when applicable, and installed locations of control points

and benchmarks associated with surveys for monitoring geotechnical instrumentation. Include details of installed instruments, accessories, and protective measures including all dimensions and materials used.

B. Product Data:

1. Utility monitoring points
2. Ground surface monitoring points
3. Structure monitoring points
4. Monitoring wells
5. Vibration monitoring equipment

C. Quality Control Submittals:

1. Monitoring Plan: Submit a geotechnical instrumentation monitoring plan showing proposed means and methods for monitoring horizontal deflections of earth support wall systems and settlement or earth movement around trenchless utility construction operations. The plan shall include the required frequency of monitoring to ensure settlement is identified and reported in a timely manner to allow corrective measures to be implemented and further settlement controlled. Monitoring plan shall include:

   a. Onsite observation of the excavation support system performance, to be performed by the Contractor.
   b. Position (survey) measurement of geotechnical instrumentation, to be performed by the Contractor's Surveyor.
   c. Review of position measurements to assess ground movement, to be performed by the Contractor.

2. Monitoring Data Submittals: Submit monitoring data within one (1) day of data collection from monitoring points and observation wells. Data submitted shall include:

   a. Accuracy of readings.
   b. Horizontal and vertical movements of monitoring points and observation well groundwater level readings since previous readings.
   c. Cumulative movements and readings over time since the initial readings of the geotechnical instruments.
   d. Comparison of current instrumentation readings to previous readings.
   e. Ground deformation readings versus time plots.
   f. Weekly summary of instrumentation data in both tabular and graphic form at the end of each week along with a weekly summary of significant work performed or other events that may have affected the excavation support system performance.

1.04 QUALITY ASSURANCE

A. Personnel Qualifications:

1. Qualified technicians for installation and monitoring of geotechnical monitoring points shall be a Professional Land Surveyor licensed in the State of Florida with a minimum of 3 years of experience in similar activities.

2. Monitoring wells shall be installed by technicians employed by a professional geotechnical engineering firm. The technicians shall have 5 years of experience in the installation of monitoring wells and shall be supervised by a Professional Engineer licensed in the State of Florida.

B. The Contractor shall notify the Engineer and the County's Inspector at least 48 hours prior to all instrumentation installation operations so that the installation work may be monitored.

1.05 INSTALLATION TOLERANCES

A. Ground Surface Monitoring Points (GMPs) shall be installed within 12 inches of the horizontal locations indicated on the approved Shop Drawings.

B. Should actual field conditions prohibit installation at the locations and elevations indicated on the approved Shop Drawings, prior acceptance shall be obtained from the Engineer for new instrument locations and elevations.

1.06 PROJECT/SITE CONDITIONS

A. Existing Subsurface Conditions: Contractor shall review the relevant Geotechnical Engineering Reports.

B. Obtain necessary permits for the installation of groundwater monitoring systems from the St Johns River Water Management District and/or FDEP.

C. All groundwater monitoring wells shall be protected from vandalism or accidental damage during construction activities.

D. Field Measurements: The Contractor shall employ a Professional Land Surveyor registered in the State of Florida to monitor utility monitoring points, ground surface monitoring points and groundwater monitoring wells.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Monitoring Point Protection Boxes: Monitoring point protection boxes for all instruments located in paved traffic areas or areas where the instrument collar must be at or below grade shall be a traffic rated Tyler Union Model 6850 two piece screw-type valve box, 5-1/4-inch shaft, or an equal approved by the Engineer. Monitoring point protection boxes shall be provided with plain 5-1/4 inch locking lids.

B. Utility Monitoring Points:

1. Utility monitoring points (UMPs) will be used to monitor vertical deformation of existing utilities crossed by the trenchless pipe installation as shown on the Drawings.

2. Provide steel pipe flange, 1-inch-diameter, ASTM A403, machined to fit within 3-1/2 inch extra strong steel sleeve.

3. Provide 3-1/2-inch extra strong steel sleeve pipe, threaded and coupled, ASTM A53 Grade B.

4. Provide 1-inch extra strong steel riser pipe, threaded and coupled, ASTM A53 Grade B.

5. Provide PVC centralizers. Centralizers shall consist of a Schedule 40 PVC pipe conforming to ASTM D1785, sized to provide a tight fit on the riser pipe, and spring-formed to a larger diameter to provide a loose fit in the sleeve pipe.

6. Provide 12-inch x 12-inch x 1/4-inch steel plate with 4-1/4-inch-diameter central hole.

7. Provide steel pipe clamp to fit 3-1/2-inch extra strong steel pipe. Steel plate and pipe clamp assembly shall be capable of transferring the total weight of the 3-1/2-inch extra strong pipe to the soil underlying the steel plate. The assembly shall also be capable of maintaining its position on the 1-inch extra strong steel pipe over time.

8. Provide 1-inch pipe cap with 1/4-inch-diameter round head stainless steel bolt set securely in cap.

C. Ground Surface Monitoring Points:

1. Ground surface monitoring points (GMPs) will be used to monitor vertical deformation of the ground at locations indicated on the approved Shop Drawings.

2. GMPs are stakes, rods, or nails installed in unpaved or paved areas at predetermined locations to measure vertical (elevation) changes of the ground surface.

3. GMPs shall consist of a 4-foot long, ¾-inch diameter steel rod and a monitoring point protection box. The top of the rod shall be rounded and punch marked at its center.

D. Structure Monitoring Points:

1. Structure monitoring points (SMPs) will be used to monitor vertical deformation of the structures at locations indicated on the approved Shop Drawings.

2. SMPs are nails installed in key structures at predetermined locations to measure vertical (elevation) changes of the structure.

E. Construction Phase Groundwater Monitoring Wells: A monitoring well is constructed in a borehole using a riser pipe section near the ground surface and a specially slotted pipe section (well screen) above the bottom of the well. The well screen length and position normally extends from several feet above to several feet below the anticipated water table range.

1. Provide a groundwater monitoring well with machine-slotted pipe, bottom caps and vented top caps as indicated on the Plans. The slotted pipe shall be 10-feet long, 2-inch, Schedule 80 PVC pipe with 3 rows of 0.01-inch wide slots on 120° centers, with a slot length to leave 0.25 inch between rows. The riser pipe shall be 2-inch, Schedule 80 flush joint PVC pipe.

2. Filter sand shall conform to ASTM C778, Standard Specification for Standard Sand.

   a. Coarse Sand: Sand for filter pack and sand backfill shall be clean natural silica sand; graded such that all of the material passes the No. 4 sieve and is retained on the No. 30 sieve.
   b. Fine Sand: Sand for filter pack seals shall be clean natural silica sand; graded such that all of the material passes the No. 10 sieve and is retained on the No. 40 sieve.

3. Granular bentonite shall be used to seal the annular space between the bore hole and the well casing above the filter pack or to plug the well at abandonment. The granular bentonite shall be either: Enviroplug Medium, as manufactured by Wyo-Ben, Inc., Billings, MT; Holeplug, as manufactured by Baroid Division, Petroleum Services, Inc., Houston, TX; Pure Gold Chips, as manufactured by CETCO, Arlington Heights, IL; or Bentonite Plug (3/8") as manufactured by Black Hills Bentonite, LLC, Mills, WY.

4. Provide one groundwater observation well adjacent to each jack and bore jacking or receiving shaft (minimum two each per each jack and bore crossing). Monitoring wells are not required for trenchless utility crossings for which dewatering is not conducted, i.e. HDD utility crossings.

F. Vibration Monitoring Equipment: The vibration monitoring equipment shall be capable of continuously recording the peak particle velocity and providing a permanent record of the entire vibration event.

PART 3 - EXECUTION

3.01 GENERAL

A. Instrumentation shall be installed at the locations indicated on the approved Shop Drawings.

B. Locate conduits and underground utilities in all areas where borings are to be drilled and instruments installed. Instrument locations shall be modified to avoid interference with the existing conduits and utilities. Repair any damage to existing utilities resulting from instrument installations.

C. All instruments shall be clearly marked, permanently labeled, and protected to avoid being obstructed or otherwise damaged by construction operations or the general public.

D. Geotechnical instrumentation shall be installed and baseline surveys or initial readings completed prior to commencing any excavation work for shafts for jack and bore installations.

1. Elevations shall be recorded to a precision of 0.005 of a foot. Horizontal survey accuracy shall be at least 0.01 feet.

E. Location Surveying: Promptly following installation, the Contractor shall survey and provide horizontal coordinates and vertical elevations of the ground surface and top of all instruments. All coordinates shall be geographically registered in the Florida State Plane Coordinate System using the contract drawings control points for horizontal and vertical controls.

F. Drilling from the Ground Surface: Contractor shall obtain any permits that may be required for boreholes drilled from the ground surface that are not already covered in the FDEP permit obtained for the project. Obtain necessary permits for each such instrument and conform to the permit requirements during drilling and installation.

3.02 INSTALLATION

A. General

1. The Contractor shall notify the Engineer and the County at least 48 hours prior to installing each monitoring point.

2. The Contractor shall install, monitor, and interpret data from instrumentation, in addition to that specified herein, that the Contractor deems necessary to ensure performance of the work in accordance with the approved Shop Drawings, and the safety of personnel, property and the Work.

3. The method of installation shall be the Contractor's option; however, the marker shall be rigidly affixed so as not to move relative to the surface to which it is attached.

4. Install and protect monitoring point protection boxes installed over each monitoring point or groundwater monitoring well.

B. Utility Monitoring Points (UMPs)

1. MPs shall be installed on utilities crossed by trenchless pipe installations at the locations shown on the Plans.

2. The location of the utility on the plan shall be determined and the borehole advanced to the top of the utility using vacuum excavation methods. The Contractor shall be responsible for any damage to the utility during installation of the utility monitoring point. Drill casing may be used during the installation.

3. After completion of installation, the as-built location in horizontal position shall be determined to accuracy of ± 0.01 foot and in elevation to accuracy of ±0.005 feet.

C. Ground Surface Monitoring Points (GMPs)

1. GMPs shall be installed adjacent to all excavations with a minimum of four monitoring points located in accordance with the approved Contractor's geotechnical instrumentation program. GMPs shall be installed at distances of 25 feet and 50 feet of the entry and exit locations for all Horizontal Directional Drilling (HDD) crossings.

2. All GMPs shall have the horizontal as-built location determined to an accuracy of ±0.01 feet and the elevation to an accuracy of ±0.005 feet.

D. Structure Monitoring Points (SMPs)

1. SMPs shall be installed on structures adjacent to all excavations with a minimum of two monitoring points located in accordance with the approved Contractor's geotechnical instrumentation program.

2. All SMPs shall have the horizontal as-built location determined to an accuracy of ±0.01 feet and an elevation determined to an accuracy of ±0.005 feet.

E. Groundwater Monitoring Wells

1. Install one construction phase Groundwater Monitoring Well within 10 feet of each structure excavation, each jack and bore jacking shaft/pit and each jack and bore receiving shaft/pit. Groundwater Monitoring Wells are not required for trenchless crossings that do not involve dewatering, i.e. HDD crossings.

2. Do not use bentonite drilling mud for installation of construction phase Groundwater Monitoring Wells. A split-spoon soil sample shall be taken at the bottom of the borehole, and submitted to the Geotechnical Engineer for a soil analysis with a split portion of the soil sample submitted to the County within 24 hours.

3. Place a filter sand pack between the bore hole and the monitoring well point slotted pipe. Filter sand shall be placed from the bottom of the bore hole to a level at least 2 feet above the top of the well point slots.

4. Seal the sand pack by placing granular bentonite from the top of the sand pack to a level at least 2 feet above the top of the sand pack. Cement grout the monitoring well from the top of the bentonite layer to the ground surface.

5. Install construction phase Groundwater Monitoring Wells at least 30 days prior to initial operation of dewatering systems.

6. Maintain each construction phase Groundwater Monitoring Well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any Groundwater Monitoring Well that ceases to be operable before adjacent work is completed.

7. During construction, maintain construction phase Groundwater Monitoring Wells, as well as existing monitoring wells shown on the Drawings installed by others prior to construction, and repair or replace them if damaged by the Contractor's operations.

F. Temporary Excavation Support Walls: Monitor horizontal deflections of temporary excavation support wall systems. Measure defections at the mid-span (in plan view)

of the walls parallel to the long axis of the excavation. Measure deflections vertically at the top, mid-span, and bottom of the excavation. The method of measurement shall be at the option of the Contractor.

G. Instrumentation Protection: Flag and protect all geotechnical instrumentation locations. Exercise care during construction so as to avoid damage to instrumentation. Repair or replace instrumentation that is damaged as a result of the Contractor's operations.

H. Vibration Monitoring and Preconstruction Condition Survey:

1. The Contractor shall employ a qualified vibration specialist to establish a safe vibration level for buildings within 400 feet of vibration producing construction. This specialist shall also supervise the Contractors vibration-monitoring program. During all vibration producing activities, the Contractor shall monitor vibration levels at the identified buildings, and shall not exceed the safe level established to preclude damage to the structures.

2. The vibration monitoring equipment shall be capable of continuously recording the peak particle velocity and providing a permanent record of the entire vibration event. Copies of all vibration records and associated construction activities (pile driving, pavement breaking, etc.) data shall be provided to the Engineer in a format approved by the Engineer.

3. A preconstruction building Condition Survey shall be conducted by the Contractor on the identified buildings, prior to the commencement of any vibration producing activity. The survey will include documentation of interior sub-grade and above grade accessible walls, ceilings, floors, roof and visible exterior as viewed from the grade level. It will detail (by engineering sketches, video tape, photographs, and/or notes) any existing structural, cosmetic, plumbing or electrical damage. The survey will be conducted by a Professional Engineer, licensed in the State of Florida.

4. A report shall be issued that will summarize the pre-construction condition of the building(s) and will identify areas of concern, including potential personnel hazards (falling debris) and structural elements that may require support or repair. Crack displacement monitoring gages will be installed as appropriate across any significant existing cracks to help verify any additional building distress if it should develop. The appropriate location, number, and type of gages will be established by the Contractor and/or the Engineer. The gages will be read prior to vibration producing activities, as well as during these activities. Data shall be obtained on a weekly basis for as long as vibration-producing activities are being conducted. A report shall be submitted which summarizes the data. The Engineer shall be alerted if any significant movement is detected by the monitoring.

3.03 MONITORING APPLICATION

A. The Contractor shall implement as specified herein a settlement control plan acceptable to the County to protect existing facilities, structures, utilities, roadways, streets, and other improvements from damage due to settlement resulting from

dewatering, excavation or trenchless utility construction. The plan shall include the specific methods that will be used to minimize loss of ground and procedures for monitoring for loss of ground as specified herein.

B. Monitoring Procedures and Schedule:

1. Monitor the geotechnical instrumentation installed in accordance with the Monitoring Schedule in Table 02012-1. Begin monitoring when underground construction, ground improvement, excavation or dewatering activity begins, whichever comes first. Record data on field data records, which shall include at least the following: instrument type and number, reading date and time, observer name, readings, remarks, visual observations other casual data including weather, temperature, and construction activities. Data shall be recorded in U.S. Customary Units, for example, feet and inches. The data shall be summarized in tabular format and submitted to the Engineer and the County's Inspector on a weekly basis.

2. Use a procedure for reading and recording geotechnical instrumentation data that compares the current reading to the last reading during data collection to eliminate spurious readings.

3. Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

4. The accuracy of elevation readings for Ground Monitoring Points shall be ± 0.01 feet. The accuracy of elevation readings for Utility Monitoring Points shall be ±0.005 feet. The accuracy of elevation readings for Structure Monitoring Points shall be ±0.005 feet. The accuracy of Monitoring Well readings shall be ±0.01 feet.

5. Notify the Engineer immediately of any Geotechnical instrumentation readings that are outside of specified limits.

TABLE 02012-1
MONITORING SCHEDULE

INSTRUMENT	SCHEDULE
All instruments	One reading within one work day after installation and two additional initial readings within one week of the initial reading. One reading at the conclusion of construction.
Observation Wells	Weekly until the conclusion of construction
Utility Monitoring Points Ground Surface Monitoring Points Structure Monitoring Points	Daily when cut-and-cover excavation, pipe jacking and boring or HDD construction is occurring within 100 feet of instrument.

TABLE 02012-1 MONITORING SCHEDULE	
INSTRUMENT	SCHEDULE
Horizontal Deflections of Excavation Support	Daily during excavation, weekly thereafter until excavation is backfilled.
Vibration Monitoring	Weekly while vibration producing construction is occurring

C. Actions to Mitigate Excessive Ground Movements:

1. The Contractor shall use whatever means and methods are necessary to limit ground movements, settlements and damage of utilities, structures and other facilities.

2. If displacement exceeds limits acceptable to the County, repairs shall be completed to the full satisfaction of the County.

3. The cost of actions required for complying with displacement limits and to repair any damage to adjacent facilities shall be borne by the Contractor.

D. Control Locations:

1. Horizontal and vertical control locations shall be established a minimum of 200 feet away from the actual Work locations.

3.04 DISCLOSURE OF DATA

A. The Contractor shall not disclose any instrumentation data to third parties and shall not publish data without prior approval and written consent of the Engineer and the County.

3.05 ABANDONMENT OF INSTRUMENTATION POINTS

A. At the completion of the Work, remove instrumentation or ground monitoring point markers. Grout the full depth of casings and pipes for monitoring points from the bottom of the casing excavation to the ground surface. Grout the full depth of monitoring well slotted pipe well point and well casings from the bottom of the monitoring well to the ground surface. Grout shall consist of cement and water, with the minimum amount of water necessary to allow pumping. Remove guard casings and valve boxes, and patch holes with materials and to durability consistent with the existing surrounding surface.

END OF SECTION

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SECTION 02050
DEMOLITION OF EXISTING STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. This Section specifies the labor, materials, equipment, and incidentals required for the demolition, relocation, and/or disposal of all structures, building materials, equipment, and accessories to be removed as shown on the Drawings and as specified herein.

2. There may be existing and active stormwater, wastewater, water, and other facilities on site as indicated on the Drawings. It is essential that these facilities, when encountered, remain intact and in service during the proposed demolition. Consequently, the Contractor shall be responsible for the protection of these facilities and shall diligently direct all his activities toward maintaining continuous operation of the existing facilities and minimizing operational inconvenience.

3. Demolition generally includes:

a. Complete demolition and removal of manholes, valve vaults, wetwells, piping, and mechanical and electrical equipment related to the Work as shown on the Drawings and specified herein.

b. Existing Piping and Electrical Utilities
Shut off or disconnect utilities affecting demolition work. Schedule shutdowns with the County by processing a C.A.R form; notify the County seven (7) working days in advance of any shutdown that is required to perform the work. The County will open/close valves on piping, and electrical disconnects required for the shutdowns.

c. Removal or Relocation of Electrical Materials and Equipment

i. Unless otherwise noted, remove existing electrical materials and equipment from areas indicated for demolition or where equipment is to be relocated. Disconnect circuits at their source. Remove materials no longer used, such as studs, straps, and conduits. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 3/4 inch below the final finished surface. Alternately, as directed by the County's Representative conduits or boxes may be sealed with removable covers or plugs that finish flush with the final finished surface. Remove existing unused wires.

ii. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface.

d. Complete demolition and removal of all above and below ground structures, concrete slabs and foundations, vaults, and underground

utilities (water, wastewater, electrical, etc.) as shown on the Drawings and specified herein.

e. All material, equipment, rubble, debris, and other products of the demolition shall become the property of the Contractor for his disposal off-site in accordance with all applicable laws and ordinances at the Contractor's expense. The sale of salvageable materials by the Contractor shall only be conducted off-site. The sale of removed items on the site is prohibited by the County.

4. Patching

Patching shall mean the restoration of a surface or item to a condition as near as practicable to match the existing adjoining surfaces unless otherwise noted, detailed, or specified.

When patching involves painting, special coating, vinyl fabric, or other applied finish, refinish the entire surface plane (i.e., wall or ceiling), unless complete refinishing of the entire space is scheduled or specified.

Patching includes cleaning of soiled surfaces.

5. The Contractor shall examine the various Drawings, visit the site, determine the extent of the Work, the extent of work affected therein, and all conditions under which he is required to perform the various operations.

6. The Contractor shall fill and compact all voids left by the removal of pipe, structures, etc. with materials described herein to a grade that will provide for positive drainage of the disturbed area to drain run-off in direction consistent with the surrounding area. The Contractor shall provide all fill materials to the site as needed. Compaction of fill shall match the compaction of adjacent undisturbed material.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 02 Section " Abandonment and Removal and Salvation or Disposal of Existing Pipe".
4. Division 02 Section " Temporary Erosion and Sedimentation Control".

1.02 QUALITY ASSURANCE

A. Permits and Licenses: Contractor shall obtain all necessary permits and licenses for performing the Work and shall furnish a copy of same to the County prior to commencing the Work. The Contractor shall comply with the requirements of the permits.

B. Notices: Contractor shall issue written notices of planned demolition to companies or local authorities owning utility conduit, wires, or pipes running to or through the project site. Copies of said notices shall be submitted to the County.

C. Utility Services: Contractor shall notify utility companies or local authorities furnishing gas, water, electrical, telephone, or sewer service to remove any equipment

in the structures to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.

D. Contractor shall notify the Orange County Risk Management Department in writing prior to beginning any demolition work.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

B. Submit to the County for their approval, two copies of proposed methods and operations of demolition or relocation of the structures specified below prior to the start of Work. Include in the schedule the coordination of shut-off, capping, and continuation of utility service as required.

C. Provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the County's operations.

D. Before commencing demolition work, all structure relocation, bypassing, capping, or modifications necessary will be completed. Actual work will not begin until the County has inspected and approved the prerequisite work and authorized commencement of the demolition work.

E. The above procedure must be followed for each individual demolition operation.

1.04 SITE CONDITIONS

A. Prior to demolition, the Contractor shall obtain written verification from the utility owner(s) that the existing utilities, including stormwater, wastewater, and/or water facilities, are not operational and are ready for demolition.

B. The County assumes no responsibility for the actual condition of the structures to be demolished or relocated.

C. Conditions existing at the time of inspection for bidding purposes will be maintained by the County insofar as practicable. However, variations within each site may occur prior to the start of demolition work.

D. No additional payment will be made for pumping or other difficulties encountered due to water.

E. Certain information regarding the reputed presence, size, character and location of existing underground structures, pipes and conduit has been shown on the Drawings. There is no certainty of the accuracy of this information, and the location of underground structures shown may be inaccurate and other obstructions than those shown may be encountered. The Contractor hereby distinctly agrees that the County is not responsible for the correctness or sufficiency of the information given; that in no event is this information to be considered as a part of the Contract; that he shall have no claim for delay or extra compensation on account of incorrectness of information regarding obstructions either revealed or not revealed by the Drawings; and that he shall have no claim for relief from any obligation or responsibility under

this Contract in case the location, size, or character of any pipe or other underground structure is not as indicated on the Drawings, or in case any pipe or other underground structure is encountered that is not shown on the Drawings.

1.05 RESTRICTIONS

A. No building, tank or structure, or any part thereof, shall be demolished until an application has been filed by the Contractor with the Building Department Inspector and a permit issued if a permit is required. The fee for this permit shall be the Contractor's responsibility. Demolition shall be in accordance with applicable provisions of the Building Code of the State of Florida.

B. No explosives shall be used at any time during the demolition. No burning of combustible material will be allowed.

C. Contractor shall notify the Orange County Risk Management Department prior to beginning any demolition work.

1.06 DISPOSAL OF MATERIAL

A. All salvageable or useable material or equipment to be retained by the County shall be shown on Drawings or specified herein, and shall be moved to a designated area by Contractor for pick up by County. Clean and prepare the equipment for storage as designated by the County's Representative, including but not limited to flushing, draining of fluids, lubricating, etc… Carefully remove and handle the equipment. Place the equipment on pallets or other means to enable future relocation by forklift. Wrap the equipment in shrink wrap or other means as designated by the County's Representative to protect it. Tag, label or identify the equipment in a manner as designated by the County's Representative. Unload the equipment within a storage location as designated by the County's Representative. The Contractor shall develop a log in MS Excel of salvaged equipment using an alpha-numerical designation to document the location, identification tags, and other pertinent information as designated by the County's Representative. The Contractor shall promptly remove all other materials from the site as indicated or shown on the Drawings.

B. All materials not retained by the County shall become the Contractor's property and shall be removed off-site.

C. The on-site storage of removed items is prohibited by the County. Off-site sale of salvageable material by the Contractor is acceptable.

1.07 TRAFFIC AND ACCESS

A. Conduct work to ensure minimum interference with on-site and off-site roads, streets, sidewalks, and occupied or used facilities.

B. Special attention is directed towards maintaining safe and convenient access to the existing facilities remaining in operation by plant personnel and plant associated vehicles, including trucks and delivery vehicles.

C. Do not close or obstruct streets, sidewalks, or other occupied or used facilities without permission from the County. Provide alternate routes around closed or obstructed traffic in access ways.

1.08 PROTECTION

A. Conduct operations to minimize damage by falling debris or other causes to adjacent buildings, structures, roadways, other facilities, and persons. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structures to be demolished and adjacent facilities to remain.

1.09 DAMAGE

A. Promptly repair damage caused to adjacent facilities by demolition operations as directed by the County at no cost to the County.

1.10 UTILITIES

A. Maintain existing utilities as directed by the County to remain in service and protect against damage during demolition operations.

B. Do not interrupt existing utilities serving occupied or operational facilities, except when authorized by County. Provide temporary services during interruptions to existing utilities as acceptable to the County.

C. The Contractor shall cooperate with the County to shut off utilities serving structures of the existing facilities as required by demolition operations.

D. The Contractor shall be solely responsible for making all necessary arrangements and for performing any necessary work involved in connection with the interruption of all public and private utilities or services.

E. All utilities being abandoned shall be terminated at the service mains in conformance with the requirement of the utility companies or the municipality owning or controlling them.

1.11 EXTERMINATION

A. If required, before starting demolition, the Contractor shall employ a certified rodent and vermin exterminator and treat the facilities in accordance with governing health laws and regulations. Any rodents, insects, or other vermin appearing before or during the demolition shall be killed or otherwise prevented from leaving the immediate vicinity of the demolition work.

1.12 POLLUTION CONTROL

A. For pollution control, use water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. The Contractor shall comply with the governing regulations.

B. Clean adjacent structures and improvements of all dust and debris caused by demolition operations as directed by the County. Return areas to conditions existing prior to the start of Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SEQUENCE OF WORK

A. The sequence of demolition and relocation of existing facilities shall be in accordance with the approved critical path schedule as specified in paragraph 1.03 above.

3.02 REMOVAL OF EXISTING PROCESS EQUIPMENT, PIPING, AND APPURTENANCES

A. Equipment to be retained by the County will be designated for retention by the County prior to bidding as specified in Paragraph 1.06 above. Subject to the constraints of maintaining existing facilities in operation as shown on the Drawings, all other process equipment, non-buried valving and piping, and appurtenances shall be removed from the site.

3.03 DEMOLITION PROCEDURES

The Contractor shall adhere to the following demolition procedures as referenced on the Drawings:

A. TO BE DEMOLISHED: Demolition shall be the breaking up, cutting, filling of any holes resulting, final grading of the area, performing any other operations required, and the removal from the site of all structures and equipment (structures, substructures, floor slabs, equipment, tanks, pipes, fittings, electrical systems, light poles, wiring, underground conduits and wiring, isolated slabs, and sidewalks) as indicated on the Drawings. All pieces of concrete, metal, and any other demolished material shall be removed to a depth of at least 5-feet below existing grade. Broken pieces of concrete may be size reduced by an on-site crusher, but in any event must be removed from the project site.

Before commencing structural demolition, remove all mechanical, electrical, piping, and miscellaneous appurtenances. Completely remove the structure by thoroughly breaking up concrete into pieces no more than 2-feet across the largest dimension.

B. TO BE REMOVED: Where indicated on the Drawings, the structures and equipment shall be completely removed from the site with all associated connecting piping or electrical service. The item shall be taken whole or in parts to be salvaged or disposed of by the Contractor.

C. TO BE ABANDONED: Where indicated on the Drawings, the structures and equipment shall be left in place, drained, and the contents properly disposed. The upper 5-feet of the structure shall be cut and removed, including the cover slab and access port, frame, and cover. All structures to be abandoned with bottom slabs shall

be drilled (two holes minimum, 2.0-inch diameter each) or hole punched to prevent flotation and filled with common fill.

D. PIPING TO BE REMOVED: Where indicated on the Drawings, pipe (and conduit) shall be drained and the contents properly disposed. The pipe (or conduit) shall then be completely removed from the site, including fittings, valves, and other in-line devices. Connections to existing piping to remain shall be plugged by mechanical means (M.J. plugs, tie-rods, or thrust blocks). Piping shall be removed in accordance with Specification Section 02080 "Abandonment, Removal and Salvage or Disposal of Existing Pipe."

E. PIPING TO BE ABANDONED: Where indicated on the Drawings, piping (or conduit) shall be left in place. All such piping shall be drained and the contents properly disposed. The pipe (or conduit) shall then be filled with grout (flowable fill) and each end of the pipe (or conduit) shall be plugged using a concrete plug in a manner acceptable to the County. Piping shall be abandoned in accordance with Specification Section 02080 "Abandonment, Removal and Salvage or Disposal of Existing Pipe."

F. TO BE PROTECTED: Where indicated on the Drawings, the utility service, fence, structure, tree, or device so designated shall be temporarily protected during the prosecution of the demolition work as specified in Division 1.

G. TO REMAIN: Where indicated on the Drawings, the designated facilities shall remain intact and in service during the prosecution of the demolition work.

3.04 DEWATERING OF EXISTING PROCESS UNITS AND DISPOSAL OF RESIDUE

A. The Contractor shall notify the County prior to beginning the dewatering work on any existing process units which contain wastewater, grit, or sludge. The Contractor, at his own expense, shall remove the entire contents of each structure and dispose off site. The proper transport and disposal of all residues shall remain the responsibility of the Contractor.

END OF SECTION

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SECTION 02080
ABANDONMENT, REMOVAL, AND SALVAGE OR DISPOSAL OF EXISTING PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: This section specifies the furnishing of all labor, materials, equipment, and incidentals required to abandon, remove, salvage, and/or dispose of existing pipelines and appurtenances as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

A. Permits and Licenses: Contractor shall obtain and pay respective fees for all necessary permits and licenses for performing the Work and shall furnish a copy of same to the County prior to commencing the Work. The Contractor shall comply with the requirements of the permits. All removal or abandonment of asbestos pipe material shall be performed by a licensed asbestos abatement Contractor or Subcontractor registered in the State of Florida.

B. Notices: Contractor shall issue written notices of planned Work to companies or local authorities owning utility conduit, wires, or pipes running to or through the project site. Copies of said notices shall be submitted to the County.

C. Standards:

1. Florida Administrative Code, Chapter 62-204.800 and 62-762.401.
2. National Emission Standards Hazardous Air Pollution (NESHAP), 40 CFR Part 61, Subpart M, latest revision
3. Occupational Safety and Health Act, 29 CFR
4. The Environmental Protection Agency (EPA) Asbestos Abatement Worker Protection Rule
5. Florida Statute 455.300
6. Asbestos pipe handling best management practices provided at the end of this section

D. Quality Control

1. It shall be the responsibility of the Contractor to provide supervision and inspections to ensure that the existing piping is removed and disposed, salvaged, or abandoned as designated in the Drawings and as specified herein.
2. Asbestos Pipe
   a. All removal or abandonment of pipe material containing asbestos shall be performed by a licensed asbestos abatement Contractor or Subcontractor.

b. The asbestos abatement Contractor or Subcontractor shall contact the Orange County Environmental Protection Division (407-836-1400) prior to removal or abandonment of any asbestos material and shall obtain all required permits and licenses and issue all required notices as required by the Orange County Environmental Protection Division. The Contractor shall be responsible for all fees associated with permits, licenses, and notices to the governing regulatory agencies.

c. The asbestos abatement Contractor shall perform Work in accordance with all applicable standards referenced in paragraph 1.02.C of this section.

d. The asbestos abatement Contractor shall have experience performing asbestos removal similar to this Project.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Shop Drawings

1. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

2. Shop Drawings shall be submitted to the County for review and acceptance prior to construction in accordance with these specifications for the following:

a. Grout
b. Caps and plugs
c. Credentials of licensed asbestos abatement Contractor including current certification.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 REMOVAL, ABANDONMENT, SALVAGE, AND DISPOSAL

A. General: Existing piping designated on the Drawings to be removed shall be exposed and removed by the Contractor.

B. Removal and Disposal

1. Pipe designated to be removed shall be completely drained and the contents properly disposed. The piping system including fittings and valves shall then be completely removed from the site.

2. Existing services and/or connections not shown on the Drawings shall be removed in accordance with this section at no additional cost. Existing live services encountered shall be maintained.

3. Asbestos: Pipe material containing asbestos shall be removed and disposed by a licensed asbestos abatement Contractor or Subcontractor.

4. Structures shall be removed in accordance with Section 02050 "Demolition of Existing Structures."

5. Where abandoned pipe is noted to be cut and capped or plugged on the drawings, the Contractor shall install a mechanical joint cap or plug on the pipe, and remove the remaining pipe as noted on the plans.

6. Where pressurized pipe is noted to be cut and capped or plugged on the drawings, the Contractor shall install a mechanical joint cap or plug with mechanical restraint for the system pressure as required, and remove the remaining pipe as noted on the plans.

C. Removal of material to be salvaged

1. Pipe designated on the Drawings to be removed and salvaged shall be completely drained and the contents properly disposed. The pipe shall then be thoroughly pressure washed, palletized on wooden skids to a dimension not exceeding the recommendation of the manufacturer, and conveyed to the County at the location designated by the County.

2. Items to be removed that may be salvaged, as determined by the Owner:

   a. Air release valves
   b. Sanitary manhole rings and covers
   c. Isolation valves
   d. Valve boxes
   e. Fire hydrant and valve assemblies

D. Abandonment

1. Pipe designated on the Drawings to be abandoned (or retired in place) shall be left in place, drained, and its contents properly disposed. Pipe requires end caps or plugs. All air release valves and vaults, valve boxes, fire hydrants, manholes, and manhole rings and covers shall be removed and disposed of or salvaged as specified above.

2. All pipe 4-inches or larger to be abandoned in place shall be completely filled with grout and each end of the pipe shall be plugged in a manner acceptable to the County.

3. Grout: Where designated on the Drawings, pipe to be abandoned shall be filled with grout in accordance with Section 03600 "Grout."

4. Plugs: Pipe to be abandoned shall be capped or plugged with a mechanical joint fitting that will prevent soil or other deposits form entering the pipe.

E. Asbestos Pipe Handling Best Management Practices

1. Projects will require worker documentation before entering the regulated Work area. A copy of: their current training certificate (workers and their supervisor); current medical condition showing the doctor approved their working with asbestos and wearing a respirator; signed acknowledgment forms; and current record (6-months) of each workers respirator fit test will be required from all workers.

2. Projects also require air monitoring. OSHA will accept historic data on air monitoring within 12-months of the Project, provided the data is from a

project of like material and conditions with a crew of the same experience, supervision, and training. Otherwise, monitoring is required throughout the Project. OSHA requires two (2) types of personnel air monitoring, full shift and 30-minute excursion level (when highest levels are anticipated).

3. Some provisions should be made for worker showering or otherwise washing following work before removing respirators, etc. Even if direct exposure is not anticipated, and at a minimum, a source of water to rinse the respirators, wash workers faces and hands, and (in the event of unanticipated direct exposure) some place to shower is required. The workers will also need a change room and some place to keep their street clothes and personal possessions.

4. Proposals to remove asbestos pipe sections by cutting must address how the cutting debris will be captured and kept from becoming airborne. Soil that could be considered contaminated may also have to be removed.

5. Licensed asbestos abatement Contractors or Subcontractors should have a pollution endorsement in their liability insurance in case of asbestos fiber release. A contingency plan, in case the project does not run as smoothly as expected, should be developed and include emergency phone numbers kept on site during the Project.

6. Daily logs of the asbestos removal work should be kept, and should include sign in sheets for the workers and whatever air monitoring was done. Accident reports and other reports or correspondence if something unusual happened should also be included.

7. Waste receipts must be kept through all stages of transport from the site to, and including, the acceptance at the dumpsite where the material will be abandoned. Amount of material removed must be equal to the amount of material to be turned into to the dump.

8. The primary Contractor will give "approval for tear down" at project completion, indicating that all asbestos removal operations are complete and whether there is a need for any air monitoring. Air monitoring, if not required by any governing agency or approved permit as discussed previously, may also be required by the County if documentation to the general public pertaining to contamination is deemed necessary. This air monitoring is normally done by collecting area samples downwind of the project at the barrier tape or just inside it. It requires a source of electricity to run the pumps, which is often provided by a generator.

END OF SECTION

SECTION 02100
EROSION AND SEDIMENTATION CONTROL

PART 1 - **GENERAL**

1.01 DESCRIPTION

A. The work specified in this Section consists of measures required to control erosion on the project, right-of-way, and in areas outside the project area where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects of public or private property adjacent to the project area and damage to work on the project. These measures will consist of construction and maintenance of temporary erosion control features or, where practical, the construction and maintenance of permanent erosion control features.

Effective May 1, 2003 construction sites that will result in a disturbance of one acre or more are required to seek coverage from FDEP under the Generic Permit for Stormwater Discharge from Large and Small Construction Activities - DEP document 62-621.300(4)(a). Accordingly, the Contractor shall be required to submit a Notice of Intent (NOI) along with the application fee to the FDEP Stormwater Notices Center to use the Generic Construction NPDES permit. This will also require the Contractor to develop and implement a Stormwater Pollution Prevention Plan (SWPPP) for this project; the requirements of which shall be followed by the Contractor for the duration of the project.

B. Related Work Described Elsewhere

1. Section 01650 – Start-up and Testing.

C. Control of Contractor's Operations Which May Result in Water Pollution

1. In addition to the erosion control measures specified herein, the Contractor shall comply with all requirements of the final approved Stormwater Pollution Prevention Plan (SWPPP) for the project.

2. Take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments, with fuels, oils, bitumens, calcium chloride, or other harmful materials. Conduct and schedule operations so as to avoid or otherwise minimize pollution or siltation of such streams, etc. Do not dump the residue from dust collectors or washers into any water body.

3. Construction operations in stormwater ponds and other impoundments shall be restricted to those areas where it is necessary to perform filling or excavation to accomplish the work shown in the Contract Documents and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear impoundments of all obstructions placed therein or caused by construction operations.

4. Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or runoff.

D. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 01 Section " Permits and Fees".
4. Division 02 Section " Finish Grading".

1.02 START OF WORK

A. Do not start work until erosion control measures are in place.

PART 2 - PRODUCTS

2.01 GENERAL

A. No testing of materials used in construction of temporary erosion control features will be required.

B. Materials used for the construction of the temporary erosion and sedimentation control measures not to be incorporated into the completed project may be new or used.

C. Coordinate with the conditions of the FDEP NOI permit.

D. Provide permits required in Section 01650.

PART 3 - EXECUTION

3.01 GENERAL

A. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, artificial coverings, berms, baled hay or straw, floating silt barriers, staked silt barriers and staked silt fences. Design details for some of these items may be found in the Water Quality Section of the applicable edition of the FDOT Roadway and Traffic Design Standards.

B. Incorporate permanent erosion control features into the project at the earliest practical time. Correct conditions, using temporary measures that develop during construction to control erosion prior to the time it is practical to construct permanent control features.

C. Construct temporary and permanent erosion and sediment control measures to prevent the pollution of adjacent water ways in conformance with the laws, rules and regulations of Federal, State and local agencies.

D. Contractor is responsible for permit requirements, including providing inspection, required inspector, and reports on site if needed.

3.02 INSTALLATION

A. Temporary Sod: This work shall consist of furnishing and placing sod in accordance with the Contract Documents.

B. Temporary Mulching: This work shall consist of furnishing and applying a two-inch to four-inch thick blanket of straw or hay mulch and then mixing or forcing the mulch into the top two inches of the soil in order to temporarily control erosion. Only undecayed straw or hay, which can readily be cut into the soil, shall be used. Other measures for temporary erosion control such as hydromulching, chemical adhesive soil stabilizers, etc., may be substituted for mulching with straw or hay. When permanent grassing operations begin, temporary mulch materials shall be plowed under in conjunction with preparation of the ground.

C. Sandbagging: This work shall consist of furnishing and placing sandbags in configurations, so as to control erosion and siltation.

1. Slope Drains: This work shall consist of constructing slope drains, utilizing pipe, fiber mats, rubble, cement concrete, asphaltic concrete plastic sheeting, or other acceptable materials, in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as may be approved as suitable to adequately perform the intended function.

2. Sediment Basins: Sediment basins shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as suitable to adequately perform the intended function. Sediment basins shall be cleaned out as necessary.

3. Artificial Coverings: This work shall consist of furnishing and applying fiber mats, netting, plastic sheeting, or other approved covering to the earth surfaces.

4. Berms: This work shall consist of construction of temporary earth berms to divert the flow of water from an erodible surface.

5. Baled Hay or Straw:

   a. This work shall consist of construction of baled hay or straw dams to protect against downstream accumulations of silt. The baled hay or straw dams shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards.
   b. The dam shall be placed so as to effectively control silt dispersion under conditions present on this project. Alternate solutions and usage of materials may be used if approved.

6. Temporary Silt Fences and Staked Silt Barriers: This work shall consist of furnishing, installing, maintaining and removing staked turbidity barriers in accordance with the manufacturer's directions, these specifications and the details as shown in FDOT's Roadway and Traffic Design Standards.

3.03 REMOVAL OF TEMPORARY EROSION CONTROL FEATURES

A. In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in such a manner that there will be no detrimental effect.

3.04 MAINTENANCE OF EROSION CONTROL FEATURES

A. General: Provide routine maintenance of permanent and temporary erosion control features until the project is completed and accepted.

3.05 PROTECTION DURING SUSPENSION OF CONTRACT TIME

A. In the event that it is necessary that the construction operations be suspended for any appreciable length of time, shape the top of the earthwork in such a manner as to permit runoff of rainwater and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes, and impoundments. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation.

END OF SECTION

SECTION 02110
CLEARING, GRUBBING, AND STRIPPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the work included in clearing, grubbing, stripping, and preparing the project site for construction operations.

1.02 CLEARING

A. Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth. Remove all evidence of their presence from the surface including sticks and branches greater than 1 inch in diameter or thickness. Remove and dispose of trash piles and rubbish. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth which are not designated for removal.

1.03 GRUBBING

A. After clearing, remove and dispose of wood or root matter, including stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 12 inches below the ground surface.

1.04 STRIPPING

A. Remove and dispose of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped.

B. Retain topsoil material onsite for dressing backfill areas before planting.

PART 2 - MATERIALS

2.01 TREES AND SHRUBBERY

A. Existing trees, shrubbery, and other vegetative material may not be shown in the drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve in place trees that are specifically shown in the drawings and designated to be preserved.

B. Preservation of Trees, Shrubs, and Other Plant Material

1. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.

2. When trees are close together, restrict entry to area within drip line by fencing. In areas where no fence is erected, protect the trunks of trees 2 inches or greater in diameter by encircling the trunk entirely with boards held securely by 12-gauge wire and staples. This protection shall extend from ground level to a height of 6 feet.

3. Cut and remove tree branches where necessary for construction. Remove branches other than those required to affect the work to provide a balanced appearance of any tree. Treat cuts with a tree sealant.

PART 3 - EXECUTION

A. Clearing and Grubbing Limits.

B. Clear and grub excavation and embankment areas associated with new structures, slabs, and roadways.

C. Disposal of Clearing and Grubbing Debris.

D. Do not burn combustible materials. Remove cleared and grubbed material from the worksite and dispose of at an appropriate off-site facility.

E. Areas to be Stripped.

F. Strip excavation and embankment areas associated with new structures, slabs, walks, and roadways. Strip stockpile areas.

G. Disposal of Strippings.

H. Remove stripped material and dispose of at an appropriate off-site facility, except topsoil.

I. Subgrade Preparation after Clearing, Grubbing and Stripping.

J. After Clearing, Grubbing and Stripping, and prior to executing any further work, the entire area is to be leveled and proof-rolled in the presence of the Orange County Resident Project Representative and a representative of the Orange County Materials Testing Agency.

END OF SECTION

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SECTION 02140
DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: This Section specifies the furnishing of equipment; labor and materials necessary to remove storm or subsurface waters from excavation areas in accordance with the requirements set forth, as shown on the Drawings, and/or geotechnical report.

1.02 QUALITY ASSURANCE

A. Qualifications: The Contractor shall engage a Geotechnical Engineer registered in the State of Florida, to design the temporary dewatering system. The Contractor shall submit conceptual plan for the dewatering system prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan and certification of this shall be provided by the Geotechnical Engineer. The dewatering system shall be designed by a firm who regularly engages in the design of dewatering systems and who is fully experienced, reputable and qualified in the design of such dewatering systems.

B. The dewatering of any excavation areas and the disposal of the water shall be in strict accordance with the latest revision of all local and state government rules and regulations.

C. Permits: The Contractor shall obtain and pay respective fees for all local, state, and federal permits (including the Orange County, St. Johns River Water Management District, and/or South Florida Management District discharge permits) required for the withdrawal, treatment and disposal/discharge of water from the dewatering operation, prior to start of work.

D. Comply with Florida Administrative Code, Chapter 62-621.300 (2).

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

B. In accordance with FAC 62-621.300(2), submit analytical test results from a certified laboratory for the parameters listed in the FDEP "Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity" to the FDEP and the County. The submitted information shall show the location of the work, where the water will be going to, as well as an estimate for the amount, rate and duration of discharge being proposed.

C. Provide notification to all jurisdictional permitting agencies in accordance with the requirements of the respective agency.

D. Provide a detailed plan and operation schedule for dewatering of excavations.

1. Provide descriptive literature of the dewatering system.

2. Provide a plan for erosion and sedimentation control during dewatering.

3. Provide copies of all permits/approvals for disposal/discharge of water during dewatering.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall have on-site and available the analytical test results performed in accordance with the FDEP "Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity" (FAC 62-621.300(2)).

B. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters which may accumulate within the excavation.

C. The Contractor's attention is directed to the water surface elevations discussed in the report(s) on subsurface investigations. Water levels will normally vary from season to season.

D. The Contractor shall be required to monitor the performance of the dewatering system during the progress of the Work and make such modifications as may be required to assure that the systems will perform satisfactorily. The dewatering system shall be designed in such a manner as to preserve the undisturbed bearing capacity of the sub-grade soils at the bottom of the trench or excavation.

E. Prior to excavation, the Contractor shall submit his proposed method of dewatering and maintaining dry conditions to the County. Approval of the dewatering plan shall not relieve the Contractor of the responsibility for the satisfactory performance of the system. The Contractor shall be responsible for correcting any disturbance of natural bearing soils or damage to structures caused by an inadequate dewatering system or by interruption of the continuous operation of the system as specified.

F. If subsurface water is encountered, the Contractor shall utilize suitable equipment to adequately dewater the excavation. A wellpoint system or other County acceptable dewatering method shall be utilized if necessary to maintain the excavation in a dry condition for preparation of the trench bottom and for pipe laying. Within and adjacent to residential areas and other areas as required by the County, engines driving dewatering pumps shall be equipped with residential type mufflers and the noise shall not exceed 55 decibels within 50-feet.

3.02 DEWATERING AND DISPOSAL

A. The Contractor shall construct and place all pipelines, structures, concrete work, structural fill, backfill and bedding material in-the-dry. In addition, the Contractor shall make the final 24-inches of excavation in-the-dry and not until the water level is

a minimum of 2-foot below proposed bottom of excavation. For purposes of this Contract, in-the-dry is defined as ±2% of the optimum moisture content of the soil.

B. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of all water entering excavations. Contractor shall keep excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

C. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

D. It is expected that dewatering will be required for pre-drainage of the soils prior to final excavation for most of the in-ground structures or piping and for maintaining the lowered groundwater level until construction has been completed so that the structure, pipeline or fill will not be floated or otherwise damaged.

E. If wellpoints are used, Contractor shall adequately space wellpoints to maintain the necessary dewatering. Provide suitable filter sand and/or other means to prevent pumping of fine sands and silts. A continual check shall be maintained by the Contractor to ensure that the subsurface soil is not being removed by the dewatering operations. Pumping from wellpoints shall be continuous and standby pumps shall be provided.

F. The Contractor's proposed method of dewatering shall include groundwater observation wells to determine the water level during construction. Observation wells shall be installed along pipelines as required to verify depth to water level and at locations approved by the County.

G. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from the surface shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped or drained by gravity to maintain an excavation bottom free from standing water.

H. Flotation shall be prevented by the Contractor by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible for all damages which may result from failure to adequately keep excavations dewatered.

I. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent properties or facilities. No water shall be discharged without appropriate treatment for adverse contaminants. No water shall be drained in work built or under construction without prior consent from the County. Water shall be filtered to remove sand and fine soil particles before disposal into any drainage system.

J. Dewatering of excavations shall be considered incidental to the construction of the Work and all costs shall be included in the various Contract prices in the Bid Form, unless a separate bid item has been established for dewatering.

3.03 GROUNDWATER TREATMENT (IF REQUIRED)

A. If concentrations of tested groundwater quality parameters exceed those allowable in the FDEP Generic Permit for the Discharge of Produced Groundwater from any Non-Contaminated Site Activity (62-621.300(2), F.A.C.), the Contractor shall treat the effluent.

B. The Contractor shall immediately notify the County and discuss the parameters that exceed allowable limits.

C. The Contractor shall meet with the FDEP to determine alternatives that are acceptable to the FDEP.

D. The Contractor shall apply for and obtain any and all permits and/or treatment approvals that FDEP requires including but not limited too:

1. Generic Permit for Discharges from Petroleum Contaminated Sites (62-621.300(1)). Allows discharges from sites with automotive gasoline, aviation gasoline, jet fuel, or diesel fuel contamination; or

2. Permit for all Other Contaminated Sites (62-04; 62-302; 62-620 & 62-660). The coverage is available only through the individual NPDES permit issued by FDEP, allows discharges from sites with general contaminant issues i.e. ground water and/or soil contamination other than petroleum fuel contamination; or

3. Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity (62-621.300(2), F.A.C.); or

4. Generic Permit for Stormwater Discharge from Large or Small Construction Activities (62-621.300(4)(a), F.A.C.); or

5. An Individual Wastewater Permit (62-604.300(8) (a)

E. The Contractor shall implement the appropriate treatment that is acceptable to FDEP and County to attain compliance for all excess limits encountered during dewatering activities. Treatment may include, but is not limited to: Chemical, Biological, Electrolysis or any combination of the three.

F. The Contractor shall make every effort to minimize the spread of contamination into uncontaminated areas. Provide for the health and safety of all workers at the job site and make provisions necessary for the health and safety of the public that may be exposed to any potentially hazardous conditions. Ensure provision adhere to all applicable laws, rules or regulations covering hazardous conditions and will be in a manner commensurate with the level of severity of the conditions.

G. If necessary, provide contamination assessment and remediation personnel to handle site assessment, determine the course of action necessary for site security and perform the necessary steps under applicable laws, rules and regulations for additional assessment and/or remediation work to resolve the contaminations issue.

H. Delineate the contamination area(s) and any staging or holding area required and develop a work plan that will provide the schedule of projected completion dates for the final resolution of the contamination issue.

I. Maintain jurisdiction over activities inside any delineated contamination areas and any associated staging or holding areas. Be responsible for the health and safety of workers within the delineated areas. Provide continuous access to representatives of regulatory or enforcement agencies having jurisdiction.

3.04 REMOVAL

A. Immediately upon completion of the dewatering system, the Contractor shall remove all of his equipment, materials, and supplies from the site of the Work, remove all surplus materials and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before work started. The site shall be thoroughly cleaned and approved by the County.

END OF SECTION

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SECTION 02160
TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

A. Description

1. Design, furnish and install temporary excavation support systems as required to maintain lateral support, prevent loss of ground, limit soil movements to acceptable limits and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, railroads and other facilities. Temporary excavation support systems shall also limit groundwater loss below existing structures during construction activities so as to minimize any settlement of existing structures and to mitigate risk of damage due to settlement. Groundwater cutoff walls which are independent of the excavation support systems may be required.

2. Common types of excavation support system include, but are not limited to singular or multiple stages comprised of cantilevered or internally braced soldier piles and lagging, steel sheetpile wall, timber sheetpile wall, trench box, or combinations thereof. Trench box temporary excavation support system is only acceptable for pipe or utility trench excavations. Temporary unsupported open cut excavation with stable sloping sides is allowed where applicable.

3. Wherever the word "sheeting" is used in this section, it shall be in reference to any type of excavation support system specified except trench box.

4. Construction of the temporary excavation support systems shall not disturb the existing structures or the completed proposed structures. Damage to such structures shall be repaired by the Contractor at no additional cost to the Owner.

5. Adjacent structures are those that bear upon soils above the proposed excavation depth and within a distance equal to twice the total depth of the excavation away from the closest edge of the excavation. Monitor and protect adjacent structures as specified and indicated.

6. Vibration monitoring for excavation support systems will be performed by Contractor’s vibration consultant and monitoring firm. Vibration due to Contractor’s operations shall not exceed specified limits stated in Paragraph D.5.

7. Use only pile driver hammers with mufflers capable of significantly reducing noise and use barriers or shielding techniques to comply with applicable federal, state, and local ordinances.

8. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the temporary excavation support systems.

The Contractor shall pay for all claims, costs and damages that arise as a result of the work performed at no additional cost to the Owner.

B. References

1. Florida Trench Safety Act
2. American Society for Testing and Materials (ASTM):
   a. A36: Standard Specification for Structural Steel
   b. A416: Standard Specification for Strand Steel, Uncoated Seven-Wire for Prestressed Concrete
   c. A572: Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel
   d. A722: Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
   e. A615: Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3. American Wood-Preserves Association (AWPA) Standards.
4. American Welding Society (AWS) Code: D1.1.
5. Federal Standard, FS TT-W-571: Wood Preservation and Treating Practices.
6. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.
7. American Concrete Institute (ACI)
8. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

C. Submittals

1. Submit the following in accordance with the General Conditions, Section 01300, and the following:
   a. Submit the following qualifications four (4) weeks prior to the construction:
      i. Qualifications of independent vibration consulting and monitoring firm as specified in Paragraph D.4. Qualifications of Contractor's temporary excavation support system designer as specified in Paragraph D.7.
      ii. Qualifications of Contractor's temporary excavation support system installer as specified in Paragraph D.8.
      iii. Qualifications of Contractor's independent tieback testing laboratory as specified in Paragraph D.9, if a tieback system is utilized.

iv. Qualifications of Contractor's temporary excavation support system installation supervisor as specified in Paragraph D.10.
v. Qualifications of vacuum excavation subcontractor as specified in Paragraph D.6, if DMPs for utilities are utilized.

2. Provide the Owner and Engineer a record of the temporary excavation support plan and calculations sealed and signed by a Registered Professional Structural Engineer in the State of Florida. The copy is to be provided at least four (4) weeks prior to start of the construction of the respective work where the support will be required. The copy will be for documentation of temporary excavation support plan for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. This information will not be reviewed or accepted by the Owner and Engineer in any manner so as to relieve the Contractor from sole responsibility from maintaining the temporary excavation support systems. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

a. Proposed temporary excavation support system(s), groundwater cutoff walls (if utilized), details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.
b. Proposed dewatering procedure plan. Plan is to list step by step procedure of installation of the dewatering system, description of system, location of deep wells relative to temporary excavation support system and cutoff walls (if utilized).
c. Certificate of Design: Submit three (3) paper copies signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the contract documents. Include list of codes, loads, and other factors used in performing these services.
d. A list of all design assumptions, including safety factors used for the temporary excavation support system(s) and all lateral pressures used for each system.
e. If utilizing a tieback system, include tieback installation procedures and criteria for acceptance of tiebacks for performance and proof tests. Submit the tieback testing results to the Engineer for information only.
f. Requirements of dewatering during the construction.
g. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.
h. List of equipment used for installing the excavation support systems.

3. Monitoring schedule, installation procedures and location plans for movement monitoring, vibration/noise monitoring, geotechnical instrumentation

(deformation monitoring points, inclinometers, etc.) and observation wells/ piezometers to monitor ground, excavation support system, adjacent structures and groundwater fluctuation during the entire construction period. The monitoring plan shall include the survey of the temporary support systems by a Registered Professional Surveyor in the State of Florida. The surveyor and structural engineer are to determine a monitoring plan and identify it within the monitoring plan. The monitoring plan shall also include a Construction Contingency Plan for addressing inclement weather and hurricane(s).

4. Submit a Construction Contingency Plan specifying the methods and procedures to maintain temporary excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

5. The Owner's Representative and Engineer shall be provided with the following information to provide reasonable assurance that the Contractor is successfully maintaining the temporary excavation support system. This information will not be reviewed or accepted by the Owner and Engineer in any manner so as to relieve the Contractor from sole responsibility from maintaining the temporary excavation support systems. Monitoring data is to be provided within one (1) calendar day of data collection from surveyor, vibration and noise recording equipment, observation wells, deformation monitoring points and offset lines. At a minimum the data shall include:

   a. Horizontal and vertical movements by surveyor, geotechnical instruments and groundwater readings.
   b. New movements since the initial readings of the geotechnical instruments and surveyor.
   c. Weekly summary in tabular and/or graphic form.
   d. A schematic plan of excavation and/or relevant construction activities at the time of monitoring.

6. For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:

   a. Survey locations of the temporary excavation support systems, including coordinates of the ends and points of change in direction.
   b. Type of the temporary excavation support system.
   c. Elevations of top and bottom of the excavation support systems left in place.

7. Prior to preparation of the temporary excavation support plan, the Contractor shall perform subsurface utility exploration in all areas where sheeting is proposed. The temporary excavation support plan shall include the provisions for avoidance of the existing utilities.

D. Quality Assurance

1. The Contractor is responsible for controlling the quality of work, including work of its subcontractors and suppliers and for assuring the quality specified is

achieved. Means and methods of construction and installation processes are the responsibility of the Contractor, and at no time is it the intent of the Engineer or Owner to supersede or void that responsibility.

2. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

3. Construction operations to conform to noise regulations provided in the Noise Control Plan and this Section.

4. Retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:

   a. Preparing, reviewing and signing of monitoring plans and daily reports, and overseeing of the monitoring and interpretation of the vibration data shall be performed by personnel with the following qualifications:

      i. Be a Registered Professional Structural Engineer in the State of Florida.
      ii. Have a minimum of five (5) years experience in the vibration consulting field.
      iii. Have successfully completed at least five (5) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

   b. Assist Contractor in selecting pile driving equipment which will generate the lowest vibration and noise levels.

   c. Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

      i. Have at least three (3) years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.
      ii. Have installed, operated, monitored and interpreted equipment and records on at least three (3) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

5. The peak particle velocity for pile driving, or other vibration-inducing operations, shall not exceed the following:

Type of Concrete	Age of Concrete, hrs	Peak Particle Velocity in/sec
Mass Concrete (footings, mats, Slab-on-grade,	0-11 11 and over	1.0 2.0

fill concrete, etc.)

Concrete Structures (walls, columns, elevated slabs, etc.)	0-11	0.5
	11-24	1.0
	24 and over	2.0
Existing Structures, residences or utilities	-	0.5

6. If utilizing deformation monitoring points (DMPs) for utilities, vacuum excavation shall be performed by subcontractor having five (5) years of experience in non-destructive vacuum excavation methods for utilities.

7. Prepare design, including calculations and drawings, under the direction of a Professional Structural Engineer licensed in the State of Florida having the following qualifications:

   a. Not less than ten (10) years experience in the design of specific temporary excavation support systems to be used.
   b. Completed not less than five (5) successful temporary excavation support system projects of equal type, size, and complexity within the last five (5) years.

8. Temporary Excavation Support System Installer's Qualifications:

   a. Not less than three (3) year experience in the installation of similar types and equal complexity as the proposed system.
   b. Completed not less than three (3) successful excavation support systems of similar type and equal complexity as the proposed system.

9. If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:

   a. Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.
   b. Employ personnel conducting testing who are trained in the methods and procedures to test and monitor tieback systems of similar type and equal complexity, as the proposed system.
   c. Have not less than five (5) years experience in testing of tieback systems of similar type and equal complexity as the proposed system.
   d. Have successfully tested at least three (3) tieback systems of similar type and equal complexity as the proposed system.

10. Install all temporary excavation support systems under the supervision of a supervisor having the following qualifications:

    a. Not less than five (5) years experience in installation of systems of similar type and equal complexity as the proposed system.
    b. Completed at least five (5) successful temporary excavation support systems of similar type and equal complexity as the proposed system.

11. All welding shall be performed in accordance with AWS D1.1.

E. Design Criteria

1. Design of temporary excavation support systems shall meet the following minimum requirements:

a. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, temporary stockpiles, construction loads, roadways, railroads, and other surcharge loads.
b. Design a bracing system to provide sufficient reaction to maintain stability.
c. Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.
d. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced temporary excavation support systems shall not be less than 5 feet below the bottom of the excavation.
e. Design temporary excavation support systems to withstand an additional 2 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.
f. Maximum width of pipe trench excavation shall be as indicated on the drawings.
g. Do not cast permanent structure walls directly against excavation support walls.
h. The design location of the excavation support wall shall be determined such that the installed wall and bracing system components are all located outside the limits of the permanent structure. Construction tolerances (e.g. wall verticality) shall be considered in determining the plan location.

F. Delivery, Storage and Handling

1. Store sheeting and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

G. Project/Site Conditions

1. Subsurface Conditions: Refer to Appendix B. The geotechnical criteria provided in Appendix B is for general reference information only and not intended to be utilized for the design of the Temporary Excavation Support System. The Structural Engineer responsible for the development of the Temporary Excavation Support System shall utilize geotechnical information as required and procured by the Structural Engineer for purposes of development of the Temporary Excavation Support System.

PART 2 - PRODUCTS

2.01 MATERIALS

1. Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstop and accessory steel shapes shall conform to ASTM A36.
2. Steel Sheet Piling: ASTM A572, continuous interlocking type.
3. Timber Lagging Left in Place: Pressured treated per appropriate AWPA standards.
4. Tieback Tendons: Tieback tendons shall be high strength steel wire strand cables conforming to ASTM A416, or bars conforming to ASTM A722. Splicing of individual cables shall not be permitted.
5. Raker Ties: ASTM A615 Grade 60.
6. Cement Grout Materials And Admixtures For Tieback Anchorages: Grout cube strength shall be a minimum 3500 psi at 7 days and 5000 psi at 28 days.
7. Concrete: Section 03300.
8. Tamping tools adapted for backfilling voids after removal of the excavation support system.
9. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

B. Equipment

1. A vibratory hammer shall be utilized for driving the temporary sheet piling providing that such operations do not exceed vibration/noise requirements of the specifications. Impact hammer shall be utilized when vibratory hammer is unable to drive temporary sheet piling to required depth and/or unable to meet vibration requirements. Impact hammer shall also comply with the maximum noise requirements in accordance with Orange County noise ordinances.

PART 3 - EXECUTION

3.01 INSTALLATION

1. Installation of the temporary excavation support systems shall not commence until the related earth excavation and dewatering submittals have been reviewed by the Engineer with all Engineer’s comments satisfactorily addressed. Submit Construction Administration Request (CAR) to the Owners Representative a minimum of seven (7) calendar days in advance of the work.
2. Install excavation support systems in accordance with the temporary excavation support plan.

3. If utilizing a tieback system, all performance and proof tests shall be conducted in the presence of the Engineer. Testing performed without the Engineer present will not be accepted. Repeat testing in the Engineer's presence at no additional cost to the Owner.

4. Do not drive sheeting within 100 feet of concrete less than seven (7) days old.

5. Carry out program of temporary excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of work ongoing or previously completed.

6. Bottom of the trench box excavation support system shall be above the pipe invert prior to installing the pipe.

7. Install and read geotechnical instrumentation in accordance with the temporary excavation support plan. Notify the Owner's Representative immediately if any geotechnical instrumentation is damaged. Repair or replace damaged geotechnical instrumentation at the sole option of the Engineer and at no additional cost to the Owner.

8. Continuously monitor movements of the ground adjacent to excavation support systems and adjacent structures. In events of the measured movements approaching or exceeding the allowable movements, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities or other measures (Construction Contingency Plan) as required.

9. Notify the Owner's Representative if existing utilities interfere with the temporary excavation support system. Modify the existing utility with the Owner's permission or have the Owner make the modifications at no additional cost to Owner.

10. If existing utilities span the excavation, the Structural Engineer responsible for the development of the Temporary Excavation Support System shall provide the Contractor the design criteria and details for temporary support of the existing utilities.

B. Ground Deformation Adjacent to Excavation Support Systems

1. Allowable Vertical (heave/settlement) and Lateral Movements: 2 inches maximum for the trench box excavation support system, and 1 inch maximum for other types of excavation support systems at any location behind the excavation support system. Allowable movements at areas adjacent to existing structures may be less. It is the intent that allowable movements are limited to values which will not cause damage to existing structures.

2. Monitoring personnel shall use a procedure for reading and recording geotechnical instrumentation data which compares the current reading to the last reading during data collection to eliminate spurious readings.

3. Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the

readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

4. Notify the Owner's Representative immediately when the allowable ground deformation is exceeded.

5. Implement Construction Contingency Plan under direction of Structural Engineer who is in Responsible Charge for the temporary excavation support system.

C. Removal Of Earth Retention System:

1. Unless required to perform the work in accordance with the Contract Documents, the sheeting shall be left in place.

2. In cases where sheeting must be removed, remove the temporary excavation support system without endangering the constructed or adjacent structures, utilities, or property. Immediately backfill all voids left or caused by withdrawal of temporary excavation support systems with bank-run gravel, screened gravel or select borrow by tamping with tools specifically adapted for that purpose.

3. When tiebacks are used, release tension in tiebacks as the excavation is backfilled. Do not leave tensioned tieback in place at the completion of the work.

4. The excavation support system left-in-place shall be cut-off a minimum of 2 feet below the bottom of the next higher foundation level or a minimum of 5 feet below finished grade, or as directed by the Structural Engineer responsible for the Temporary Excavation Support System.

5. Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

D. Contract Closeout

1. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02215
FINISH GRADING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide finish grading to all areas within the limits of construction.

B. Grade sub-soil. Cut out areas to receive stabilizing base course materials for paving and sidewalks. Place, finish grade, and compact topsoil.

1.02 PROTECTION

A. Prevent damage to existing fencing, trees, landscaping, natural features, benchmarks, pavement, and utility lines. Correct damage at no cost to the County.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

PART 2 - PRODUCTS

2.01 MATERIALS

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

B. Topsoil: Friable loam free from subsoil, roots, grass, excessive amount of weeds, stones, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4% and a maximum of 25% organic matter. The topsoil shall be suitable for the proposed plant growth shown on the Drawings and specified. Use topsoil stockpiles on site if conforming to these requirements. If there is not sufficient topsoil available at the project site, the Contractor shall furnish additional topsoil as required to complete the Work at no additional cost to the County.

PART 3 - EXECUTION

3.01 SUB SOIL PREPARATION

A. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. Remove sub-soil that has been contaminated with petroleum products.

B. Cut out areas to subgrade elevation which are to receive stabilizing base for paving and sidewalks.

C. Bring sub soil to required levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.

D. Slope grade away from building a minimum of 2-inches in 10-feet unless indicated otherwise on the Drawings.

E. Cultivate subgrade to a depth of 3-inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted sub-soil.

3.02 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting is to be performed. Place to the following minimum depths, up to finished grade elevations.

1. 6-inches for seeded areas
2. 4-1/2-inches for sodded areas
3. 24-inches for shrub beds
4. 18-inches for flower beds

B. Use topsoil in relatively dry state. Place during dry weather.

C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.

D. Remove stones, roots, grass, weeds, debris, and other foreign material while spreading.

E. Manually spread topsoil around trees, plants, and buildings to prevent damage which may be caused by grading equipment.

F. Lightly compact placed topsoil.

3.03 SURPLUS MATERIAL

A. Remove surplus sub soil and topsoil from site.

B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 02220
EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Excavate, backfill, and compact as required for the construction of the utility system consisting of piping and appurtenances, and structural construction as shown on the Drawings and specified herein. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to perform all excavation, backfill, compaction, grading, and slope protection to complete the Work. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, all under ground utilities locations and appurtenances shown on the construction Drawings.

B. Definitions:

1. Maximum Density: Maximum weight in pounds per cubic foot of a specific material as determined by AASHTO T-180 (ASTM D155).

2. Optimum Moisture: Percentage of water in a specific material at maximum density.

3. Rock Excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery.

4. Suitable: Suitable materials for fills shall be non-cohesive, non-plastic granular local sand and shall be free from vegetation, organic material, marl, silt, or muck. The Contractor shall furnish all additional fill material required.

5. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-8 in accordance with AASHTO Designation M 145.

C. Plan For Earthwork: The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrata, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under this Contract. Prior to commencing the excavation, the Contractor shall submit a plan of his proposed operations, including maintenance of traffic, to the County for review. The Contractor shall consider, and his plan for excavation shall reflect, the equipment and methods to be employed in the excavation. The prices established in the Proposal for the Work to be done will reflect all costs pertaining to the Work.

1.02 QUALITY ASSURANCE

A. Testing laboratory employed by the County will make such tests as are deemed advisable. The Contractor shall schedule his work to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress. Costs for initial testing shall be paid by the County; however, tests which have to be repeated because of the failure of the tested material to meet specification shall be paid for by the Contractor and the cost of re-testing shall be deducted from payments due the Contractor.

B. Standards

1. AASHTO: American Association of State Highway and Transportation Officials
2. ANSI: American National Standards Institute
3. ASCE: American Society of Civil Engineers
4. ASTM: American Society for Testing and Materials
5. AWWA: American Water Works Association
6. OSHA 29 CFR Subpart P – Excavations and Trenches a) 1926.650, 1926.651, 1926.652
7. OSHA 29 CFR Subpart J - a) 1910.146 for Confined Space Entry

1.03 JOB CONDITIONS

A. Existing Utilities

1. The Contractor is responsible for subsurface verification of existing utilities prior to construction. Coordinate with SWRF operation staff and locate existing utilities in the area of work in accordance with Sunshine State One Call regulations, Chapter 556, "Underground Facility Damage Prevention and Safety Act", FS.
2. Should uncharted or incorrectly charted piping or other utility be encountered during excavation, notify the County. Keep all facilities in operation and repair damaged utilities to the satisfaction of the County.
3. Damage and repair costs to such piping or utilities are the Contractor's responsibility.
4. If utilities are to remain in place, the Contractor shall provide adequate means of protection.

B. Test borings and the sub-surface exploration data if previously done on the site will be made available upon request and are for the Contractor's information only.

1.04 PROTECTION

A. Sheeting and Bracing

1. Requirements of the Trench Safety Act shall be adhered to at all times.

2. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, to protect adjacent structures and power poles from undermining, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other acceptable methods. If the County is of the opinion that at any point sufficient or proper supports have not been provided, the County may order additional supports put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the County.

3. The Contractor shall construct the sheeting outside the neat lines of the foundation unless indicated otherwise for the method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressure to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected by the Contractor at their own expense so as to provide the necessary clearances and dimensions.

4. Where sheeting and bracing is required to support the sides of excavations for structures, the Contractor shall engage a Professional Geotechnical Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and the Professional Engineer shall provide certification of this.

5. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.

6. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the County may direct him in writing to leave in place at any time during the progress of the Work for the purpose of preventing damage to structures, utilities, or property, whether public or private. The County may direct that timber used for sheeting and bracing be cut off at any specified elevation.

7. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by the County.

8. The right of the County to order sheeting and bracing left in place shall not be construed as creating any obligation on the County's part to issue such orders,

and their failure to exercise this right shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the Work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

9. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1-foot above the top of any pipe.

B. Pumping and Drainage:

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing the water level to return to the natural level as stipulated in Section 02140 "Dewatering." The Contractor shall engage a Professional Geotechnical Engineer registered in the State of Florida to design the dewatering systems. The Contractor shall submit to the County for a plan for dewatering systems prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan, and the Professional Engineer shall provide certification of this. The Professional Engineer shall be required to monitor the performance of the dewatering systems during the progress of the Work and require such modifications as may be required to assure that the systems are performing satisfactorily.

2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed bottom of excavation and to preserve the integrity of adjacent structures. Dewatering by trench pumping will not be permitted if migration of fine grained natural material from bottom, sidewalls, or bedding material will occur.

3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.

4. The Contractor shall take all additional precautions to prevent uplift of any structure during construction.

5. Permission to use any storm sewers or drains for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the County or the authority having jurisdiction, at no cost to the County.

6. The Contractor shall prevent flotation by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.

7. Removal of dewatering equipment shall be accomplished after compaction/density testing has been completed and the system is no longer required. The Contractor shall remove the material and equipment constituting the system.

8. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, or other contaminates in order to prevent adverse effects on groundwater quality.

1.05 TESTING AND INSPECTION SERVICE

A. The County will provide a geotechnical testing and inspection service. The services include testing soil materials and quality control testing during filling and backfilling operations. Samples of soil materials shall be furnished to the testing service by the Contractor. The County shall pay costs of initial geotechnical testing. The Contractor shall pay for any subsequent testing required due to failure and laboratory stand-by charges incurred.

B. The Contractor shall provide monthly density testing reports to the County during backfilling activities. Density testing reports not submitted in a timely manner shall result in rejection of the pipe installed and rejection of the density testing reports until such time that density re-testing is coordinated and repeated at the Contractors expense.

C. Density testing scheduled by Owner with Contractor's written requests shall be coordinated with, and witnessed by the County. The on-site RPR shall schedule all testing following the Contractors written request. Failure by the Contractor to coordinate or have the County present shall result in rejection of the submitted density testing reports and re-testing at the Contractor's expense.

D. Dewatering systems shall not be removed until compaction/density testing has been completed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. All fill material shall be subject to the review and acceptance of the County.

2. All fill material shall be free of organic material, trash, or other objectionable material. The Contractor shall remove excess or unsuitable material from the job site.

B. Common Fill Material: Common fill shall consist of mineral soil, substantially free of clay, organic material, muck, loam, wood, trash, and other objectionable material which may be compressible or which cannot be compacted properly. Common fill

shall not contain stones larger than 3-1/2-inches in any dimension in the top 12-inches or 6-inches in any dimension in the balance of fill area. Common fill shall not contain asphalt, broken concrete, masonry, rubble or other similar materials. It shall have physical properties that allow it to be easily spread and compacted during filling. Additional common fill shall be no more than 12 % by weight finer than the No. 200 mesh sieve, unless finer material is approved for use in a specific location by the County. Select Common Fill shall be as specified as above from common fill, except that the material shall contain no stones larger than 1/2-inches in largest dimension, and shall be no more than 5 % by weight finer than the No. 200 mesh sieve.

C. Structural Fill: Structural fill shall be reasonably well graded sand to gravelly sand having the following gradation:

US Sieve Size	Percent Passing By Weight
No. 1	100
No. 4	75 - 100
No. 40	15 - 80
No. 100	0 - 30
No. 200	0 - 12

D. Class 1 Soils*: Manufactured angular, granular material, 1/4 to 1-1/2-inches (6 to 4 mm) size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.

Crushed Stone: Crushed stone shall consist of clean mineral aggregate free from clay, loam or organic matter, conforming to ASTM C33 stone size No. 89 and with particle size limits as follows:

U.S. Sieve Size	% Passing By Weight
½	100
3/8	100
No. 4	20 – 25
No. 8	5 – 30
No. 16	0 - 10
No. 50	0 - 2

E. Class II Soils**:

1. GW: Well graded gravels and gravel-sand mixtures, little or no fines. Fifty percent or more retained on No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.

2. GP: Poorly graded gravels and gravel-sand mixtures, little or no fines. Fifty percent or more retained on No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.

3. SW: Well graded sands and gravelly sands, little or no fines. More than passes No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.

4. SP: Poorly graded sands and gravelly sands, little or no fines. More than 50 % passes No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.

*Soils defined as Class I materials are not defined in ASTM D2487.
**In accordance with ASTM D2487, less than 5 % pass No. 200 sieve.

F. Coarse Sand: Sand shall consist of clean mineral aggregate with particle size limits as follows:

U.S. Sieve Size	Percent Passing By Weight
3/8	100
No. 10	85 – 100
No. 40	20 – 40
No. 200	0 - 12

G. Other Material: All other material, not specifically described, but required for proper completion of the Work shall be selected by the Contractor and acceptable by the County.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clearing:

1. The construction areas shall be cleared of all obstructions and vegetation including large roots and undergrowth within 10-feet of the lines of the excavation.

2. Strip and stockpile topsoil on the site at the location to be determined by the County.

3.02 EXCAVATION

A. General: Excavations for roadways, structures, and utilities must be carefully executed in order to avoid interruption of utility service.

B. Excavating for Roadways/Structures/Utilities:

1. Excavation shall be made to such dimensions as will give suitable room for building the foundations and the structures, for bracing and supporting, for pumping and draining, and for all other work required.

a. Excavation for precast or prefabricated structures shall be carried to an elevation 2-feet lower than the proposed outside bottom of the structure to provide space for the select backfill material. Prior to placing the select backfill, the excavation shall be measured by the County to verify that the excavation has been carried to the proper depth and is reasonably uniform over the area to be occupied by the structure.

b. Excavation for structures constructed or cast in place in dewatered excavations shall be carried down to the bottom of the structure where

dewatering methods are such that a dry excavation bottom is exposed and the naturally occurring material at this elevation leveled and left ready to receive construction. Material disturbed below the founding elevation in dewatered excavations shall be replaced with Class B concrete.

c. Footings: Cast-in-place concrete footing sides shall be formed immediately after excavation.

2. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.

3. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the course of the Work.

4. Encounters with subsurface obstructions shall be hand excavated.

5. Excavation and dewatering shall be accomplished by methods that preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of structures as a result of inadequate dewatering or other construction methods shall be removed and replaced by crushed stone as required by the County at the Contractor's expense.

6. The bottom of excavations shall be rendered firm and dry before placing any piping or structure.

7. All pavements shall be cut with saws or approved power tools prior to removal.

8. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor.

3.03 DRAINAGE

A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations, and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition. The dewatering method used shall prevent disturbance of earth below grade.

B. All water pumped or drained from the Work shall be disposed of in a suitable manner without undue interference with other work, without damage to surrounding property, and in accordance with pertinent rules and regulations.

C. No construction, including pipe laying, shall be allowed in water. No water shall be allowed to contact masonry or concrete within 24-hours after being placed. The Contractor shall constantly guard against damage due to water and take full responsibility for all damage resulting from his failure to do so.

D. The Contractor will be required at his expense to excavate below grade and refill with crushed stone (gradation 57 or 89) or other acceptable fill material if the County determines that adequate dewatering has not been provided.

3.04 UNDERCUT

A. If the bottom of any excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due the Contractor's excavation methods, he shall refill to normal grade with fill at his own cost. Fill material and compaction method shall be approved by the County.

3.05 FILL AND COMPACTION

A. Compact and backfill excavations and construct embankment according to the following schedule. (Modified Proctor standard shall be ASTM D-1557):

3.06 STRUCTURES AND ROADWORK

Area	Material	Compaction
Beneath Structures	Structural Fill	12-inch lifts, compacted to 98% maximum density as determined by AASHTO T-180. Fill Should not be placed over any in-place soils until those deposits have been compacted to 98% Modified Proctor.
Around Structures	Structural Fill	12-inch lifts, 98% of maximum density as determined by AASHTO T-180. Rubber Tire or vibratory plate compactors shall be used
Beneath Paved Surfaces	Common Fill	12-inch lifts, 98% by maximum density as determined by AASHTO T-180 or as required by the FDOT Standards.
Open Areas	Common Fill	12-inch lifts, 95% by maximum density as determined by AASHTO T-180.

A. Pipe shall be laid in open trenches unless otherwise indicated on the Drawings or elsewhere in the Contract Documents.

B. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected. The backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.

C. Embankments shall be constructed true to lines, grades, and cross sections shown on the plans or ordered by the County. Embankments shall be placed in successive layers of not more than 8-inches in thickness, loose measure, for the full width of the embankment. As far as practicable, traffic over the Work during the construction phase shall be distributed so as to cover the maximum surface area of each layer.

D. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such request shall be in writing to the County. Acceptance will be considered only after the Contractor has performed tests, at the Contractor's expense, to identify the material used and density achieved throughout

the backfill area utilizing the method of backfill requested. The County's acceptance shall be in writing.

E. One compaction test location shall be required for each 300 linear feet of pipe and for every 100 square feet of backfill around structures as a minimum. The County may determine that more compaction tests are required to certify the installation depending on field conditions. The locations of the compaction tests within the trench shall be in conformance with the following schedule:

1. At least one test at the spring line of the pipe.
2. At least one test for each 12-inch layer of backfill within the pipe bedding zone for pipes 24-inches and larger.
3. One test at an elevation of 1-foot above the top of pipe.
4. One test for each 2-feet of backfill placed from 1-foot above the top of the pipe to finished grade elevation.
5. Density testing is required for sanitary sewer manholes. Tests shall be staggered around the manhole within 3-feet of the structure's outside diameter.
    a. First test shall be 1-foot above the structure base.
    b. Second test shall be 2-feet above the first test and subsequent tests every 2-feet up the finished grade.
6. The Contractor shall provide additional compaction and testing prior to commencing further construction if the County's testing reports and inspection indicate that the fill has been placed below specified density.
7. The Contractor shall coordinate testing with the County approved testing laboratory and shall provide monthly test results to the County in a timely manner during construction activities. Density testing scheduled subsequent to backfilling activities shall be coordinated with the County and witnessed by the County representative. Failure by the Contractor to coordinate or have the County representative present shall result in rejection of the submitted density testing reports and re-testing at the Contractor's expense. Density testing reports not submitted in a timely manner shall result in rejection of the pipe installed and rejection of the density testing reports until such time that density re-testing is coordinated and repeated at the Contractor's expense as deemed necessary by the County's representative.
8. Dewatering systems shall not be removed until compaction/density testing has been completed.

END OF SECTION

SECTION 02222
PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials and procedures for protecting existing underground utilities.

PART 2 - MATERIALS

2.01 REPLACEMENT IN KIND

A. Except as indicated below or as specifically authorized by the County's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 - EXECUTION

3.01 GENERAL

A. Replace in kind street improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.

B. Where utilities are parallel to or cross the construction but do not conflict with the permanent work to be constructed, follow the procedures given below. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. For utility crossings not shown in the drawings, refer to the General Conditions and the instructions of the Owner's Representative for guidance.

C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in work.

3.02 PROCEDURES

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified in the drawings or in the specifications.

B. Cut and Plug Ends: Cut abandoned utility lines and plug the ends. Plug storm drains and sewers with an 8-inch wall of brick and mortar. Cap waterlines with a cast-iron cap or install a 3-foot-long concrete plug. Dispose of the cut pipe in an appropriate off-site facility at no additional cost to the owner.

C. Remove and Reconstruct: Where so indicated in the drawings or as required by the County's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

3.03 COMPACTION

A. Utilities Protected in Place: Backfill and compact under and around the utility so that no voids are left.

B. Utilities Reconstructed: Prior to replacement of the utility, backfill the trench and compact to an elevation 1 foot above the top of the ends of the utility. Excavate a cross trench of the proper width for the utility and lay, backfill, and compact.

C. Alternative Construction--Sand Slurry: Sand slurry consisting of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability may be substituted for other backfill materials to aid in reducing compaction difficulties. Submit specific methods and procedures for review by the County's Representative prior to construction.

3.04 SPECIAL CONSTRUCTION

A. Reinforced Concrete Beam: Where indicated in the drawings or as determined by the County's Representative, support utilities by a reinforced concrete beam. The primary purpose of the beam is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction and shall incorporate the beam as part of the protection.

B. Concrete Support Wall: Where indicated in the drawings or as determined by the County's Representative, support the utilities by a concrete support wall as shown on the utility support details in the drawings. The purpose of the concrete support wall is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction.

3.05 THRUST BLOCKS ON WATERLINES

A. The Contractor's attention is called to thrust blocks for pipelines throughout the project whose thrust is in the direction of the new excavation and, therefore, may be affected by the construction. These pipelines are owned and operated by the County. Protect thrust blocks in place or shore to resist the thrust by a means accepted by the County's Representative and reconstruct. If the thrust blocks are exposed or rendered

to be ineffective in the opinion of the County's Representative, reconstruct them to bear against firm unexcavated or backfill material or restrain pipe mechanically.

B. Provide firm support by backfilling that portion of the trench for a distance of 2 feet on each side of the thrust block to be reconstructed from the pipe bedding to the pavement subgrade, with either:

1. Sand-cement slurry (94 pounds of cement per cubic yard).
2. The native material compacted to a relative compaction of 95%.

C. Then excavate the backfill material for construction of the thrust block.

D. Test compaction of the backfill material before pouring any concrete thrust block. Use Class A concrete per Section 03300 for reconstruction.

END OF SECTION

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SECTION 02227
TRENCH SAFETY REQUIREMENTS

PART 1 - GENERAL

1.01 INTENT

A. The purpose and intent of this section is to provide for increased worker safety by requiring compliance with sufficient standards for trench safety ("Florida Trench Safety Act", 90-96, Laws of FL, effective October 1, 1990).

1.02 CONTRACT BID ITEMS

A. The contract bid submitted by the contractor who will perform such excavation shall include:

1. A reference to the trench safety standards that will be in effect during the period of construction of the project.
2. Written assurance by the contractor performing the trench excavation that such contractor will comply with the applicable trench safety standards.
3. A separate item identifying the cost of compliance with the applicable trench safety standards.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. A contractor performing trench excavation shall:

1. As a minimum, comply with the excavation safety standards which are applicable.
2. Adhere to any special shoring requirements, if any, of the state or other political subdivision which may be applicable to such a Project.
3. If any geotechnical information is available from the owner, the contractor, or otherwise, the contractor performing trench excavation shall consider this information in the contractor's design of the trench safety system which it will employ on the project. This paragraph shall not require the owner to obtain geotechnical information.

END OF SECTION

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SECTION 02230
SITE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Site clearing, tree protection, stripping topsoil and demolition.

B. Related Specification Sections include but are not necessarily limited to:

1. Orange County Utilities - Bidding Requirements, Contract Forms, and Conditions of the Contract Documents.
2. Division 01 - General Requirements.
3. Section 02310 - Finish Grading.
4. Section 02100 – Temporary-Erosion and Sediment Control.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect existing trees and other vegetation to remain against damage.

1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
3. Provide temporary protection as required.

B. Repair or replace trees and vegetation damaged by construction operations.

1. Repair to be performed by a qualified tree surgeon.
2. Remove trees which cannot be repaired and restored to full-growth status.
3. Replace with new trees of minimum 4 inches caliper.

C. Owner will obtain authority for removal and alteration work, if any, on adjoining property.

3.02 SITE CLEARING

A. Topsoil Removal:

1. Strip topsoil to depths encountered.
    a. Remove heavy growths of grass before stripping.
    b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
    c. Separate from underlying subsoil or objectionable material.
2. Stockpile topsoil where directed by Engineer.
    a. Construct storage piles to freely drain surface water.
    b. Seed or cover storage piles to prevent erosion.
3. Do not strip topsoil in wooded areas where no change in grade occurs.
4. Borrow topsoil: Reasonably free of subsoil, objects over 2 inches DIA, weeds and roots.

B. Clearing and Grubbing:

1. Clear and grub within the areas of the limits of construction, sand-clay base material pits, lateral ditches, and any other areas shown in the Plans to be cleared and grubbed. Remove and dispose of all trees, stumps, roots and other such protruding objects, structures, appurtenances, existing flexible asphalt pavement, and other facilities necessary to prepare the area for the proposed construction. Remove and dispose of all product and debris not required to be salvaged or not required to complete the construction.
2. In all areas where excavation is to be performed remove roots and other debris to a depth of 12 inches below the ground surface. Remove roots and other debris from all excavated material to be used in the construction of roadway embankment or roadway base. Plow the surface to a depth of at least 6 inches, and remove all roots thereby exposed to a depth of at least 12 inches. Completely remove and dispose of all stumps within the limits of construction.
3. Remove all roots, etc., protruding through or appearing on the surface of the completed excavation within the roadway area and for structures, to a depth of at least 12 inches below the finished excavation surface.

C. Disposal of Waste Materials:

1. Do not burn combustible materials on site.
2. Remove all waste materials from site.
3. Do not bury organic matter on site.

3.03 ACCEPTANCE

A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

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SECTION 02282
CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 - GENERAL

A. Description

This section includes materials and installation of connections to existing buried pipelines including connections by hot tap, line stop and connections to existing Prestressed Concrete Cylinder Pipe (PCCP). If the existing buried pipelines that are to be verified by the Contractor are determined to be another material than PCCP as noted below, the following requirements shall apply to the extent to which they are applicable.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following;
2. Submit appropriate reference material and documentation as specified herein.
3. Submit manufacturer's catalog data for tapping sleeves, tapping valves, completion plugs, blind flanges and appurtenances. Submit materials of construction for all components indicating ASTM standards with which they comply as well as coatings.
4. Submit confirmation of field investigation of the existing pipeline material, size and condition, as specified herein and illustrated in the Drawings.
5. Submit the qualifications and reference material of the Contractor, or Subcontractor, who will be performing the hot taps and line stops on the Project.
6. Submit the qualifications and reference material of the Engineer who the Contractor, or Subcontractor, is required to retain for detailing each of the respective line stops and hot taps illustrated in the Drawings.
7. Submit the qualifications and reference material of the Engineer who the Contractor, or Subcontractor, is required to retain for detailing the connections between the existing Prestressed Concrete Cylinder Pipe (PCCP) and the new sections of Ductile Iron Pipe (DIP).
8. Submit the qualifications and reference materials from PCCP Manufacturer at US-PIPE and Forterra Pressure Pipe (formerly known as Hanson Pipe and Precast) who will provide services from the PCCP Manufacturer regarding the details of connection to the PCCP pipe.
9. The Contractor’s, or Subcontractor’s, Engineer preparing the detailed shop drawings for each line stop and hot tap shown in the Drawings shall include

the following at a minimum. The submittal shall be signed and sealed by that Engineer;

a. Dimensional Drawings of each location with identification of all respective fittings, valves and appurtenances required.
b. Details of the existing utility as determined from field exploration; including but not limited to depth, size, and material, method of restraint and current service condition.
c. Calculations for the sizing of and the dimensional drawings illustrating the limits of the encasement for the tapping sleeve with completion plug and blind flange.
d. Calculations for the determination and dimensional drawings illustrating the method of restraint of the existing piping including mechanical restraint devices and/or concrete thrust collars or blocks.
e. Bypass piping arrangement.
f. Shoring/Sheeting or means of maintaining the excavation in compliance with the Trench Safety Act.
g. Method of support of the existing utility within the excavation if required.
h. Schedule and sequence for the execution of the Work.

10. Submit results of field evaluation of existing Prestressed Concrete Cylinder Pipe (PCCP) and recommendations of PCCP Manufacturer for the connections.

11. The Contractor's, or Subcontractor's, Engineer preparing the detailed shop drawings for detailing the connections between the existing Prestressed Concrete Cylinder Pipe (PCCP) and the new sections Ductile Iron Pipe (DIP) shall include the following at a minimum. The submittal shall be signed and sealed by that Engineer;

    a. Shop Drawings from the existing PCCP originally installed as provided by the original PCCP pipe manufacturer if available.
    b. Dimensional Drawings of each location with identification of all respective fittings, pipe, valves and appurtenances required to perform the Work as defined in the Contract Documents.
    c. Field determination of the existing PCCP bell and spigot locations in vicinity to the proposed points of connection as illustrated in the Drawings.
    d. Detailing of the Bell End and Spigot End connections with the existing PCCP as recommended per the PCCP Manufacturer.
    e. The Contractor's, or Subcontractor's, Engineer preparing the details for the connections to the PCCP pipe shall prepare a detailed dimensional shop drawing including the following at a minimum;

        i. Calculations for the sizing of thrust collars required to restrain the piping system.
        ii. Detailing for cutting out an existing section of PCCP and protection of the existing bell and spigots.

iii. Detailing for capping and grout filling the existing sections of PCCP to be abandoned in place.
iv. Shoring/Sheeting or means of maintaining the excavation in compliance with the Trench Safety Act.
v. Method of support of the existing utility within the excavation if required.
vi. Schedule and sequence for the execution of the Work.

12. For all connections with existing utilities, the Contractor, or Subcontractor, shall prepare an Emergency Contingency Plan if the existing pipeline is damaged or fails during the anticipated operation. At a minimum it shall include the process that will be used for spill protection, maintaining service within the existing pipeline and/or emergency bypass. The Owner's Representative and Engineer shall be provided with this information as reasonable assurance that the Contractor or Subcontractor is prepared in the event an emergency should arise.

C. Qualifications

1. The Contractor, or Subcontractor, performing the line stop and hot taps shall meet the following minimum experience requirements:

a. Completed not less than twenty-five (25) successful hot taps and/or line stops of similar type, size, and complexity performed within the last ten (10) years, from the date that Bids are opened, and located within the United States of America.
b. Submit references for projects of equal type, size, and complexity to demonstrate experience. Include Work type, size, and contact information for Owner four (4) weeks prior to the construction.

2. The Contractor's, or Subcontractor's Engineer, preparing the detailed shop drawings for each line stop and hot tap shown in the Drawings shall meet the following minimum experience requirements. The Engineer shall be a Registered Professional Engineer in the State of Florida;

a. Designed not less than ten (10) hot taps and/or line stops of similar type, size, and complexity which were constructed within the last five (5) years, from the date that Bids are opened, and located within the United States of America.

3. The Contractor's, or Subcontractor's Engineer, preparing the detailed shop drawings for detailing the connections between the existing Prestressed Concrete Cylinder Pipe (PCCP) and Ductile Iron Pipe (DIP) shall meet the following minimum experience requirements. The Engineer shall be a Registered Professional Engineer in the State of Florida;

a. Designed not less than four (4) similar connections with PCCP within the last ten (10) years, from the date that Bids are opened, and located within the United States of America.

PART 2 - MATERIALS

A. Utility Exploration and Materials Verification:

Expose all existing pipelines at points of construction to confirm size, material and condition, prior to procurement or preparation of submittals. Determine if each existing pipeline is mechanically restrained. All existing piping requiring a new connection is to be mechanically restrained. Support the pipeline in a manner that will not damage the pipe and provide Temporary Excavation Support Systems per Section 02160.

B. Verification of Pipe O.D. and Condition

Expose the existing pipeline and determine the pipe diameter and wall thickness prior to ordering the line stop materials. Utilize pipe thickness testing using ultrasonic technology or other no destructive means.

C. Tapping Sleeves for Ductile-Iron, and PVC (Cast-Iron O.D.) Pipes

Tapping sleeves shall comply with MSS SP-60, and MSS SP-113.

Tapping Sleeves shall be furnished and installed as specified per the Section 15100, Ancillary Equipment.

Pressure rating shall be at least 200 psi for piping 12 inches and smaller and at least 150 psi for piping 14 through 24 inches. For piping larger than 24 inches up to 42 inches pressure rating shall be at least 100 psi.

D. Test Plug

Test plug shall be ¾-inch NPT Type 304 stainless steel. Coat threads to prevent galling.

E. Gaskets for Water Service

For potable water service, gaskets shall be NSF 61 certified. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

F. Gaskets in Other than Potable Water

Gaskets shall be full face, 1/8-inch thick, Buna-N having a hardness of 55 to 65 durometer. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Provide Garlock Style 9122 or equal.

G. Coating for Tapping Sleeves

Coat with fusion-bonded epoxy per Section 09961.

H. Tapping Gate Valves

Type V137 per Section 15100 unless otherwise noted.

I. Bolts and Nuts

Bolts and nuts shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

J. Rubber Stopper for Line Stop

Fully expandable rubber, minimum 100 psi pressure rating or carbon steel pivoting head with Buna-N sealing element, minimum 100 psi pressure rating.

PART 3 - EXECUTION

A. Owner Representative Notification

Following the acceptance of the respective submittal for a connection to an existing utility, submit a Construction Administration Request (CAR) to the Owner's Representative to schedule the Work. The request shall be made a minimum of fourteen (14) calendar days prior to performing the Work. This request shall include the following:

1. Copy of the accepted submittal.
2. The Contractor's, or Subcontractor's, Emergency Contingency Plan.
3. Scheduled date and time to have meeting with the Owners Representative to discuss the Work, at a minimum of five (5) days prior to performing the Work.

Connections shall only be made on the agreed upon date and time. If the work is not performed in the agreed upon manner or schedule, the work shall be rescheduled by following the above procedure.

B. General Procedure – Hot Taps

Follow the procedure outlined within the accepted submittals for a respective location. The following is intended as a general procedure for performing a hot tap procedure;

1. All existing piping requiring a new connection shall be restrained prior to the connection being made.

2. Install mechanical restraint devices on the existing pipelines or place reinforced concrete thrust collars against undisturbed soil on either side of collars by keeping over-excavation to a minimum. Allow all concrete to reach design strength (4,000 PSI).

3. Support the pipeline in a manner that will not damage the pipe.

4. Provide Temporary Excavation Support Systems per Section 02160.

5. Excavate around the pipe at the proposed line stop or hot tap location. Limit excavation to area immediately beyond the limits of the tapping sleeve. Clean the existing pipeline and smooth any roughness that may inhibit sealing with the tapping sleeve.

6. Install the tapping sleeve.

7. Install reinforced concrete encasement around the pipe and tapping sleeve. Allow all concrete to reach design strength (4,000 PSI).

8. Install the tapping valve.

9. Tap pipeline, remove coupon, close tapping valve and remove tapping machine.

10. Connect the new utility to the tapping valve and perform respective pressure testing requirements for the new utility.

11. Repair damage that occurs due to the Contractor's, or Subcontractor's, work at the Contractor's, or Subcontractor's expense.

12. Dispose of the reclaimed water and existing pipe at no additional cost to the Owner. Comply with FDEP permit requirements.

C. General Procedure – Line Stops

Follow the procedure outlined within the accepted submittal for a respective location. The following is intended as a general procedure for performing a line stop procedure;

1. All existing piping requiring a new connection shall be restrained prior to the connection being made.

2. Install mechanical restraint devices on the existing pipelines or place reinforced concrete thrust collars against undisturbed soil on either side of collars by keeping over-excavation to a minimum. Allow all concrete to reach design strength (4,000 PSI).

3. Support the pipeline in a manner that will not damage the pipe.

4. Provide Temporary Excavation Support Systems per Section 02160.

5. Excavate around the pipe at the proposed line stop or hot tap location. Limit excavation to area immediately beyond the limits of the tapping sleeve. Clean the existing pipeline and smooth any roughness that may inhibit sealing with the tapping sleeve.

6. Install the tapping sleeve.

7. Install reinforced concrete encasement around the pipe and tapping sleeve. Allow all concrete to reach design strength (4,000 PSI).

8. Install the tapping valve.

9. Tap pipeline, remove coupon, close tapping valve and remove tapping machine.

10. Attach the line stop valve, connect the bypass or new pipeline, and close the line stopping valve.

11. Construct the new in-line isolation valve, cap or appurtenance as illustrated within the Drawings.

12. Following the temporary by-pass or linestop work, install completion plug, remove valves, install DI blind flange (150 psi) on sleeve outlet. Install reinforced concrete encasement around sleeve outlet closure/cap.

13. Repair damage that occurs due to the Contractor's, or Subcontractor's, work at the Contractor's, or Subcontractor's expense.

14. Dispose of the reclaimed water and existing pipe at no additional cost to the Owner. Comply with FDEP permit requirements.

END OF SECTION

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SECTION 02310
FINISH GRADING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Topsoiling and finished grading.

B. Related Specification Sections include but are not necessarily limited to:

1. Orange County Utilities - Bidding Requirements, Contract Forms, and Conditions of the Contract Documents.
2. Division 01 - General Requirements.
3. Section 02230 - Site Preparation.
4. Section 02100 -Temporary- Erosion and Sediment Control.

C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.02 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
2. Project Data: Test reports for furnished topsoil.

1.03 SITE CONDITIONS

A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil:

1. Original surface soil typical of the area.
2. Existing topsoil stockpiled under Specification Section 02230.

3. Capable of supporting native plant growth.

2.02 TOLERANCES

A. Finish Grading Tolerance: 0.1 feet plus/minus from required elevations.

PART 3 - EXECUTION

3.01 PREPARATION

A. Correct, adjust and/or repair rough graded areas.

1. Cut off mounds and ridges.
2. Fill gullies and depressions.
3. Perform other necessary repairs.
4. Bring all sub-grades to specified contours, even and properly compacted.

B. Loosen surface to depth of 2 inches, minimum.

C. Remove all stones and debris over 2 inches in any dimension.

3.02 ROUGH GRADE REVIEW

A. Reviewed by Engineer in Specification Section 02230.

3.03 PLACING TOPSOIL

A. Do not place when subgrade is wet or frozen enough to cause clodding.

B. Spread to compacted depth of 4 inches for all disturbed earth areas.

C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.

D. Provide finished surface free of stones, sticks, or other material 1 inch or more in any dimension.

E. Provide finished surface smooth and true to required grades.

F. Restore stockpile area to condition of rest of finished work.

3.04 ACCEPTANCE

A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.

B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

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SECTION 02361
TERMITE CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Soil treatment with termiticide or acceptable to O.C. Bldg. Dept.
2. Polymer barrier fittings with termiticide for installation around utility penetrations.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of termite control product.

1. Include the EPA-Registered Label for termiticide products.
2. Provide all paperwork to Owner for Records.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For termite control products, from manufacturer.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Polymer Barrier Fittings with Termiticide Application Report: After installation of polymer barrier fittings with termiticide is completed, submit report for Owner's records and include the following:

1. Plan drawing showing number and locations of each type of polymer barrier fitting with termiticide.
2. Termiticide brand name and manufacturer.
3. Schedule of inspections for one year from date of Substantial Completion.

E. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

C. Install polymer barrier fittings with termiticide around utility penetrations prior to pouring concrete and after installation and inspection of plumbing and electrical pipes and conduits, slab vapor barrier, and concrete slab reinforcement.

1.07 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

B. Polymer Barrier Fittings with Termiticide Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of installation of polymer barrier fittings with termiticide, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

2.02 POLYMER BARRIER FITTINGS

A. Pipe/Conduit Fitting: Integral 2-1/2-inch- (65-mm-) long polymer sleeve and 1-inch-(25-mm-) wide circular flange with lambda-cyhalothrin termiticide sealed between two outer polymer layers; with fasteners.

B. Tub Trap Fitting: Integral polymer boot and 23-by-23-inch (585-by-585-mm) flange with lambda-cyhalothrin termiticide sealed between two outer polymer layers; with fasteners.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.03 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.04 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

4. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

5. Post warning signs in areas of application.

6. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.05 INSTALLING POLYMER BARRIER FITTINGS

A. Remove any pipe wrap material so that the polymer barrier fittings can be applied directly to the pipe or conduit. After installing the barrier, reapply pipe wrap material both below and above the blocker to protect the pipe from contact with concrete.

B. Install polymer barrier fittings around each utility pipe and conduit penetrating concrete slab and foundation walls according to the EPA-Registered Label for the product and manufacturer's written instructions.

END OF SECTION

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SECTION 02441
IRRIGATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this section.

B. Related work specified or as shown elsewhere:

1. Section 02930 – PLANTING

1.02 SCOPE OF WORK

A. Provide all labor, materials to install the specified Irrigation System as shown on the drawings and stated in the Technical Specifications.

B. Connection to water source on property at location shown on drawings.

1.03 QUALITY ASSURANCE

A. Comply with Federal, State, County, Local and other duly constituted authorities and regulatory agencies.

B. Installation and materials shall conform to the Standards and Specifications for Turf and Landscape Irrigation Systems, Florida Irrigation Society, and the current Uniform Plumbing Code Mechanical Code, state statutes and prevailing county and/or municipal ordinances.

1.04 JOB CONDITIONS

A. Responsibility to the owner: The Contractor shall not willfully install the plumbing irrigation system as specified in the Contract Documents when it is obvious in the field that there are obstructions, grade differences and/or discrepancies in area dimensions until such conditions are brought to the attention of the Landscape Architect.

B. Utilities and Structures: Attention is directed to the fact that overhead, underground and surface utilities, structures and vegetation are in the area of the work and must be protected against damage during the progress of the work.

C. Protection and Safety: The Contractor shall be responsible and liable for the protection and safety against injury of property and persons on or about the project site during the term of his work. The contractor shall provide and properly maintain necessary warning signs and lights, barricades, railings, and other safeguards. The Contractor shall conform to the current Occupational Safety and Health Standards.

D. Site Familiarity: The Contractor shall visit the project site to examine such conditions as soils, vegetation, utilities, structures, water supply, etc., as they will influence the work pursuant to bid submission and/or contract execution.

E. Utility Connections: Location of utility connections shall be shown on the plans or as shown by the utility company. The Contractor shall include in his bid all costs for such utility connections.

1.05 SUBMITTALS

A. Submit the following:

1. Submit proposed work schedule.

2. Product Data: Submit two (2) copies of manufacturer's technical data and installation instructions for underground sprinkler system. Submit samples of all materials and equipment to be installed on the project.

3. Equipment: Submit a schedule of equipment to be installed to include : Automatic controller, zone control valves, gate valves, vacuum breaker valves, Pressure throttle valves, direct burial wire, pop-up rotor heads, pop-up spray heads, fixed shrub heads, bubbler heads, special purpose heads, emitter pipe, filters, fittings and valve boxes.

4. Design Data: Submit any all design data under these specifications for all areas not shown on the irrigation plans that need irrigation rework of the existing system.

1.06 DEFINITIONS AND ABBREVIATIONS

A. The Definitions and abbreviations given here below shall be considered a part of these specifications and shall apply to the interpretation and execution hereof.

1. P.S.I.: Static water pressure shall be given as pounds per square inch abbreviated: P.S.I., and where (1) P.S.I. shall equal 2.31 feet of head.

2. G.P.M.: Volume of water shall be given as gallons per minute abbreviated G.P.M.

3. Zone: A zone shall be defined as a group of heads or emitter pipes operating at the same downstream under a common control valve. A zone shall be derived as further described hereinafter based on available water pressure, volume, and physical location/orientation.

4. P.V.C.: P.V.C shall denote the abbreviation for polyvinyl Chloride (schedule 40) material used in the manufacture of pipe and fittings as further specified hereinafter.

5. Poly pipe and Poly connectors: A flexible polyethylene pipe and fittings used in swing joints, head and pipe connectors and emitter systems.

6. Owner: That entity which holds title or control to the premises on which the work is performed.

7. Landscape Architect: This person or firm is the responsible representative of the owner who produces the landscape and/or irrigation plans and specifications.

8. Contractor: In reference to these specifications, the "Contractor" shall mean the irrigation contractor bidding on and/or being awarded the contract for the work stipulated. Said contractor shall be duly licensed and insured as an irrigation supplier/contractor to perform necessary water supply and distribution function in the state, county and municipality where the work is to be executed.

9. Project: the project as referenced herein shall be the tract of real property where the irrigation system is to be installed.

10. Contract Documents: For the purpose of bid submission, contract agreement and execution of the work, the contact documents shall be binding upon all parties and shall include but not be limited to applicable plans, details, schedules, specifications and bidder instructions.

11. Equivalency: relevant to manufacturer product lines specified herein, equivalents shall be of like type, manufacture, design, material, operation and performance. They shall be approved by the Landscape Architect.

12. The Plans: Design drawings and specifications provided by the Landscape Architect. In the event of conflict between the plans and the written specifications, the plans shall prevail.

PART 2 - MATERIALS

2.01 PRODUCTS

A. All material shall be of new stock and best grade of its kind. It shall be as specified unless otherwise specifically approved by the Landscape Architect. Materials not named shall be subject to approval or rejection by the Landscape Architect. In all cases, workmanship and material shall conform to the local plumbing code having jurisdiction. Materials shall be installed as recommended by the Manufacturer.

B. Available Manufacturers:

1. Subject to compliance with requirements, manufacturers offering products, which may be incorporated in the work, include the following (or approved equivalent):

   a. Rain Bird
   b. Hunter Industries
   c. Netafim

2. If the contractor wishes to use the product from a manufacture that is not in the aforementioned list, an "Approved Equivalent" must be submitted to the Landscape Architect, in writing, a minimum of ten (10) days prior to the bid date. The Landscape Architect will provide either an approval or rejection of all products submitted in this fashion.

C. Plastic Pipe shall be rigid, high impact, Type 1, un-plasticized polyvinyl chloride. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign

materials, blisters, deleterious wrinkles or dents and shall conform to the following dimensions and physical properties:

1. All plastic pipes shall be continuously and permanently marked with manufacturer's name, kind of pipe, material size, IPS, NSF approval, schedule and type.
2. Plastic pipe shall be manufactured by Lasco, Celanese, Pacific Western, Colonial, Universal, or as by specified emitters, at appropriate P.S.I. ratings.
3. Polyethylene pipe to be used for swing joints (for spray heads only), connectors or emitters at appropriate P.S.I. ratings.

D. Pipe fittings:

1. Plastic pipe fittings to be installed shall be medium weight injection molded for virgin Type 2 high impact un-plasticized rigid polyvinyl chloride (P.V.C.) molding compound. All plastic slip couplings shall be extruded fittings from same material as specified for plastic piping herein, unless otherwise approved by the Landscape Architect. Plastic pipe cement shall be recommended by pipe manufacturer.
2. Galvanized pipe and fittings: Where indicated, or required by code, use galvanized steel pipe ASA Schedule 40 mild steel screwed pipe. Fittings shall be medium galvanized screwed, beaded malleable iron. Galvanized couplings may be a merchant coupling.
3. Under Pavement Lines: All piping under concrete and asphalt vehicle pavement, curbs, and unpaved areas subject to other than normal loads shall be rigid P.V.C. Schedule 40.

E. Sprinkler Risers and Connectors:

1. Shrub risers are to be Schedule 40.
2. Pop-up spray connectors (from tee to head base) are to be ½ "Flexible PVC
3. Pop-up rotor connectors (from tee to head base) are to be rigid 3/4" Lasco Swivel Joints

F. Valves:

1. Manufacturer's standard, of type and size required, and as herein further specified, clearly identified with purple markings or labels for Reclaimed Waste Water.
2. Automatic Circuit Valves: Globe or angle configuration valves operated by low power solenoid, normally closed, manual flow adjustment. All electric/hydraulic control valves shall be fully compatible with the automatic controller with respect to the type of control, voltage, amperage or pressure specifications and "normal" sequence positioning.
3. Quick Coupling Valves (if specified): Shall have brass two-piece body designed for working pressure of 150 P.S.I. operable with a quick coupler. Key size and type shall be as shown on the plans or presented in the

equipment schedule. Cover to be clearly identified by purple markings for Reclaimed Waste Water.

G. Sprinkler Heads:

1. Manufacturer's standard unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure. Top of head to be clearly identified with purple markings for Reclaimed Waste Water.

2. Pop-up Spray: Fixed or adjustable pattern, with screw-type flow adjustment and stainless steel retraction spring.

3. Pop-up Rotary Sprays: Gear-driven, full circle and part circle.

H. Valve Boxes:

1. All gate and control valves shall be set in valve boxes with snap lock covers flush with finished grade. Valve boxes shall be "Nelson 8500" or "Ametek".

I. Automatic Control System:

1. The automatic controllers shall be as specified on the Plans or shall be of a capacity as required to efficiently operate the zones throughout the building and parking lot sites. The 120-volt electrical power to the automatic controller's location is to be furnished by the Owner (See Facilities Manager for exact controller location). Irrigation Sub-Contractor shall make all connections in the low-voltage system between the automatic controller and the valves.

2. Schedule the controller time clocks to operate the system control as nearly as possible between the hours of 11:00 P.M. and 7:00 A. M., and on the days required by local watering guidelines for deep well water source systems.

J. Sleeves and Conduits:

1. All pipe and wiring under paving or concrete shall be placed in separate Schedule 40 P.V.C. sleeves and conduit respectively for the full pavement covered length. Sleeves and conduit are to be installed as shown on the Irrigation Plan or determined in the field. Sleeves and conduit shall be of adequate diameter to accommodate the pipe (s) / wire (s) with sufficient free play to allow removal and reinstallation without binding. Water jetting under roads is not permitted.

K. Control Wiring:

1. Connections between the automatic controllers and the electric valves shall be made with direct burial wire AWG-U.F. # 14-600 volts. Use red for pilot wire and white for common wire. Install in accordance with valve manufacturer's specification and wire chart. Wire shall occupy the same trench and be installed along the same route as pressure supply or lateral lines. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of ten (10) feet. When wire only is placed in a trench, place under a continuous strip of subgrade: use pressure treated southern yellow pine,

1”x2”. An expansion curl shall be provided within three (3) feet of each wire connection and at least every hundred (100) feet in length. Expansion curls shall be formed by wrapping at least five (5) turns of wire around a pipe 1” (or more) in diameter, then withdrawing pipe. All splices shall be made with King Dryconn Wire-Nuts. All control wiring or tubing routed beneath or through pavement, walks, curbs and/or other structural elements shall be run through P.V.C. Schedule 40 conduit of sufficient diameter for wire pulling. All conduit and sleeves for irrigation pipes and control wiring shall be installed by the irrigation sub-contractor. The 120 Volt electrical power to the controller location to be furnished by the Owner.

L. Valves:

1. General: Manufacturer’s standard, of type and size required. And/or as specified on the Plans.
2. Gate Valves shall conform to federal specifications WWV 54, Type 1, Class A, with all brass or bronze body, non-rising stem,” Apollo by Lasco”
3. Valves shall be clearly identified with purple markings and labels when reclaimed water is used.
4. Automatic Circuit Valves: Globe or Angle configuration valves operated by low-power solenoid, normally closed, manual flow adjustment. All electric/hydraulic control valves shall be fully compatible with the automatic controller with respect to the type of control voltage, amperage or pressure specifications and “Normal” sequence positioning.
5. Quick Coupling Valves: When specified, shall have a brass two-piece body designed for working pressure of 150 P.S.I. operable with a quick coupler. Key size and type shall be as shown on the plans or presented in the equipment schedule.
6. Other Valves: shall be as stated on the plan.

M. Filters:

1. A Vu-Flow 60 mesh filter is required on all emitter systems. One filter will be required for each source of supply. Filters shall be located underground in an appropriately sized meter box.

N. Backflow Prevention: (if applicable)

1. Backflow prevention shall be approved by the governing body.

O. Emitter Pipe:

1. Emitter pipe shall be manufactured by one of the aforementioned suppliers for the express purpose of subsurface irrigation.
2. Pipe shall have prefabricated irrigation orifices placed 12 inches on center.
3. Emitter pipe, if different from those stated herein, must be approved in writing by the Landscape Architect.

PART 3 - EXECUTION

3.01 SYSTEM DESIGN

A. General:

1. The Contractor shall provide any additional irrigation design data required to complete the Contract Documents. All Contractor submitted design data must provide 100% coverage to all planting and sodded areas to be irrigated as shown on the plans.

B. Design Liability:

1. All irrigation design data provided by the contractor shall be the full liability of the contractor. All such design data shall be consistent with manufacturer's materials and installation methods, code compliance, coverage, application, distribution and operation and the provided plans and technical specifications.

C. Design Pressure:

1. Design pressures should be as recommended by the pipe and fitting manufacturer type of pipe selected, or as indicated on drawings.

D. Emitter Pipe Locations:

1. If design data is required, the Contractor is to provide final layout plans of the emitter system specified to reflect the zone and valve locations, and specified coverage.

2. The application rate shall not exceed the intake rate of the soil, and as recommended by the manufacturer.

3. The system shall provide the capability of accomplishing complete watering of the entire areas, for the particular combination of soil type and vegetation being irrigated, within a period no greater than that currently being recommended by recognized authorities.

4. Friction losses for pipe will be determined by the Hazen-Williams Formula. The retardance coefficient for P.V.C. pipe shall be 150 and for galvanized pipe 100. "C" factors for other products shall be determined from Marks Mechanical Engineers Handbook or other comparable friction loss tables. Maximum water velocity shall not exceed 5 feet per second in any part of the system.

3.02 INSTALLATION

A. Comply with all requirements of the uniform plumbing code.

B. Layout

1. The locations of heads are approximate. Make minor adjustments as necessary to avoid plantings and other obstructions and to obtain coverage. Pipe may be shown in building, concrete, and/or asphalt areas for clarity only. Locate all pipe in planting areas where appropriate.

2. Emitter lines shall be installed as shown on the plans.

C. Excavation/Trenching

1. Trenches shall be dug straight. Trench bottoms shall be true gradient providing support to pipe through its entire length and shall be free from rocks, clods, debris and sharp edged objects. The minimum depth of lines measured to top of pipe, unless otherwise indicated on plans, shall be:

   a. Main lines and quick coupler lines shall be 24".
   b. Lateral sprinkler lines shall be 12"
   c. Non-pressure rotor lines shall be 12".
   d. Top of Emitter lines shall be at grade
   e. Provide minimum cover of 24" for all control wiring.

2. Where required or indicated on the plans existing sod shall be removed where trenches are to be dug, and shall be protected from drying and replaced within 48 hours. Sod shall be cut in such a manner that a minimum of 2" of soil remains on the roots. The soil should be moist, but not wet, to prevent excessive loss due to crumbling. This is Irrigation Sub-Contractor shall have all the responsibilities to maintain sodding and grass, trees, shrubs and plants. As required by Section 02930. This Irrigation Sub-Contractor may, at his option contract with the Landscape, sodding and grass Sub-Contractor to handle this responsibility

3. Back-fill shall not be placed until the installed irrigation system has been thoroughly inspected and tested by the Contractor (the Landscape Architect may request an inspection by his own personnel prior to back filling of trenches).Back-fill material shall be approved soil, free from large rocks, debris, or sharp objects. In general, the material removed from evacuation may be used. Excavated rocky material shall be removed from the site and suitable fill material obtained for back-fill. Back filling shall be done when pipe is not in an expanded or contracted condition due to temperature extremes. Cooling of the pipe can be accomplished by operation of the system for a short time before back-fill, or by back filling in the early part of the morning before the heat of the day. Long runs of P.V.C. pipe shall be "snaked" in the trench to allow for contraction. Back-fill shall follow excavation with the least possible delay. Open trenches shall be adequately protected to cause the least possible hazard to and interference with people and animals. Back-fill shall be compacted in compliance with Earthwork Section. The operation shall be repeated until finished grade of back-filled trenches matches that of adjacent soil.

D. Water Connection:

1. Connect irrigation system to existing source on site. Connection shall include but may not be limited to the installation of appropriate gate valves, shut-off valves, and concrete meter box as required. Coordinate time of connection with affected persons in order to minimize irrigation downtime. Required

modifications and/or relocations of equipment associated with the existing well shall be included in the irrigation work.

2. Municipal and County regulations must be adhered to during this and all other portions of work in this section.

E. Circuit Valves:

1. Provide union on downstream side

2. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

3. Wherever possible, locate valves in plant bed areas for best concealment and accessibility.

4. Valves are to be installed in "Carson" valve boxes, large enough to accommodate maintenance and operation of valves. Provide a ½" diameter river gravel sump 3" thick at bottom of valve pit.

F. Piping

1. Pipe shall be handled and stored in a manner to prevent damage. The plastic pipe and fittings shall be stored under cover, and shall be transported in a vehicle with a bed long enough to allow the length of the pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any plastic pipe that has been dented or damaged shall not be used unless damage has been cut and pipe is rejoined with a coupling.

2. Clean interior of pipe thoroughly and remove all dirt or foreign matter before lowering pipe into trench. Keep pipe clean during operations by plugs or other approved methods. The ends of all threated shall be reamed out full size with a long taper reamer to be partially bell-mouthed and perfectly smooth. All water lines shall be thoroughly flushed out before heads are installed.

3. Lay pipe on solid sub-base, uniformly sloped without humps or depressions.

4. Install P.V.C. pipe in dry weather when temperature is above 40 degrees Fahrenheit in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperatures above 40 degrees Fahrenheit before testing, unless otherwise recommended by manufacturer.

5. Welded joints shall be given at least 15 minutes set-up curing time before moving or handling. Pipe shall be partially center loaded to prevent arching and whipping under pressure. Plastic pipe shall be cut with a handsaw, hacksaw or other tool approved for such use in a manner to insure square ends. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained. All plastic-to -plastic joints shall be solvent-weld joints. Only the solvent recommended by the pipe manufacturer shall be used. The solvent-weld joints shall be made in the following matter:

   a. Thoroughly clean the mating pipe and fitting with a clean dry cloth.
   b. Apply primer to all connections prior to applying solvent. Use only compatible primer following manufacturer's specifications.

c. Apply a uniform coat of solvent to outside of the pipe with a non-synthetic bristle brush. Apply solvent to fitting in a similar matter.

d. Reapply a light coat of solvent to pipe and quickly insert it into the fitting. Give the pipe or fitting a quarter turn to insure even distribution of the solvent and make sure the pipe is inserted to the full depth of the fitting socket.

e. Hold in position for 15 seconds. Wipe off excess solvent that appears at the outer shoulder of the fittings.

f. Care shall be taken so as not to use an excess amount of solvent thereby causing a burr or obstruction to form on the inside of the pipe. The joints shall be allowed to set at least 24 hours before pressure is applied to the system.

G. Pipe jointing, in general, shall be performed by competent tradesmen specially trained in the type of work required and using tools and equipment recommended by the manufacturers of the pipe, fittings or equipment.

H. Galvanized Steel Pipe and Fittings: Threads shall be sound, clean cut, and well fitting. Threated joints shall be made up with the best quality pure joint compound or lead paste, carefully and smoothly placed on the male threads only, remade with new material. Use of thread cement or caulking to make joints tight will not be permitted. All cut ends shall be remade to full bore before assembly.

I. Plastic to Steel Connections: Male thread plastic to female thread steel shall be used. The same shall apply to plastic and brass or other metal. In no case shall metal be screwed into a plastic fitting. A non-hardening pipe dope such as “Permatex No. 2” or equal shall be used on threated plastic to metal joints, and light wrench pressure should be used.

J. Hose bibs:

1. If specified, shall be installed upstream of the electric valve in the same meter box. (Hose bibs may be used with a pressure gauge to check pressure.)

K. Sprinkler Heads and Adjustment:

1. Sprinkler heads shall be installed in a plumb position at intervals not to exceed the maximum spacing specified by the manufacturer for project conditions, or as indicated on the drawings.

2. Heads in turf areas shall be installed 6”away from the edge of the curb or walk, and shall be set 3/8” below the edge of the curb or walk. All heads shall be installed on flexible connectors or swing joints and shall allow for vertical adjustment of heads, 6” pop-up spray heads or 4” pop-up rotors (where appropriate) shall be used in turf areas.

3. All groundcover areas, including mass plantings of dwarf shrubs not exceeding 22”, shall be irrigated with 12” pop up spray heads and extenders.

4. Shrub risers shall only be installed in hedges or mass plantings of large shrubs and are not to extend more than 3” above the installed height of the shrub. If risers are used in hedges abutting parking areas, they must be placed a

minimum of 30”away from back of curb and imbedded in hedge so as not to be seen or damaged by vehicle overhang. All risers and other aboveground piping and fixtures shall be painted with a permanent flat black enamel paint. Stake all risers over 2’ with 1/4” reinforcing rod fastened securely to riser.

5. Provide swings joints on all pop-ups and rotors. Flexible poly pipe may be used as swing joints for spray heads only. All rotor heads shall be installed on appropriate sized rigid Schedule 40 PVC swing joints.

6. Pop-up heads adjacent to vehicle pavement that is not curbed shall be installed with concrete donut protectors set flush with the top of the heads. Heads installed adjacent to pedestrian walk or curbs shall be installed 6” away from the curb or walk. Where adjacent to buildings, fences or similar structures, heads shall be installed 12” away from the structure.

7. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.

3.03 SYSTEM CHECK

A. In no event shall the Contractor cover up or otherwise remove from view any work under this contract that has not been thoroughly inspected and tested, **if required**. If inspections are required, the Owner and/or Landscape Architect shall be present at time of inspection and testing. Any work covered prior to being inspected shall be opened to view by the Contractor at his expense. Notify the Owner and Landscape Architect when testing will be conducted.

B. Pressure Testing: All pressure lines shall be tested prior to back-fill of joints. As soon as lines are connected, flushed out, and valves are attached, cap all outlets and hydrostatically test at available pressure for a continuous 4 hour period, at the end of which the lines and joints will shall be inspected. If leaks develop, the joint or joints shall be replaced, and the test repeated until all leaks are repaired. Any covered pipe, found to leak, shall be excavated and repaired at the Contractor’s expense.

C. Operational Testing: The entire installation shall be placed in operation by the Contractor and tested in the presence of the Owner or his representative for proper functioning as a whole. Location and arc of heads shall be adjusted if required to eliminate any dry spots, over-water or spillage on adjacent areas and to prevent over-spray onto walks, roadways and buildings as much as possible.

3.04 AS BUILT RECORDS AND ADDITIONAL EQUIPMENT

A. Furnish record drawings of “as built” conditions as follows:

1. Location of water supply

2. Tie-in and Owner furnished electrical service and disconnects.

3. Location of valve controllers and other control equipment.

4. Routing and sizing of sprinkler main line.

5. Location and type of sprinkler heads.

6. Location and size of gate and zone control valves.

7. Location of wire-splice boxes.

8. Routing of zone control valve electrical wiring.

9. The location of all "as built" conditions different from the original drawing shall be to scale from permanent points of reference. Exact location of main line, control cables, and control valves shall be shown.

B. The Contractor shall provide as part of this contract, two sets of sprinkler wrenches for adjusting, cleaning or disassembling each type of sprinkler. Two each of any special tools required for any other equipment shall also be furnished.

C. Two (2) service manuals for all equipment used shall be furnished to the Owner. Manuals may be loose-leaf and should show shop drawings or exploded views of equipment and catalog number. Operation instructions for all equipment shall be furnished.

3.05 WARRANTY

A. The Irrigation Sub-Contractor and Contractor shall warranty all Materials employed in the irrigation installation, are installed as specified and is in accordance with best trade practices. The Warranty shall also state there are no unauthorized substitutions of materials.

B. The Irrigation Sub-Contractor and Contractor shall warranty the work for a period of one (1) year.

C. The Contractor shall be responsible to replace all plant materials, which have declined in health or have died due to a defective irrigation system. The contractor shall replace affected plantings with plants of same variety and value within ten days of notice.

D. Corrections: should any trouble develop within the specified warranty period which in the opinion of the owner is due to inferior or faulty materials and/or workmanship, the trouble shall be corrected without delay by the Contractor, to the satisfaction od and at no expense to the Owner.

E. Liability: Any damage to rainwater drains, water supply lines, shall be repaired and made good by the Contractor at no extra cost to the Owner. It is the responsibility of the Contractor to be aware of the location of all utilities or other permanent or non-permanent installations from any damage whatsoever.

END OF SECTION

SECTION 02550
PIPING, FITTINGS, VALVES, AND ACCESSORIES FOR UNDERGROUND UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide all valves and appurtenances, ready for operation, as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

A. All valves, appurtenances, and ancillary equipment shall be products of well-established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

PART 2 - PRODUCTS

2.01 GENERAL

A. All valves, appurtenances, and ancillary equipment shall be of the sizes shown on the Drawings and specified herein.

B. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

C. All valves, appurtenances, and ancillary equipment shall be as specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 AIR RELEASE VALVES

A. For Water Service and Reclaimed Water Service

1. General: Water mains shall be equipped with combination air release valves located as shown on the Drawings. Valves shall be made to remove air at high points where elevation changes exceed 5-feet. Automatic air release valves shall be located at high points for pipe systems greater than 12-inches in diameter.

2. Water and Reclaimed Water Combination Air Release Valves: The valve body shall be 316 stainless steel, 316 stainless steel float, bronze water diffuser Buna-N or Viton seat and stainless steel trim.

3. Fittings from the main to the air release valve shall be threaded and made of brass.

B. For Wastewater Service

1. General: Wastewater force mains shall be equipped with combination air release valves located as shown on the Drawings. Valves shall be made to remove air at high points where elevation change is 2-feet or greater, located in an enclosure as detailed on the Drawings.

2. Wastewater Combination Air Release Valves: The valve body shall be conical in shape and shall be 316 stainless steel with a funnel shape lower body to automatically drain sewage back into the system. All internal parts shall be corrosion resistant 316 stainless steel or non-metallic plastic materials.

3. On flanged connections 316 stainless steel bolts, nuts and washers are to be used along with the proper sized gasket.

C. Air release valves shall be installed in an enclosure.

2.03 TAPPING SLEEVES AND VALVES

A. General: Tapping sleeves shall be mechanical joint sleeves.

B. Mechanical Joint Sleeves: Sleeves shall be cast of gray-iron or ductile-iron and have an outlet flange with the dimensions of the Class 125 flanges shown in ANSI B16.1 and properly recessed for tapping valve. Glands shall be gray-iron or ductile iron. Gaskets shall be vulcanized natural or synthetic rubber. Bolts and nuts shall comply with ANSI/AWWA C111/ANSI A21.11. Sleeves shall be capable of withstanding a 200-psi working pressure.

C. Fabricated Mechanical Joint Tapping Sleeves: Sleeves shall be of split mechanical joint design with separate end and side gaskets. Sleeves shall be fabricated of high strength steel, meeting ASTM A283 Grade C or ASTM A-36. Outlet flange shall meet AWWA C-207, Class "D" ANSI l50-pound drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel to AWWA C111 (ANSI A21.11). Gasket shall be vulcanized natural or synthetic rubber. Sleeve shall have manufacturer applied fusion-bonded epoxy coating, minimum l2-mil thickness.

D. Tapping Valves: Tapping valves shall be resilient seated gate valves flange by mechanical joint ends. Valves shall be compatible with tapping sleeves as specified above and specifically designed for pressure connection operations.

1. Tapping valves with alignment lip shall be placed vertical where possible for Water and Reclaimed Water.

2. Tapping Valves 16-inch and larger shall be AWWA C515 resilient seated only (16-inch and 24-inch no gearing required) above 24-inch shall be installed vertically with a spur gear actuator. When tapping existing mains, valves 24-inch and above shall be furnished with NPT pipe plugs for flushing the tracks.

E. Fabricated Tapping Sleeves for PCCP Pipe: Sleeves shall be saddle type with bolts and straps. Sleeves shall be fabricated of high strength steel, meeting ASTM A283 Grade C or ASTM A-36. Outlet flange shall be combination type with draw flange and valve flange. Valve flange shall be ANSI l50-pound drilling and be properly recessed for the tapping valve. Bolts and nuts shall be 18-8 grade, type 304 stainless steel, coated to prevent galling. Gasket shall be SBR rubber compounded for water and wastewater service. Sleeve shall be completely coated by manufacturer with fusion-bonded epoxy, minimum l2-mil thickness. Sleeve shall be as manufactured by JCM, Smith-Blair or Romac and be specifically suited for PCCP pipe. The Contractor shall coordinate the product and submittal with the Tapping Contractor for compatibility with tapping equipment and tapped pipe material, diameter, surface condition, and field verification. Refer to sections 02282 and 02661R for additional requirements when connecting to buried pipelines.

2.04 VALVE BOXES FOR BURIED VALVES

A. Standard 2-piece Cast Iron Valve Box: Required for mains less than 6-feet below finished grade and less than or equal to 12-inches in diameter.

1. Valve boxes shall be provided with suitable heavy bonnets and shall extend to such elevation at or slightly above the finished grade surface as directed by the County's Representative.

2. The barrel shall be 2-piece, screw type only, having 5-1/4-inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with locking cast iron covers. Coat buried cast iron pieces with coal tar epoxy.

B. Valve Box Assembly: Valve box assemblies with operating nut extension is required for any size main that is 6-feet or greater below finished grade or if mains are greater than 12-inches in diameter.

1. Valve boxes shall be 1 complete assembled unit composed of the valve box and extension stem that attaches and locks to the 2-inch wrench nut. The extension shall be high strength, corrosion resistant steel construction, and permanently attached to the operating nut.

2. The operating nut extension insert shall be 1 complete assembled unit with a self-adjusting extension stem system that fits inside a standard valve box that will accommodate variable trench depths 6-feet and greater as shown in the Drawings. All moving parts of the extension stem shall be enclosed in a housing to prevent contact with the soil.

3. A valve box-centering device designed to eliminate the shifting of the valve box against the operating nut of the valve shall be used. Valve box assembly shall be adjustable to accommodate variable trench depths 6-foot and greater as shown in the Drawings.

C. The stem assembly shall be of a telescoping design that allows for variable adjustment length. The material shall be at minimum galvanized square steel tubing. The stem assembly shall have a built-in device that prevents the stem assembly from

disengaging at its fully extended length. The extension stem must be capable of surviving a torque test to 1,000-foot-pounds without failure.

D. Valve boxes shall have locking cast iron covers utilizing a 5-sided nut with a special wrench needed to open. Covers shall have "WATER", "SEWER", or "RECLAIMED WATER" cast into the top, as applicable

E. Concrete Collar: Each valve installed in an unimproved area (outside of pavement, driveways or sidewalks) shall require a 24-inch by 24-inch by 6-inch concrete pad or collar as shown in the Drawings.

F. Identification Disc: Each 16-inch or larger valve (unless otherwise shown on the Drawings) installed shall be identified by a 3-inch diameter bronze disc anchored in the concrete pad or collar in unimproved areas and/or anchored on a 4-inch by 4-inch by 18-inch long concrete post set flush with the pavement surface in improved areas. The disc shall be stamped with the following information as shown on the Drawings:

1. Size of the valve
2. Type of valve
3. Service
4. Direction and number of turns to open

G. Valve markers are to be made of schedule 80 PVC and have decal applied containing information as shown on the Drawings. The marker shall be the same color as the pipe being marked.

2.05 LINE STOPPING ASSEMBLIES

A. Sleeves used to line-stop existing mains shall be provided and installed at locations as shown on the Drawings. Line-stopping sleeve shall be steel fusion epoxy coated body with stainless steel straps, bolts, nuts, and washers. Contractor shall determine the outside diameter of the existing main prior to ordering sleeve.

B. The line-stopping equipment shall consist of a resilient sealing element, which shall be attached to and transported by a plug inserter perpendicularly into the pipe. The linear actuator shall extend and retract the Line-Stopper into and out of the pipe. When retracted from the pipe, the element and inserter shall be contained within the stopper housing.

C. The hollow cylindrical sealing element shall be molded of natural rubber. The lower interior chamber of the element shall be enlarged into a hemispherical cavity to allow symmetrical deformation into sealing conformity with the bore of the pipe.

D. The linear actuator shall be hydraulic and shall have a self-contained hand operated pump. The actuator shall exert a force sufficient to perpendicularly deform the cylindrical element into axially symmetrical sealing contact with the bore of the pipe. Design of actuator shall provide adequate stroke and means to continually align the line-stop bullet stopping assemblies in sizes 14-inch through 20-inch with pressure rating to 250-psig.

E. Equalization of pressure across the sealed element shall not be required to retract the element from the pipe. No equalization fittings shall be required downstream of the line-stopper.

F. The line-stopping equipment shall be accurately aligned on the 4-inch through 8-inch fittings by locating in the external threads of the fitting nozzle. With sizes 10-inch and 12-inch the location shall be made on the centering groove of the fitting flange.

G. Line-stopping equipment must be capable of function and acceptance of multiple stopper heads and shall be compatible with existing system fittings.

2.06 FIRE HYDRANTS AND VALVE ASSEMBLIES

A. Fire hydrants shall be 5-1/4-inch minimum valve opening and shall comply with the current AWWA Standard Specifications C502-54 for 150-psi working pressure. Fire hydrants shall be of ample length for 3-1/2-foot depth of bury with necessary extensions to place safety flange the required 3-inches above finished grade. Each hydrant shall be made in at least 2 sections bolted together. All interior working parts of the hydrant shall be removable form the top of the hydrant to allow repairs without removing the hydrant barrel after it has been installed. It shall be provided with 2 (two) 2-1/2-inch hose nozzles and 1 (one) 4-1/2-inch pumper nozzle, all having its specific Fire District Standard hose threads. All nozzles shall have caps attached by chains. Operating nuts shall be AWWA Standard. Drain or weep holes shall be permanently plugged by the manufacturer.

B. Fire hydrant painting and coating shall meet the requirements of Section 09900 "Painting." Fire hydrants shall be painted silver in accordance with the present Orange County standards. Three (3) operating wrenches shall be furnished for every 10 hydrants installed or relocated.

C. All hydrant assemblies shall incorporate anchoring hydrant fittings, including M.J. Locked Hydrant Tee with split gland to provide the locking together of the entire assembly. Gate valve shall be as specified in Specification Section 15111 "Plug Valves."

D. All hydrants shall have a 24-inch to 48-inch square by 6-inch thick reinforced concrete shear paid as shown in the Drawings.

E. Fire hydrants shall be located in the general location as shown on the Drawings. Final field location of all hydrants shall be as approved by the County. All hydrants shall be located no less than 5 and no more than 10-feet from the edge of pavement of the adjacent roadway and no less than 5-feet from any physical feature which may obstruct access or view of any hydrant unless otherwise approved by the County.

2.07 SERVICE SADDLES

A. Stainless Steel Service Saddles: Shall be epoxy or nylon coated ductile iron body with stainless steel, 18-8 type 304 straps, AWWA tapered threads for 1-inch and 2-inch to be iron pipe threads. Controlled OD saddles to be used on C905 PVC pipe, double straps to be 2-inch minimum width each, single strap to be minimum of 3-inches wide.

B. PVC Pipe Service Saddle

1. One-inch and 2-inch services utilize brass body saddle with controlled OD for 12-inches and smaller pipe.

2. One-inch and 2-inch taps on existing pipes larger than 12-inches shall use controlled OD epoxy or nylon coated ductile iron body with stainless steel 18-8 type 304 straps.

3. Four-inch or larger services shall be mechanical tapping sleeves.

C. Ductile Iron Pipe Service Saddle

1. One-inch services shall be direct tapped.

2. Two-inch service shall use a controlled OD service tapping saddle with stainless steel straps and a ductile iron body that is either nylon or epoxy coated

3. Four-inch or larger services shall be mechanical tapping sleeves.

D. HDPE Pipe Service Saddle

1. One-inch and 2-inch shall utilize controlled O.D. tapping saddle with epoxy or nylon coated stainless steel 18-8 type 304 double straps.

2. Four-inch or larger, shall use wide body tapping sleeves with a broad cross section gasket set in a retaining groove that increases sealing capability as pressure increases.

E. Concrete Pressure Pipe Service Saddle

1. Tapped concrete pressure pipe shall be in accordance with AWWA M-9, using a strap-type saddle made specifically for concrete cylinder pressure pipe.

F. Steel Pipe Service Saddle

1. Welded-on steel sleeves shall be used for all sizes and applications.

2.08 CORPORATION STOPS AND CURB STOPS

A. Corporation Stops: Shall be brass body reduced port type compatible with the polyethylene tubing and threaded in accordance with AWWA C800, AWWA C901, and shall comply with NSF-61.

B. Curb Stops: Shall be brass body reduced port type compatible with the polyethylene tubing and threaded in accordance with AWWA C800, AWWA C901, and shall comply with NSF-61.

2.09 WATER MAIN AND RECLAIMED WATER MAIN SERVICE PIPE

A. Polyethylene Service Pipe: One-inch and 2-inch service lines shall be polyethylene tubing conforming to AWWA C901 and AWWA C800. Tubing shall be approved for potable water use and bear the seal of the National Sanitation Foundation (NSF). The product shall be rated for a minimum working pressure of 150-psi and a

(Dimension Ratio) DR-9 size. The tubing shall be designated copper tube size and the material PE-2406 cell classification minimum PE213323C in accordance with ASTM 3350.

B. Ductile Iron Service Pipe: Services 4-inch and larger shall be DIP. If the existing main is on the same side of the street as the property to be serviced, the service pipe shall be DIP from the point of connection to the existing main to the meter assembly. If the existing main is on the opposite side of the street as the property to be serviced, at a minimum, the segment of pipe immediately upstream from the meter assembly shall be DIP.

C. No service pipe shall terminate under a driveway.

2.10 PRESSURE GAUGES

A. Pressure gauges shall be installed on each pump station discharge pipe as indicated on the Drawings.

B. Pressure gauge shall be direct mounted, diaphragm (type) gauge, stainless steel case, stainless steel sensing element, liquid filled, with a 4-1/2-inch diameter dial and furnished with a clear glass crystal window and 1/4-inch shut-off (isolation) valve. Gauges shall be weatherproof.

C. The pressure gauge face dial shall be white finished aluminum with jet-black graduations and figures and shall indicate the units of pressure measured in psi. Gauges shall be provided with pressure at normal operation at the mid range of the gauge.

D. As wastewater flows through the housing, the cylinder shall transmit pressure through the sensing liquid. Gauge outlet in the spool or ring shall be threaded, 1/4-inch, per ANSI B2.1.

E. Nipples for connecting gauges to piping shall be Schedule 80S, Grade TP 316 seamless stainless steel, conforming to ASTM A 312. Fittings shall conform to ASTM A 403, Class WP316. Threads shall conform to ANSI B2.1. Size of pipe nipple shall match the gauge connection size.

2.11 TIE RODS

A. Steel for tie rods and tie bolts shall conform to the requirements of ASTM Designation A 242, and rods shall be galvanized in conformance with requirements of ASTM Designation A 123.

2.12 BACK FLOW PREVENTION

A. Reduced Pressure Backflow Preventer shall conform to the requirements of ASSE 1013, rated to 180°F and supplied with full port ball valves. The main body and access covers shall be bronze and meet ASTM B 584, the seat ring and all internal polymers shall be NSF Noryl and the seat disc elastomers shall be silicone.

B. Dual check valves shall be required and shall be accessible for maintenance without removing the relief valve or the entire device from the line.

C. The bottom of the preventer shall be installed a minimum of 12-inches above grade and not more than 30-inches above grade.

2.13 FLANGED COUPLING ADAPTERS

A. All adapters shall be harnessed with the bolts across the joint (flange to flange or flange to lug) designed for the pipe test pressure.

B. Adapter Size: Conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150-pound standard unless otherwise required for connections.

C. Exposed Sleeve Type

1. Material: Steel, ASTM A36

2. Coating: Fusion Bonded Epoxy

3. Bolting: Type 304 stainless steel conforming to ASTM A 193, Grade B8 for bolts, and ATM A 194, Grade 8 for nuts and washers. Bolts and nuts greater than 1-1/8-inches shall be carbon steel, ASTM A 307, Grade B, with cadmium plating, ASTM A 165, Type NS.

4. Acceptable Manufacturers: Dresser Manufacturing Co. - Style 128 for cast iron ductile iron and steel pipes with diameters of 2-inches through 96-inches, or equal.

D. Buried Sleeve Type

1. Material: Steel, ASTM A36

2. Bolting: Type 304 stainless steel conforming to ASTM A 193, Grade B8 for bolts, and ATM A 194, Grade 8 for nuts and washers. Bolts and nuts greater than 1-1/8-inches shall be carbon steel, ASTM A 307, Grade B, with cadmium plating, ASTM A 165, Type NS.

3. Acceptable manufacturers: Smith-Blair 913, 3-inches through 96-inches.

E. Split Type

1. Material: Malleable or ductile iron.

2. Design: For use with grooved or shouldered end pipe.

3. Coating: Fusion Bonded Epoxy

4. Acceptable Manufacturers: Victaulic Company of America - Style 741 for pipe diameters of 2-inches through 12-inches, Victaulic Company of America - Style 742 for pipe diameters of 14-inches through 16-inches, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All ancillary equipment shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the County before installation.

B. After installation, all ancillary equipment shall be tested as specified for adjacent piping. If any joint or equipment proves to be defective, it shall be repaired and retested to the satisfaction of the County.

C. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures, which have a direct bearing on the location and shall be responsible for the proper location of these valves and appurtenances during the Construction of the structures.

D. Notification and Connections to Existing Mains

1. The Contractor shall submit a completed "System Connection" form to the County to schedule the connection. The request shall be made a minimum of 5-working days prior to the proposed tie-in to the existing main for pressure connections and 10-working days prior to the proposed tie-in to the existing main for non-pressure connections. In this request, the Contractor shall provide the following information:

   a. Points of connection, fittings to be used and method of flushing and disinfection if applicable
   b. Estimated construction time for said connections
   c. Identify pressure and non-pressure connections

2. Connections shall only be made on the agreed upon date and time. If the Contractor does not perform the Work in the agreed upon manner or schedule, the Contractor shall be required to reschedule the connection by following the procedure outlined above.

E. Pressure Connections: Sufficient length of main shall be exposed to allow for installation of the tapping sleeve and valve and the operation of the tapping machinery. The main shall be supported on concrete pedestals or bedding rock at sufficient intervals to properly carry its own weight, plus the weight of the tapping sleeve, valve and machinery. Any damage to the main due to improper or insufficient supports will be repaired at the Contractor's expense.

1. The Contractor shall verify that the existing pipe to be tapped is fully restrained in each direction per the pipe manufacturer’s standards. If restraining devices are not verified or found, the Contractor shall restrain the existing piping in a sufficient manner as required. The restraining methods and materials shall be suitable to the existing pipe and joint materials as determined by the Contractor and the Pipe Manufacturer’s standards and shall

be submitted to the Engineer for approval. The Contractor shall be responsible for providing proper pipe restraint required for the existing piping to allow the performance of the tapping work as shown on the drawings.

2. The Contractor shall excavate a dry and safe working area pit of sufficient size to enable the necessary Work. The Contractor shall position the tap to allow proper clearance for the tapping work. Prior to the tap, the Contractor shall assemble all materials, tools, equipment, labor, and supervision necessary to make the connection without delay or interruption.

3. The inside of the tapping sleeve and valve, the outside of the main and the tapping machine shall be cleaned and swabbed or sprayed with 1% liquid chlorine solution prior to beginning installation for water system pressure connections and must comply with AWWA C-651-99 or most current version.

4. After the tapping sleeve has been mounted on the main, the tapping valve shall be bolted to the outlet flange, making a pressure tight connection. Prior to beginning the tapping operation, the sleeve and valve shall be pressure tested under the observation of County personnel to 150-psi for 30-minute duration to ensure that no leakage will occur.

5. For pressure connections 4-inch through 20-inch installation, the minimum diameter cut shall be 1/2-inch less than the nominal diameter of the pipe to be attached. For larger taps, the allowable minimum diameter shall be 2 to 3-inches less than the nominal diameter of the pipe being attached or as noted on the drawings. After the tapping procedure is complete, the Contractor shall submit the coupon to the County.

6. The tapping valve shall be placed horizontally for pressure connections to wastewater force mains. For permanent connections, a plug valve shall be attached to the tapping valve after the tapping procedure is complete. The tapping valve shall be left in the open position prior to backfilling.

7. Adequate restrained joint fittings and restrained pipe joints or other methods as determined by the Contractor shall be provided to prevent movement of the installation when test pressure is applied.

8. The Contractor shall be responsible for properly backfilling the work area pit after the Work is completed.

F. Non-Pressure Dry Connections

1. For water service connections, no customer shall be without service for more than 6-hours. For wastewater connections, provide bypass operations per Section 01516 "Collection System Bypass." This accommodation to customers may include scheduling after Normal Working Hours.

2. The Contractor shall be ready to proceed by pre-assembling as much material as possible at the site to minimize the length of service interruption.

3. Needed pipe restraints must be installed prior to the initiation of the shutdown.

4. The excavation shall be opened and needed site preparations must be completed before the initiation of the connection work.

5. County shall postpone a service cut-off if the Contractor is not ready to proceed at the scheduled time.

6. Only County personnel shall operate the valves needed to perform the shutdown on the existing system.

3.02 PAINTING

A. All exterior surfaces of iron body valves shall be clean, dry, and free from rust and grease before coating.

B. For valves installed underground or in valve vaults, all exterior ferrous parts of valve and actuator shall be coated at the factory with a thermally bonded epoxy coating in accordance with AWWA C550, latest revision.

C. For aboveground service, the exterior ferrous parts of all valves shall be coated in weatherproof paint. The color of the finish coats shall be in accordance with the Orange County Utilities Standards.

END OF SECTION

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SECTION 02570
STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: All labor, materials, and equipment required to install stabilized subgrade.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 02 Section " Finish Grading".

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:

1. AASHTO T-180 – Moisture-Density Relations of Soils Using a 10-lb Rammer and 18-in Drop

B. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition:

1. Section 914 – Stabilization Materials

1.03 QUALITY ASSURANCE

A. Field compaction density, stability, and thickness testing frequencies of the subgrade shall be tested once every 300 linear feet of paving per 24-foot wide strip, staggered left, center, and right of centerline. Where less than 300 linear feet of asphalt is placed in 1-day, provide minimum of one test for each per day's construction at a location designated by the County.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Materials certificates signed by material producer and Contractor, certifying that each material item complies with specified requirements.

1.05 SYSTEM DESCRIPTION

A. Stabilize the roadbed below the proposed base to provide a firm and unyielding subgrade.

B. Provide a finished roadbed section that meets the bearing value requirements regardless of the quantity of stabilizing materials necessary to be added.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied, when applicable, shall be one of the products specified in the FDOT Approved Product List (Latest Edition). The list can be found at the FDOT web page: https://fdotwp1.dot.state.fl.us/ApprovedProductList/

B. The Contractor may choose the type of stabilizing material.

C. Materials may be lime rock, shell rock, cemented coquina, or shell-base sources approved by the FDOT.

D. At least 97% by weight of the total material shall pass a 3-1/2-inch (90-mm) sieve. Material having a plasticity index greater than 10 or a liquid limit greater than 40 shall not be used as a stabilizer.

2.02 LIMEROCK

A. For limerock, carbonates of calcium and magnesium shall be at least 70%.

2.03 CRUSHED SHELL

A. Crushed shell for this use shall be mollusk shell (i.e., oysters, mussels, clams, cemented coquina). Steamed shell will not be permitted.

B. At least 50% by weight of the total material shall be retained on the No. 4 (4.75 µm) sieve.

C. Not more than 20% by weight of the total material shall pass the No. 200 (75 µm) sieve. The determination of the percentage passing the No. 200 (75 µm) sieve shall be by washing only.

2.04 LOCAL MATERIALS

A. Local materials used for this stabilizing may be soils or recyclable materials such as crushed concrete, roof tiles, asphalt coated base, or reclaimed pavement. However, no materials that deteriorate over time, cause excessive deformations, contain hazardous substances, contaminates, or do not improve the bearing capacity of the stabilized material may be used.

PART 3 - EXECUTION

3.01 GENERAL

A. Prior to the beginning of stabilizing operations, construct the area to be stabilized to an elevation such that, upon completion of stabilizing operations, the completed stabilized subgrade will conform to the lines, grades, and cross-section shown in the plans. Prior to spreading any additive stabilizing material, bring the surface of the

roadbed to a plane approximately parallel to the plane of the proposed finished surface.

B. Process the subgrade to be stabilized in one course, unless the equipment and methods being used do not provide the required uniformity, particle size limitation, compaction, and other desired results, in which case, the County will direct that the processing be done in more than one course.

3.02 APPLICATION OF STABILIZING MATERIAL

A. When additive stabilizing materials are required, spread the designated quantity uniformly over the area to be stabilized.

B. When materials from an existing base are to be used in the stabilizing at a particular location, place and spread all of such materials prior to the addition of other stabilizing additives.

C. Spread commercial stabilizing material by the use of mechanical material spreaders, except that where use of such equipment is not practicable, use other means of spreading, but only upon written approval of the proposed alternate method.

3.03 MIXING

A. Perform mixing using rotary tillers or other equipment meeting the approval of the County. The Contractor may mix the materials in a plant of an approved type suitable for this Work. Thoroughly mix the area to be stabilized throughout the entire depth and width of the stabilizing limits.

B. Perform the mixing operations as specified (either in place or in a plant) regardless of whether the existing soil, or any select soils placed within the limits of the stabilized sections, have the required bearing value without the addition of stabilizing materials.

3.04 MAXIMUM PARTICLE SIZE OF MIXED MATERIALS

A. At the completion of the mixing, ensure that the gradation of the material within the limits of the area being stabilized is such that 97% will pass a 3-1/2-inch sieve and that the material does not have a plasticity index greater than 8 or liquid limit greater than 30. Note that clay balls or lumps of clay size particles (2 microns or less) cannot be considered as individual particle sizes. Remove any materials not meeting the plasticity requirements from the stabilized area. The Contractor may break down or remove from the stabilized area materials not meeting the gradation requirements.

3.05 COMPACTION

A. Compact the materials at a moisture content permitting the specified compaction. If the moisture content of the material is improper for attaining the specified density, either add water or allow the material to dry until reaching the proper moisture content for the specified compaction.

3.06 FINISH GRADING

A. Shape the completed stabilized subgrade to conform to the finished lines, grades, and cross-section indicated in the Drawings. Check the subgrade using elevation stakes or other means approved by the County.

3.07 CONDITION OF COMPLETED SUBGRADE

A. After completing the stabilizing and compacting operations, ensure that the subgrade is firm and substantially unyielding to the extent that it will support construction equipment and will have the bearing value required by the Drawings.

B. Remove all soft and yielding material, and any other portions of the subgrade that will not compact readily. Replace yielding material with suitable material so that the whole subgrade is brought to line and grade with proper allowance for subsequent compaction.

3.08 MAINTENANCE OF COMPLETED SUBGRADE

A. After completing the subgrade, maintain it free from ruts, depressions, and any damage resulting from the hauling or handling of materials, equipment, and tools. The Contractor is responsible for maintaining the required density until the subsequent base or pavement is in place including any repairs or replacement of curb and gutter or sidewalk which might become necessary in order to recompact the subgrade in the event of underwash or other damage occurring to the previously compacted subgrade. Perform any such recompaction at no expense to the County. Construct and maintain ditches and drains along the completed subgrade section.

3.09 FIELD QUALITY CONTROL

A. When proper moisture conditions are attained, compact the material to not less than 98% of maximum density determined by AASHTO T-180, and a minimum LBR of 40.

END OF SECTION

SECTION 02571
LIMEROCK BASE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish and install a base course composed of limerock.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:

B. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest implemented edition.

1.03 QUALITY ASSURANCE

A. Density, thickness, and moisture content shall be determined and tested in accordance with this specification.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Lime rock design mix.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied, when applicable, shall be one of the products specified in the FDOT Approved Product List (Latest Edition). The list can be found at the FDOT web page: https://fdotwp1.dot.state.fl.us/ApprovedProductList/

2.02 MATERIALS

A. The minimum of carbonates of calcium and magnesium in the limerock material shall be 70%.

B. The maximum percentage of water-sensitive clay mineral shall be 3%.

C. The liquid limit shall not exceed 35 and the material shall be non-plastic.

D. Limerock material shall not contain cherty or other extremely hard pieces, lumps, balls, or pockets of sand or clay size material in sufficient quantity as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

E. At least 97% (by weight) of the material shall pass a 3-1/2-inch sieve and the material shall be graded uniformly to dust. The fine material shall consist entirely of dust of

fracture. All crushing or breaking-up which might be necessary in order to meet such size requirements shall be done before the material is placed on the road.

F. Limerock shall have an average LBR of not less than 100.

PART 3 - EXECUTION

3.01 GENERAL

A. The limerock shall be transported to the point where it is to be used, over rock previously placed if practicable, and dumped on the end of the preceding spread. Hauling over the subgrade and dumping on the subgrade will be permitted only when, in the County's opinion, these operations will not be detrimental to the base.

3.02 SPREADING LIMEROCK

A. The limerock shall be spread uniformly. All segregated areas of fine or coarse rock shall be removed and replaced with properly graded rock.

B. When the specified compacted thickness of the base is greater than 6-inches, the base shall be constructed in two courses. The thickness of the first course shall be approximately one-half the total thickness of the finished base, or enough to bear the weight of the construction equipment without disturbing the subgrade.

C. All operations for constructing limerock base for shoulder construction at any particular location shall be done prior to placing the final course of pavement on the traveled roadway. In the construction of limerock base on the shoulders, the Contractor shall assure that the dumping of the limerock material shall be at such points and in such manner, that no significant material is allowed on the adjacent pavement, to scar or contaminate the pavement surface. Any limerock material deposited on the surface course for any reason shall be immediately swept off.

3.03 COMPACTING AND FINISHING BASE

A. For single course base, after the spreading is completed, the entire surface shall be scarified and shaped to produce the required grade and cross section after compaction.

B. For double course base, the first course shall be cleaned of foreign material and bladed and brought to a surface cross section approximately parallel to that of the finished base. Prior to the spreading of any material for the upper course, the density tests for the lower course shall be made and the County shall have determined that the required compaction has been obtained. After the spreading of the material for the second course is completed, its surface shall be finished and shaped to produce the required grade and cross section after compaction, and free of scabs or laminations.

C. When the material does not have the proper moisture content to insure the required density, wetting or drying will be required. When water is added, it shall be uniformly mixed in by disking to the full depth of the course compacted. Wetting or drying operations shall involve manipulation, as a unit, of the entire width and depth of the course compacted.

D. As soon as proper conditions of moisture are attained, the material shall be compacted to a density of not less than 98% of maximum density as determined by AASHTO T-180. The minimum density acceptable at any location outside the traveled roadway (such as intersections, crossovers, turnouts, shoulders, etc.) shall be 98% of such maximum.

E. At least three density determinations shall be made on each day's final compaction operations on each course. The density determinations shall be made more frequently if deemed necessary by the County. During final compaction operations, if grading of any areas is necessary to obtain the true grade and cross section, the compacting operations for such areas shall be completed prior to making the density tests on the finished base.

3.04 CORRECTION OF DEFECTS

A. If at any time the subgrade material should become mixed with the base course material, the Contractor shall dig out and remove the mixture, reshape and compact the subgrade, and replace the materials removed with clean base material, without additional compensation.

B. If cracks or checks appear in the base, either before or after priming, which in the opinion of the County would impair the structural efficiency of the base, the Contractor shall remove the cracks or checks by re-scarifying, reshaping, adding base material where necessary, and re-compacting.

3.05 TESTING SURFACE

A. The finished surface of the base course shall be checked with a template cut to the required crown and a 15-foot straightedge placed parallel to the centerline of the road. Both templates shall be provided by the Contractor. All irregularities greater than 1/4-inch shall be corrected by scarifying and removing or adding limerock as required, after which the entire area shall be re-compacted.

3.06 PRIMING AND MAINTAINING

A. The prime coat shall be applied when the base meets the specified density requirements and moisture content in the top half of the base does not exceed 90% of the optimum moisture of the base material. At the time of priming, the base shall be firm, unyielding, and in such condition that no undue distortion will occur.

B. The Contractor shall be responsible for assuring that the true crown and template are maintained, with no rutting or other distortion, and the base meets all the requirements at the same time the surface course is applied.

3.07 THICKNESS REQUIREMENTS

A. Thickness of the base shall be measured in intervals of not more than 200-feet. Measurements shall be taken at various points on the cross section, through holes not less than 3-inches in diameter.

B. Where the compacted base is deficient by more than 3/8-inches from the thickness called for in the Drawings, the Contractor shall correct such areas by scarifying and

adding limerock. The base shall be scarified and limerock added for a distance of 100-feet in each direction from the edge of the deficient area. The affected areas shall then be brought to the required state of compaction and to the required thickness and cross section.

END OF SECTION

SECTION 02572
SOIL CEMENT BASE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish and install base course using a combination of soil, Portland cement, and water.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 02 Section " Finish Grading".
4. Division 02 Section " Stabilized Subgrade".
5. Division 02 Section "Soil Cement Base".

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:

1. AASHTO T-88: Particle Size Analysis of Soils
2. AASHTO T-89: Determining the Liquid Limit of Soils
3. AASHTO T-90: Determining the Plastic Limit and Plasticity Index of Soils
4. AASHTO T-134: Moisture-Density Relations of Soil-Cement Mixtures
5. AASHTO T-135: Wetting and Drying Test of Compacted Soil-Cement Mixtures
6. AASHTO T-267: Determination of Organic Content in Soils by Loss on Ignition

B. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest implemented edition:

1. Specification Section 911: Limerock Material for Base and Stabilized Base
2. Specification Section 916: Bituminous Materials
3. Specification Section 921: Portland Cement and Blended Cement

1.03 QUALITY ASSURANCE

A. For density and thickness determination, a LOT is defined as 2,500 square yards of base, plus any small section of base at the end of a day's operation in the preceding LOT. The County may include small irregular areas as part of another LOT. Areas such as an intersection, crossover, and ramp will be considered as a separate LOT.

No LOT shall include more than 3,500 square yards or it shall be considered as a separate LOT.

B. Five (5) density tests shall be performed at locations randomly selected by the County within each LOT.

C. Five (5) thickness measurements shall be performed at locations randomly selected by the County within each LOT. Three-inch minimum diameter test holes are required to determine the thickness.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Soil-cement design mix

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Cement shall be Portland cement, Type I, II, III, or Type 1-P per FDOT Specification Section 921.

B. Use water that is free from substances deleterious to hardening of the soil-cement mixture.

C. Curing Material shall be per FDOT Specification Section 916.

D. Emulsified asphalt shall be Grade SS, RS, or MS as approved by the County. Dilute as recommended by the manufacturer.

E. Soils for base course construction shall be either limerock material per FDOT Specification Section 911 or soils meeting the following requirements:

Table 02572-1
Soil Requirements

Physical Characteristic	Acceptance Level	Testing Standard
Organic Material	Maximum 5%	AASHTO T-267
Total Clay and Silt Content (Minus No. 200 Sieve)	Maximum 25%	AASHTO T-88
Plastic Index	Maximum 10%	AASHTO T-90
Liquid Limit	Maximum 25%	AASHTO T-89

Table 02572-2
Soil Gradation Requirements

Soil Gradation Requirements (Per AASHTO T-88)	
Passing 2-inch sieve	Minimum 100%
Passing No. 4 sieve	Minimum 55%
Passing No. 10 sieve	Minimum 37%

2.03 PROPORTIONING OF MIX

A. Submit for approval a design mix for the soil proposed for use in soil-cement construction prepared by a testing laboratory approved by the County. The design mix submittal shall include the results of tests run to verify that the soil meets the requirements; results of tests used to establish the cement content; and a final design laboratory sample. Submit the design mix to the County for approval a minimum of 60-calendar days prior to beginning of soil-cement construction for Brush Loss Design Method or 15-calendar days prior to beginning of soil-cement construction for Strength Design Method. Express the cement as a percentage of the dry unit weight of the soil. For mixed-in-place construction, use a ratio of cement based on the maximum density of the soil determined in accordance with AASHTO T-99 and rounded up to the nearest pound per cubic yard.

B. When proportioning the soil-cement mixture in accordance with strength design, determine the minimum cement content using FM 5-520. The design compressive strength specified shall be achieved in 7-days. Ensure that the cement content is not less than 5% by weight except as noted below.

C. When proportioning the soil-cement mixture in accordance with Brush Loss Design criteria, determine the minimum cement content in accordance with AASHTO T-135. Ensure that the cement content is not less than 5% by weight except as noted below. Ensure that the soil-cement loss at the completion of 12 cycles of testing conforms to the limits in the following table.

Table 02572-3
Soil Limits

Soil Group	Limits
AASHTO Soils Groups A-1, A-2-4, A-2-5, and A-3	Not over 14%
AASHTO Soils Groups A-2-6, A-2-7, A-4, and A-5	Not over 10%
AASHTO Soils Groups A-6 and A-7	Not over 7%

D. When proportioning of soil-cement mixture by the Brush Loss Design Criteria Method and processing by Central-Plant-Mixing where the requirements noted below are met, the County will not require strength testing of field specimens. Verify the properties of the parent material during the processing, on a random frequency, to ensure that the final mix has not changed from the original design. Provide the County a printout of each day's production that shows proportioning of the mixture meets the approved Brush Loss Design, including cement.

E. Do not apply the minimum 5% cement content specified above if obtaining the soil material used in producing a soil-cement mixture from a commercial source (not to exclude recycled materials) where soil properties are consistently uniform, and if processing the mixture in a central mix plant that automatically weighs components and automatically records the weight of each component on a printed ticket, tape, or other digital record.

PART 3 - EXECUTION

3.01 GENERAL

A. Use any machine, combination of machines, or equipment that is in good, safe working condition and that will produce results meeting the requirements for cement application, soil pulverization, mixing water application, compaction, finishing, and curing, as required herein. Compaction equipment shall be used that will produce a base at the required density.

3.02 SUBGRADE PREPARATION

A. Subgrade shall be completed before beginning base construction operations. Ensure that the subgrade is firm enough to support the equipment used in the soil-cement base operations without appreciable distortion or displacement. Remove any unsuitable material and replace it with suitable material.

B. When constructing the base with central-plant-mixed soil-cement, grade and shape the subgrade to the lines, grades, and typical cross-section shown in the plans. Ensure that the subgrade is moist but not ponded at the time of placing the mixed base course material.

3.03 BASE SOIL FOR MIXED-IN-PLACE PROCESSING

A. Grade and shape the area over which the base is to be constructed to an elevation that will provide a base in conformance with the grades, lines, thickness, and typical cross-sections shown on the plans. Remove all roots, sticks, and other deleterious matter during processing.

3.04 PROCESSING OF SOIL-CEMENT MIXTURE

A. Mix the soil, cement, and water either by mixed-in-place or central-plant-mix methods.

B. Do not allow the percentage of moisture in the soil at the time of cement application to exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations.

C. During seasons of freezing temperature, do not spread any cement or soil-cement mixture unless the ambient temperature is at least 40°F in the shade.

D. At the completion of moist-mixing, pulverize the soil so that 100% passes a 1-1/2-inch sieve, 95 to 100% passes the 1-inch sieve and a minimum of 80% passes a No. 4 sieve, exclusive of gravel, shell, or stone.

E. Operations shall be completed within a period of 4-hours starting at the time mixing commences.

3.05 MIXED-IN-PLACE METHOD

A. Where feasible, process the entire width of the base in a single operation. Uniformly spread the design quantity of cement on the soil at the required rate of application, by means of an approved method. Replace spread cement that becomes displaced before starting mixing. Check the uniformity of spread rate by:

1. Weight of cement spread/square yards covered for a short trial section that is between 100 and 300-feet in length; or

2. Use of a square yard cloth/box

B. After applying the cement, begin mixing within 60-minutes. Initially mix the soil and cement until the cement has sufficiently blended with the soil to prevent formation of cement balls when applying additional water; then add water if necessary, and re-mix the soil-cement mixture. Do not perform windrow mixing.

C. Process up to the full depth in 1 course, provided the distribution of cement and water and the specified density are satisfactory to the County. If not, construct courses of such thickness to obtain satisfactory results. Make provisions to achieve adequate bonding between courses.

D. Immediately after mixing of the soil and cement, add any additional water that is necessary. If the moisture content exceeds that specified, manipulate the soil-cement mixture by re-mixing or grading as required to reduce the moisture content to within the specified range. Avoid excessive concentrations of water. Continue mixing during and after applying water until obtaining a uniform mixture of soil, cement, and water.

E. As an alternative to the above-described procedure, the Contractor may use an approved machine that will blend the cement and the soil. Additional water may be added and mixed as necessary.

3.06 CENTRAL-PLANT-MIXED METHOD

A. Mix the soil, cement, and water in a pugmill of either the batch or continuous-flow type. Equip the plant with feeding and metering devices that will accurately proportion the soil, cement, and water in the quantities specified. Mix soil and

cement sufficiently to prevent cement balls from forming when adding additional water. Continue mixing until obtaining a uniform mixture of soil, cement, and water.

B. Haul the mixture to the roadway in trucks equipped with protective covers. Place the mixture on the moistened subgrade in a uniform layer with suitable equipment. Do not allow more than 60-minutes to elapse between placing of soil-cement in adjacent passes of the spreader at any location, except at construction joints. Ensure that the layer of soil-cement is uniform in thickness and surface contour and in such quantity that the completed base will conform to the required grade and cross-section. Do not perform windrow mixing.

3.07 CONSTRUCTION JOINTS

A. Prior to joining any previously constructed section of base, form a vertical construction joint by cutting back into the completed work to form a true vertical face of acceptable soil-cement to the full depth of the base course. Moisten the vertical face as needed prior to placing new material against it.

3.08 SHAPING AND FINISHING

A. Prior to final compaction, shape the surface of the soil-cement to the required lines, grades, and cross-section. In all cases where adding soil-cement mixture to any portion of the surface, lightly scarify the surface with a spring tooth harrow, spike drag, or other approved device to uniformly loosen the surface prior to adding material and prior to the initial set of the soil-cement mixture. Compact the resulting surface to the specified density. Continue rolling until all rutting ceases and until the base conforms to the density requirements.

B. Ensure that the surface material is moist but not ponded, and maintained at not less than 2% below its specified optimum moisture content, during finishing operations. Perform surface compaction and finishing in such a manner as to produce a smooth dense surface, free of compaction planes, construction cracks, ridges, and loose material.

C. If the time limits specified above are exceeded, either remove and replace the base or leave the base undisturbed for a period of 7-days, after which, the County will examine it to determine its suitability. If found unsuitable, remove and replace the base at no additional cost to County.

3.09 COMPACTION

A. Begin compacting the soil-cement mixture immediately after mixing or placing. Do not allow more than 30-minutes to elapse between the last pass of moist-mixing or spreading and the start of compaction of the soil-cement mixture at a particular location.

B. Determine the optimum moisture content and the maximum density in the field by the methods prescribed in AASHTO T-134 on representative samples of the soil-cement mixture obtained immediately after the initial mixing. Determine the density for each day's run or change of material.

C. Uniformly compact the loose material to meet the density requirements specified below. During compaction operations, reshape the material to obtain required grade and cross-section.

3.10 PROTECTION AGAINST DRYING

A. While finishing and correcting the surface, keep the surface of the base continuously moist by sprinkling water as necessary until applying the emulsified asphalt curing material. As soon as practicable, protect the base from drying for 7-days by applying the emulsified asphalt at the rate of 0.20 to 0.25-gallons of the diluted mixture per square yard. Provide complete coverage without excessive runoff. While applying the bituminous material, ensure that the soil-cement surface is dense, free of all loose and extraneous material, and contains sufficient moisture to prevent excessive penetration of the bituminous materials.

B. If it is necessary to allow construction equipment or other traffic to use the completed base before the bituminous material has cured sufficiently to prevent pickup or displacement, sand the bituminous material, using approximately 10-lbs of clean sand per square yard. Do not use cover material containing organic acids or other compounds detrimental to the soil-cement base.

C. Maintain the curing material during the 7-day protection period.

3.11 OPENING TO TRAFFIC

A. Do not allow traffic on the base subsequent to completion of the finishing operations for a minimum period of 72-hours. As an exception to this requirement, allow equipment necessary for correction of surface irregularities, application of water, and application of curing materials on the base, if the tire contact pressures of such equipment do not exceed 45-psi. Under special conditions (i.e. low speed limit, low traffic volume, urban conditions), the County may waive the 72-hour period.

3.12 MAINTENANCE

A. Maintain the base to a true and satisfactory surface until the wearing surface is constructed. If the County requires any repairing or patching, extend the repair or patch to the full depth of the base, and make them in a manner that will ensure restoration of a uniform base course in accordance with the requirements of these Specifications. Do not repair the base by adding a thin layer of soil-cement or concrete to the completed work. Make full depth repairs to small or minor areas, such as at manholes or inlets, with Class I concrete.

B. For patching of deficient areas less than 100-square feet and less than 1-inch in depth, correct the areas using Type S-III Asphalt Concrete. For patching of deficient areas less than 100-square feet and greater than 1-inch in depth, remove the areas to full depth and replace them using Asphalt Base Course Type 3, Type S Asphaltic Concrete, or soil-cement.

3.13 DENSITY TESTING REQUIREMENTS

A. As soon as possible after completing compaction, perform field density testing to ensure that the density is 97% of the maximum density as determined by methods prescribed in AASHTO T-134.

B. If an individual test value within a LOT is less than 94% of the maximum density, determine the extent of this deficiency by performing density tests using a 5-foot grid pattern until a test value of 95% or greater is located in all directions. Remove the delineated area of base, and replace it with base meeting all requirements of this section, at no cost to the County.

C. As an exception to the foregoing, if 3 or more of the original 5 individual test values within a LOT are less than 94% of the maximum density, the County will reject the entire LOT, and the Contractor shall remove all base within the LOT and replace it with base meeting all requirements of this Section, at no expense to the County.

3.14 SURFACE FINISH ACCEPTANCE REQUIREMENTS

A. After compacting and finishing, and not later than the beginning of the next calendar day after constructing any section of base, measure the surface with a template cut to the required cross-section and a 15-foot straightedge placed parallel to the centerline of the road. Both templates shall be provided by the Contractor. Correct all irregularities greater than 1/4-inch to the satisfaction of the County with a blade adjusted to the lightest cut which will ensure a surface that does not contain depressions greater than 1/4-inch under the template or the straightedge. The County may approve other suitable methods for measurement.

3.15 THICKNESS ACCEPTANCE REQUIREMENTS

A. Construction tolerances for thickness are as follows:

Table 02572-4
Thickness Tolerances

	Allowable Deviation From Plan Thickness
Central-Plant-Mixed Processing	-1-inch
Mixed-in-Place Processing	+/- 1-inch

B. When any thickness measurement is outside the construction tolerance, the County will take additional thickness measurements at 10-foot intervals parallel to the centerline in each direction from the measurement which is outside the construction tolerance until a measurement in each direction is within the construction tolerance.

C. The County will evaluate an area of base found to have a thickness outside the construction tolerance and may require the Contractor to remove and replace it with acceptable base of the thickness shown in the plans at no expense to the County.

3.16 STRENGTH TESTING OF FIELD SPECIMENS

A. Check the adequacy of cement content and uniformity of distribution of cement within the base by sampling and testing the completed mix.

B. Take samples at the project site just prior to final compaction and perform a minimum of 2 Strength Test Values (STV) each day, with at least 1 STV per each 2,500 square yards mixed.

C. Ensure that each STV is the average strength value of a minimum of 3 individual specimens.

D. Take representative samples of the mixed soil-cement material for determining an STV just prior to final compaction, recording the sample location, and ensuring that the samples are large enough to mold 3 or more compressive strength test specimens as prescribed in FM 5-520.

E. Mold test specimens at the field moisture content and cast the individual test specimens as close to identical as possible

F. Rest the molds during compaction of strength test specimens on a 200-pound concrete block that the Contractor provides.

G. Gently extrude these test specimens from the compaction mold, and carefully place them in a moist curing environment (not in direct contact with water) such as a tightly closed container under wet cloth or burlap at locations where they will not be disturbed.

H. Continue the initial field cure for at least 24-hours, and if after 24-hours it is determined that the specimens have not gained sufficient strength to be moved without probable damage, continue field curing until the County determines that each specimen can be safely moved without probable damage occurring. When the County determines that the specimens can be safely moved, transport them to the laboratory where they will be cured, as described in the design procedure (FM 5-520), to 7-days of age. At 7-days of age, test the individual specimen for determination of compressive stress and ensure that the loading procedure and rates are the same, as described in FM 5-520.

I. If an STV is less than 60% of the Laboratory Design Strength, remove and replace the material represented by the STV, at no expense to the County.

J. When the LOT average thickness of soil-cement base is deficient by more than 1-inch and the judgment of the County is that the area of such deficiency should not be removed and replaced, payment for the area retained will be at 50%.

K. When multiple deficiencies occur, the applicable percent payment schedule will be applied to the LOT of base that is identified with each deficiency. The penalty for each deficiency will be applied separately to the unit price.

END OF SECTION

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SECTION 02573
ASPHALT PAVEMENT REMOVAL AND REPLACEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Mill or remove existing asphalt pavement and base materials and install asphalt paving on a prepared base or as an overlay to existing asphalt pavement sections. Provide Maintenance of Traffic. Coordinate and install temporary and permanent replacement of traffic signalization and pavement striping and markings.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 02 Section " Finish Grading".
4. Division 02 Section " Standardize Subgrade".
5. Division 02 Section " Asphalt Pavement Removal and Replacement".

1.02 REFERENCES

A. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, 2017 edition.

1. Section 300 – Prime and Tack Coats for Base Courses (2017 Edition)
2. Section 320 – Hot Mix Asphalt – Plant Methods, and Equipment (2017 Edition)
3. Section 327 – Milling of Existing Asphalt Pavement (2017 Edition)
4. Section 330 – Hot Mix Asphalt – General Construction Requirements (2017 Edition)
5. Section 334 – Superpave Asphalt Concrete (2017 Edition)
6. Section 901 – Coarse Aggregate (2017 Edition)
7. Section 902 – Fine Aggregate (2017 Edition)
8. Section 916 – Bituminous Materials (2017 Edition)
9. Section 917 – Mineral Filler (2017 Edition)

B. Florida Department of Transportation (FDOT) Design Standards, 2017 edition.

1.03 QUALITY ASSURANCE

A. Asphalt pavements shall be plant-mixed hot bituminous mixtures. Plant operations shall not begin unless all weather conditions are suitable for laying operations. A prime and tack coat shall be first applied to newly constructed bases. A tack coat shall be applied on existing pavements that are to be overlaid with an asphalt mix and between successive layers of asphalt mix. Apply prime and tack coats when ambient or base surface temperature is above 40°F, and when temperature has been above

35ºF for 12-hours immediately prior to application. Construct asphaltic concrete paving when ambient temperature is above 45°F. Do not apply when base is wet, contains excess moisture, or during rain. Establish and maintain required lines and elevations.

B. Do not spread the mixture when the wind is blowing to such an extent that proper and adequate compaction cannot be maintained or when sand, dust, etc., are being deposited on the surface being paved to the extent that the bond between layers will be diminished.

C. Field compaction density and thickness testing frequencies of the asphalt shall be tested once every 300-linear feet of paving per 24-foot wide strip, staggered left, center, and right of centerline. Where less than 300-linear feet of asphalt is placed in 1-day, provide minimum of one test for each per day's construction at a location designated by the County.

D. Asphalt extraction gradation shall be tested from grab samples collected once every 1,800-square yards of asphalt delivered to the site, or a minimum of once per day. Obtain the results in a timely manner (no later than the end of the day) so that adjustments can be made if necessary.

E. On initial use of a Superpave mix design at a particular plant, as a minimum, run an additional extraction gradation analysis if more than 500-tons [450-metric tons] of mixture are produced on the first day of production.

F. Tolerances for Quality Control Tests (Extraction Gradation Analysis) shall be in accordance with FDOT Specification Section 334.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Submit for each proposed design mix the Gradation analysis; Grade of asphalt cement used; and Marshall Stability in pounds flow.

2. Provide a single percentage of asphalt by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1%. For structural mixes (S-1, S-3) establish the optimum asphalt content at a level corresponding to a minimum of 4.5% air voids. Provide the laboratory density of the asphalt mixture for all mixes except Open-Graded Friction Courses.

3. Identify source and description of the materials to be used.

4. Provide certification that the mix design conforms to specification requirements.

5. Field compaction density and thickness testing.

6. Field asphalt extraction gradation.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied, when applicable, shall be one of the products specified in the FDOT Approved Product List (Latest Edition). The list can be found at the FDOT web page: https://fdotwp1.dot.state.fl.us/ApprovedProductList/

B. Must meet the requirements of "Section 334 Super Pave Concrete" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition, and all other sections referenced in Section 334 Super Pave Concrete.

PART 3 - EXECUTION

3.01 GENERAL

A. Set up, install and maintain temporary traffic control devices and detours as necessary in accordance with Specification Section 1570 "Maintenance of Traffic."

B. Asphalt pavements, including all surface courses and base courses, where shown to be open cut and removed on the Drawings or specified in the Project Manual, shall be removed to a line back from each edge of the trench, other excavation, or to the limits indicated on the Drawings. Pavements shall be cut straight, clean and square with a power saw or other tools and equipment suitable for the Work.

C. Asphalt pavements, where shown to be milled on the Drawings or specified in the Project Manual, shall be milled according to FDOT Specification Section 327.

D. Asphalt mixtures shall meet the general construction requirements specified in FDOT Specification Section 330.

E. Spread the mixture only when the surface upon which it is to be laid has been previously prepared, is intact, firm, and properly cured, and is dry. Do not spread mixture that cannot be finished and compacted during daylight hours.

F. Deliver the asphalt cement from the asphalt plant at a temperature not to exceed 350°F and equip the transport tanks with sampling and temperature sensing devices meeting the requirements of FDOT. Maintain the asphalt cement in storage within a range of 230°F to 350ºF in advance of mixing operations. Maintain constant heating within these limits, and do not allow wide fluctuations of temperature during a day's production.

G. Produce a homogeneous mixture, free from moisture and with no segregated materials, that meets all specification requirements for the mixture, including compliance with the Marshall Properties. Also, apply these requirements to all mixes produced by the drum mixer process and all mixes processed through a hot storage or surge bin, both before and after storage.

3.02 LIMITATIONS OF OPERATIONS

A. Must meet the requirements of "Section 330-3 Limitations of Operations" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.03 PREPARATION OF APPLICATION SURFACES

A. Must meet the requirements of "Section 330-4 Surface Preparation" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.04 PAVING EQUIPMENT

A. Must meet the requirements of "Section 330-5 Paving Equipment" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.05 PLACING MIXTURE

A. Must meet the requirements of "Section 330-6 Placing Mixture" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.06 COMPACTING MIXTURE

A. Must meet the requirements of "Section 330-7 Compacting Mixture" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.07 JOINTS

A. Must meet the requirements of "Section 330-8 Joints" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.08 SURFACE REQUIREMENTS

A. Must meet the requirements of "Section 330-9 Surface Requirements" of the FDOT Standard Specifications for Road and Bridge Construction, 2017 Edition.

3.09 REPAIR AND RESTORATION

A. Replace asphalt pavement or roadway surfaces cut or damaged to equal or better condition than the original, including stabilization, base course, surface course, curb and gutter, and other appurtenances.

3.10 SIGNALIZATION, PAVEMENT STRIPING AND MARKING

A. The Contractor shall be responsible for coordinating, repairing or replacing all traffic signalization devices and traffic loops damaged during the pavement milling, removal and replacement process.

B. The Contractor shall be responsible for coordinating, inventorying, and replacing all temporary and permanent pavement striping and markings damaged during the asphalt pavement milling, removal, and replacement process.

C. Temporary pavement striping and markings shall be paint or reinforced retro-reflective removal tape. Foil back tape is not acceptable. Permanent pavement striping and markings shall be alkyd thermoplastic tape and raised reflective pavement markers.

END OF SECTION

SECTION 02576
CONCRETE SIDEWALKS AND DRIVEWAYS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Constructing new concrete sidewalks, driveways, and curb and gutters as shown on the Drawings.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 02 Section " Stabilized Subgrade".
4. Division 03 Section "Concrete Framework".
5. Division 03 Section "Concrete Reinforcement".
6. Division 03 Section " Concrete Joints and Joint Accessories".
7. Division 03 Section " Concrete Finishes".
8. Division 03 Section " Modifications and Repair to Concrete".

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with applicable sections of F.D.O.T. Specifications and local governing regulations.

B. The mixture, placement, and curing of all concrete work shall be in accordance with F.D.O.T. Specifications.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

B. Furnish manufacturer's product data, design mixes, test reports, and materials certifications.

1.04 JOB CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Utilize flagman, barricades, warning signs, and warning lights as required.

1.05 GUARANTEE

A. All restored shall be guaranteed for 1-year after final acceptance. In the event of cracked or broken concrete surfaces, the Contractor shall make the necessary repairs to restore the concrete within 10-calendar days after notification by the County. The cost of such repairs shall be paid by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied, when applicable, shall be one of the products specified in the FDOT Approved Product List (Latest Edition). The list can be found at the FDOT web page: https://fdotwp1.dot.state.fl.us/ApprovedProductList/

2.02 CONCRETE MATERIALS

A. Forms: Steel or wood for each type of use of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.

1. Use flexible spring steel forms or laminated boards to form radius bends as required.

2. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.

B. Concrete Materials: Comply with requirements of F.D.O.T. Section 347 for concrete materials, admixtures, bonding materials, curing materials, and others as required.

C. Epoxy Resin Grout: Type N as specified in F.D.O.T. Section 926.

2.03 CONCRETE MIX, DESIGN, AND TESTING

A. Comply with requirements of applicable F.D.O.T. Section 347 for concrete mix design, sampling and testing, and quality control, and as herein specified.

B. Design the mix to produce standard weight concrete consisting of Portland cement, aggregate, air entraining admixture, and water to produce the following properties.

1. Compressive Strength: Class B, 3,000 psi for walks and curbs.

2. Compressive Strength: Class A, 4,000 psi for driveways.

3. Air Content: 3% to 6%.

C. Concrete slump shall not exceed plus or minus 1-inch from approved design slump.

PART 3 - EXECUTION

3.01 CONCRETE SIDEWALK, DRIVEWAY, AND CURB AND GUTTER

A. Surface Preparation:

1. Remove loose material from the compacted sub base surface immediately before placing concrete.

2. Proof-roll prepared sub base surface to check for unstable areas and the need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

B. Form Construction:

1. Set forms to the required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of the Work and so that forms can remain in place at least 24-hours after concrete placement.

2. Check completed formwork for grade alignment to the following tolerances:

   a. Top of forms not more than 1/8-inch in 10-feet.
   b. Vertical face on longitudinal axis, not more than 1/4-inch in 10-feet.

3. Clean forms for reuse immediately after use, and coat with form release agent as often as required to ensure separation from concrete without damage.

C. Concrete Placement:

1. Do not place concrete until sub base and forms have been checked for line and grade. Moisten if required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are completed to required finish elevation and alignment. Use special colors or aggregate as required to match existing material.

2. Place concrete using methods that prevent segregation of the mix. Consolidate concrete along the face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices. Do not use vibrators to push or move concrete in forms or chute.

3. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.

4. An automatic machine may be used for sidewalk or curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed the minimum herein specified. Machine placement must produce sidewalks and/or curbs and gutters to the required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

5. Joints: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise indicated. Construct transverse joints at right angles to the centerline, unless otherwise indicated. When joining existing structures place transverse joints to align with previously placed joints, unless otherwise indicated.

   a. Weakened-Plane Joints: Provide weakened-plane (contraction) joints sectioning concrete into areas as shown on the Drawings. Construct weakened plane joints for a depth equal to at least 1/4 concrete thickness, by sawing within 24-hours of placement or formed during

finishing operations. Place joints at intervals not to exceed 10-feet if not otherwise indicated.

b. Construction Joints: Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints. Construction joints shall be as shown or, if not shown, use standard metal keyway-section form of appropriate height.

c. Expansion Joints:

i. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basin, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.

ii. Locate expansion joints at 12-feet on center for concrete walks unless otherwise indicated.

iii. Extend joint fillers full-width and depth of joint, and not less than 1/2-inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

iv. Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together. Pieces shorter than 4-inches shall not be used unless specifically shown as such.

v. Protect the top edge of the joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

vi. Fillers and Sealants: Comply with the requirements of these specifications for preparation of joints, materials installation, and performance, and as herein specified.

D. Concrete Finishing:

1. After striking-off and consolidating concrete, smooth the surface by screening and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compact the surface and produce a uniform texture.

2. After floating, test surface for trueness with a 20-foot straightedge. Variations exceeding 1/3-inch for any two points within 10-feet shall not be acceptable. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

3. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round 10-1/2-inch radius, unless otherwise indicated. Eliminate any tool marks on concrete surface.

4. After completion of floating and when excess moisture or surface sheen has disappeared, broom finish sidewalks by drawing a fine-hair broom across

concrete surface, perpendicular to a line of pedestrian traffic. If the existing material has another finish, match existing finish.

5. Do not remove forms for 24-hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas.

E. Curing:

1. Protect and cure finished concrete paving and walks, complying with applicable requirements of F.D.O.T. Section 350. Use moist-curing methods for initial curing of approved concrete curing compounds whenever possible.

F. Repairs and Protections:

1. Repair or replace broken or defective concrete, as directed by the County.

2. Drill test cores where directed by the County, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy resin grout.

3. Protect concrete from damage until acceptance of work. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

4. Sweep concrete pavement and wash free of stains and discolorations, dirt, and other foreign material just prior to final inspection.

3.02 FIELD QUALITY CONTROL

A. General: Repair or remove and replace unacceptable concrete sidewalk, driveways, or curb and gutter as directed by the County.

B. Surface Elevation: Actual surface elevations shall be within ± 0.05 feet of specified or indicated elevations at any given point. Surface elevations between any 2 given points shall be interpolated from a direct line between the 2 points. Surfaces exceeding actual elevation tolerances of more than ± 0.05 feet at any 2 points within a distance of 15-feet will not be acceptable.

END OF SECTION

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SECTION 02577
STORMWATER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Construction of culverts, storm sewers, inlets, and other drainage structures as shown on the Drawings and specified herein.

1.02 QUALITY ASSURANCE

A. Provide certification of quality by manufacturer to County 10-days prior to delivery to the job site.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Grates and castings
2. Precast structures
3. Product data for drainage piping

B. SUBMITTALS: Submittals shall be submitted to the County for review and acceptance.

1. Pipe certification of quality by manufacturer shall be delivered to County 10-days prior to delivery to the job site.

1.04 JOB CONDITIONS

A. Existing Drainage System: Maintain operational and prevent siltation.

1. Perform site survey, research public utility records and verify existing utility locations. Verify that storm system shall be installed in compliance with the Drawings and Specifications prior to installation.
2. Coordinate with other utility work.

1.05 REFERENCES

A. Applicable Codes, Standards, and Specifications: The drainage work under this contract shall be in strict accordance with the applicable provisions of the following;

1. The Florida Department of Transportation "Standard Specifications for Road and Bridge Construction" Latest Edition (DOT)
2. American Association of State Highway and Transportation Officials (AASHTO)

3. American Society for Testing and Materials (ASTM) including

   a. ASTM C76: Reinforced Concrete Culvert, Storm Drain and Sewer Pipe; and
   b. ASTM C443: Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied, when applicable, shall be one of the products specified in the FDOT Approved Product List (Latest Edition). The list can be found at the FDOT web page: https://fdotwp1.dot.state.fl.us/ApprovedProductList/

2.02 MATERIALS

A. General: The Contractor shall furnish drainage pipe as shown on the Drawings.

B. Reinforced Concrete Pipe (RCP)

1. Concrete pipe: Concrete pipe shall be reinforced concrete culvert pipe conforming to ASTM Designation C-76, Table III, except when otherwise indicated. Pipe joints shall be rubber gasket joints, and the pipe joint shall be manufactured to meet the requirements of the approved type of gasket to be used. Pipe joints and rubber gaskets shall conform to the requirements of Sections 941 and 942 of the FDOT Standard Specifications.

C. Drainage Structures

1. Brick: Brick for drainage structures shall be dense, hard burned, shale or clay brick conforming to ASTM Designation C 32, Grade MM or C 62, Grade MW, except that brick absorption shall be between 5 and 25 grams of water absorbed in 1-minute by dried brick, set flat face down, in 1/8-inch of water.

2. Cement Mortar: Cement mortar for manhole construction shall be 1 part cement and 2 parts clean sharp sand to which may be added lime in the amount of not over 25% volume of cement. It shall be mixed dry and then wetted to proper consistency for use. No mortars that have stood for more than 1-hour shall be used.

3. Concrete: Concrete shall be Class I that conforms to the requirements of Section 345: Portland Cement Concrete. FDOT Standard Specifications for Road and Bridge Construction (latest edition).

4. Precast Concrete Structures: Precast concrete structures shall conform to applicable requirements of FDOT Standard Specification for Road and Bridge Construction (latest edition), FDOT Roadway, and Traffic Design Standard (latest edition).

5. Castings: Castings for inlets and other items shall conform to the ASTM Designation A-48, Class 25. Castings shall be true to pattern in form and

dimensions and free of pouring faults and other defects in positions that would impair their strength or otherwise make them unfit for the service intended. No plugging or filling will be allowed. Casting patterns shall conform to those shown or indicated on the Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

A. Pipe Trenches

1. Pipe trenches shall be prepared in accordance with Section 02220 "Excavating, Backfilling, and Compacting."

3.02 INSTALLATION

A. Laying Drainage Pipe

1. Join pipe and fittings with rubber gaskets in accordance with C443, and install piping in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual." All pipe shall be carefully laid true to the line and grade shown on the Drawings. Any deviation from true alignment or grade which would result in a displacement from the normal position of the gasket of as much as 1/4-inch, or which would produce a gap exceeding 1/2-inch between sections of pipe for more than 1/3 of the circumference of the inside of the pipe, will not be acceptable and where such occurs, the pipe shall be re-laid without additional compensation. No mortar, joint compound, or other filler which would tend to restrict the flexibility of the gasket joint shall be applied to the gap. Pipes having defects that have not caused their rejection are to be so laid that these defects will be in the upper half of the sewer.

2. Install gaskets, seals, sleeves, and couplings in accordance to manufacturers' recommendations for use with lubricants, cements, and other installation requirements. Before installation of the pipe gasket, the gasket and the surface of the pipe joint, including the gasket recess, shall be clean and free from grit, dirt, or other foreign matter at the time the joints are made. In order to facilitate closure of the joint, application of an approved vegetable soap lubricant immediately prior to closing of the joint shall be permitted.

3. All pipes shall be laid with bells or grooves uphill. As the pipes are laid throughout the Work, they shall be thoroughly cleaned and protected from dirt and water. No length of pipe shall be laid until the two preceding lengths have been thoroughly embedded in place to prevent any movement or disturbance of the finished joint. No walking on or working over the pipes after they are laid, except as may be necessary in tamping earth and refilling, will be permitted until they are covered to a depth of 1-foot. No pipe shall be laid except in the presence of the County. Fill placed around the pipe shall be deposited on both sides simultaneously to approximately the same elevation and uniformly compacted. Whenever the pipe laying is discontinued, the

unfinished end is to be securely protected from displacement and a suitable stopper shall be inserted therein.

B. Drainage Structures

1. Concrete inlets or other structures shall be constructed in conformity with the Drawings. Forms shall be designed and constructed so that they may be removed without damage to the concrete and shall be left in place for at least 24-hours after concrete is placed. Concrete shall be thoroughly cleaned, saturated with water, and pointed up with mortar.

2. Precast inlets or other structures may be used in lieu of cast-in-place structures. Grates are to be set in place in mortar to the proper line and grade.

C. Backfilling for Pipe Culverts and Drainage Structures

1. After the pipe has been installed, approved selected material at a moisture content that will facilitate compaction shall be placed along side the pipe in layers not exceeding 6-inches loose measure in depth. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by rolling or tamping with mechanical rammers. This method of filling and compacting shall be continued until the fill is 12-inches above the pipe, then the remainder of the backfill shall be placed in lifts not exceeding 9-inches. The operation of heavy equipment shall be conducted so that no damage to the pipe will result. Backfill material greater than 12-inches above the top of the pipe shall be compacted to not less than 95% of maximum density as determined by AASHTO Designation T-180. Selected material for backfill shall not contain any stones or rock larger than 3-inches. Tests for density of compaction may be made at the option of the County, and deficiencies shall be corrected by the Contractor without additional cost to the County.

2. Backfill for drainage structures shall be placed and compacted in the same manner as specified above for pipe, except the concrete shall be permitted to cure for not less than 5-days before the backfill is placed.

3.03 FIELD QUALITY CONTROL

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses.

C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections after pipe has been installed and approximately 2-feet of backfill is in place, and again at completion of project.

D. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and re-inspect.

END OF SECTION

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SECTION 02660
POTABLE WATER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide a complete system for water transmission/distribution pressure piping and appurtenant items.

B. Related Work Described Elsewhere

1. Section 02220 - Excavating Backfilling and Compacting.

1.02 QUALITY ASSURANCE

A. Design Requirements

1. Piping shall be laid with a minimum cover of 36-inches below finished grade for mains sized 12-inch and below and a minimum cover of 48-inches for mains sized 16-inch and greater. Minimum cover shall not apply where plans indicate the depth or elevation to install pipe.

2. Pipelines shall be constructed of the materials indicated in this specification and on the Drawings.

B. Pipe Inspection:

1. The Contractor shall obtain a certificate of inspection from the pipe manufacturer stating that the pipe and fittings supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications.

2. The entire product of any plant may be rejected when, in the opinion of the County, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce inferior pipe or fittings.

3. All pipe and fittings shall be subjected to a visual inspection at the time of delivery and before being lowered into the trench. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

4. The County reserves the right to sample and test any pipe or fitting after delivery and to reject all pipe and fittings represented by any sample which fails to comply with the specified requirements.

C. Prevention of electrolysis is required in accordance with AWWA C105 and when crossing, or adjacent to, a power easement, gas easements, any location where induced currents may be present, in areas where aggressive soils exist, and where shown on Drawings. Electrolytic action through the contact of dissimilar metals shall be prevented by either:

1. The separation of one material from the other by means of an insulating or dielectric coupling (polyethylene wrap), or

2. The use of alternative materials, as directed by the County.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Mill test certificates or certified test reports on pipe

2. Details of restrained and flexible joints

3. Detailed laying schedule for pipe

4. Valves and valve boxes

1.04 JOB CONDITIONS

A. Water in Excavation

1. Dewatering shall be in accordance with. Section 02140 "Dewatering." Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the County. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.

2. In no case shall the pipelines being installed be used as drains. The ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment.

3. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the Work any such material has entered the pipelines, it must be cleaned as directed by the County so that the entire system will be left clean and unobstructed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Pipe, Fittings, Valves, and Ancillary Equipment shall be installed as shown on the Drawings and as specified in Division 15.

B. Additional Work: Additional items of construction, necessary for the complete installation of the systems, shall conform to specific details shown on the Drawings

and shall be constructed of first-class materials conforming to the applicable portions of these specifications.

PART 3 - EXECUTION

3.01 PREPARATION

A. Bedding:

1. Pipe Cradle: Upon satisfactory installation of the pipe bedding material as specified in Section 02220 "Excavating, Backfilling and Compacting", a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.

2. Cleanliness: The interior of the pipes shall be thoroughly cleaned of all foreign matter before being gently lowered into the trench and shall be kept clean during laying operations by means of plugs or other methods approved by the County. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.

3.02 INSTALLATION

A. Pipe Identification/Location

1. All PVC water mains shall be solid blue. All lettering shall appear legibly on the pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use.

2. All ductile iron water mains shall be color coded blue with tape. The tape (minimum 2-inches) shall be permanently affixed to the top and each side of the pipe (3 locations parallel to the axis of the pipe). For pipes less than 24-inches in diameter, a single tape may be used along the top of the pipe.

3. All HDPE water mains shall be a solid blue or black with 4 co-extruded equally spaced blue stripes of the same material as the pipe. Stripes painted on the pipe outside surface shall not be acceptable.

4. If main is located over 30-feet from the edge of the pavement or in an easement, the Contractor shall install 4-inch diameter schedule 80 PVC utility pipe line markers over the pipe alignment at 1,000-feet intervals, at all valves, and at all locations where fittings deflect the pipe alignment in the horizontal plane. Utility pipeline markers shall include a decal and shall be colored blue for water service.

5. All mains (PVC, HDPE, and DI) shall be installed with a continuous, insulated 10-gauge copper wire installed directly above the pipe for location purposes. Locate wire shall terminate in a test station box and be capable of extending 12-

inches above the top of the box. Directionally drilled pipe shall be installed with 2 insulated 10-gauge copper wires.

B. Pipe: The color stripe and pipe text shall be located on the top of the pipe when installed. When installing PVC pipe, no additional joints will be installed until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

1. Gradient: Pipe shall be laid straight and depth of cover shall vary to provide uniform gradient or slope to pipe, whether grading is completed or proposed at time of pipe installation. When a grade or slope is shown on the Drawings, batter boards with string line paralleling design grade, or other previously approved means, shall be used by the Contractor to assure conformance to required grade.

2. Pipe Joint Deflection

a. Ductile Iron Pipe: Whenever it is desirable to deflect pipe, the amount of deflection shall not exceed 75% of the maximum limits as shown in AWWA Standard C600 for ductile iron pipe.

b. PVC Pipe: Joint deflection or pipe bending shall not be permitted. The maximum allowable tolerance in the joint due to variances in installation is 0.75° (degrees) (3-inches per joint per 20-foot stick of pipe). No bending tolerance in the pipe barrel shall be acceptable. Alignment change shall be made only with sleeves and fittings.

3. Rejects: Any pipe found defective shall be immediately removed and replaced with sound pipe at the Contractor's expense.

4. Joint Compounds: No sulfur base joint compound shall be used.

5. Thrust restraints shall be accomplished by the use of mechanical restraining devices unless specifically identified otherwise on the Drawings or herein. Restraining devices shall be specified in Sections 15062 "Ductile Iron Pipe and Fittings" and 15064 "Polyvinyl Chlorine (PVC) Pipe and Fittings", respectfully.

C. Installing Valves and Boxes

1. Valves: Valves shall be carefully inspected, fully opened, and then tightly closed and the various nuts and bolts shall be tested for tightness. Any valve that does not operate correctly shall be removed and replaced.

2. Valve Boxes: Valve boxes shall be carefully centered over the operating nuts of the valves so as to permit a valve key to be fitted easily to the operating nut. In unpaved areas, valve boxes shall be set to conform to the level of the finished surface and held in position by a concrete collar placed under the support flange as shown on the Drawings. The letter "V" shall be etched in the curb at each valve location. The valve box shall not transmit surface loads to the pipe or valve but be supported by bedding rock as shown on the Drawings. Extensions or risers for valve boxes shall be an integral part of the box. No cut sections of D.I. or PVC pipe shall be used in extending the box to

its proper height. Care shall be taken to prevent earth and other material from entering the valve box. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug out and reset. Before final acceptance of the Work all valve boxes shall be adjusted to finish grade.

3. Concrete Collar: Each valve installed in an unimproved area (outside of pavement, driveways or sidewalks) shall require a 24-inch by 24-inch by 6-inch concrete pad or collar as shown in the Drawings.

4. Identification Disc: Each 16-inch or larger valve (unless otherwise shown on the Drawings) installed shall be identified by a 3-inch diameter bronze disc anchored in the concrete pad or collar in unimproved areas and/or anchored on a 4-inch by 4-inch by 18-inch long concrete post set flush with the pavement surface in improved areas. The disc shall be stamped with the following information as shown on the Drawings:

   a. Size of the valve
   b. Type of valve
   c. Service
   d. Direction and number of turns to open

D. Concrete Encasement

1. Concrete encasement shall be constructed in accordance with details shown on the Drawings and shall be constructed of Class C concrete. Encasement shall be constructed where;

   a. Indicated on the Drawings
   b. The County orders the pipe encased

2. The points of beginning and ending of pipe encasement shall be not more than 6-inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

E. Flush Out Connections: Flush out connections shall be installed at the locations as determined by the County and be full pipe size.

F. Service Connections: Service connections shall be installed at the locations determined by the County and in the manner shown on the Drawings. No service line shall terminate under a driveway.

G. Backfilling: Backfilling shall be in accordance with Section 02220 "Excavating, Backfilling and Compacting" of these specifications.

3.03 CLEANING

A. General: At the conclusion of the Work, the Contractor shall thoroughly clean the new pipelines by flushing with water or other means to remove all dirt, stones, or other material which may have entered the line during the construction period. Flushing is permitted for pipes less than or equal to 12-inch diameter.

B. Correction of Non-Conforming Work: All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the County. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of this Project Manual and/or the Drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the Drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, visible or detectable leakage, or failure to pass any specified test or inspection.

3.04 FIELD QUALITY CONTROL

A. Flushing

1. All pipelines less than or equal to 12-inches shall be flushed to remove all sand and other foreign matter. After initial slow-fill, pipe shall sit full for 24-hours to facilitate cleaning and collection of debris from interior of pipe. Flushing shall be accomplished through full pipe size connections at full pipe depth. The velocity of the flushing water shall be at least 2.5-feet per second. Flushing shall be terminated at the direction of the County. The Contractor shall dispose of the flushing water without causing a nuisance or property damage. The Contractor shall arrange with the County and pay for the source of flushing water.

2. In lieu of flushing, new water mains may be hydraulically or pneumatically cleaned with a polypropylene swabbing device in accordance with "Orange County Utilities Standards and Construction Specifications Manual."

   a. The Contractor is responsible to provide temporary access and egress points.
   b. Passage of the cleaning swabs through the system shall be constantly monitored, controlled, and all poly swabs entered into the system shall be individually marked and identified.
   c. Cleaning of the system shall be done in conjunction with the initial filling of the system for its hydrostatic test.
   d. The Contractor is responsible for collection of debris, water, and the swab. Considerations shall be made for protecting surrounding property and personnel.
   e. Swabbing speed shall range between 2 and 5-feet per second.

B. Pressure and Leakage Tests of Pressure Piping

1. General: The Contractor shall perform hydrostatic pressure and leakage tests on all pressure piping. Tests shall be made between valves and shall not exceed 2,000-feet. Each side of all valves shall be pressure tested. Multiple sections of main may be tested simultaneously providing there are non-pressurized sections in between each pressure-tested section.

2. Standard: AWWA C600, Section 4, with the exceptions required herein and the exception that the Contractor shall furnish all gauges, meters, pressure pumps, and other equipment needed to test the lines.

3. Hydrostatic Pressure Test

a. Test Pressure: Pressure test at 50% above the normal working pressure, but not less than 150-psi, unless otherwise noted on the Drawings.
b. Test Duration: Duration is 2-hours. If during the test, the integrity of the tested line is in question, the County may require a 6-hour pressure test.
c. Air Release: Corporation cocks at least 3/4-inch in diameter, pipe riser, and angle globe valves shall be provided at each dead-end to bleed air from the line.

4. Hydrostatic Leakage Test

a. General: Following the pressure test, the Contractor shall perform the leakage test. The line shall be filled with water and all air removed for the test. The Contractor shall provide a pump to maintain the test pressure for the entire test period.
b. Test Pressure: Maximum operating pressure as determined by the County but not less than 150-psi unless otherwise noted.
c. Test duration: 2-hours.
d. Allowable leakage:

$$L = \frac{SD(P)0.5}{148{,}000}$$

L = Allowable leakage (gallons per hour)
S = Length of pipe tested (feet)
D = Nominal diameter of pipe (inches)
P = Average test pressure maintained (psig)

e. Visible Leakage: All leaks evident at the surface shall be repaired and leakage eliminated regardless of the measured total leakage.
f. Leakage Measurement: The amount of water required to maintain the test pressure is the leakage.

C. Wire Continuity Check: The Contractor shall perform a continuity check of the 10-gauge locating wire for the entire length of the main by performing a continuity test at each valve test station box.

3.05 DISINFECTING POTABLE WATER PIPELINES

A. General: Before being placed in service, all potable water pipelines shall be disinfected by chlorination. Taps for chlorination and sampling shall be uncovered and backfilled by the Contractor as required. The disinfection procedure shall be approved by the County.

B. Standard: AWWA 651, "Standard Procedures for Disinfecting Water Mains."

C. Procedure

1. Flush all dirty or discolored water from the line and introduce chlorine in approved dosages through a tap at one end while water is being withdrawn at the other end of the line.

2. The chlorine solution shall remain in the pipeline for 24-hours.

3. Following the chlorination period, all treated water shall be flushed from the line and replaced with water from the distribution system.

4. Bacteriological sampling and analysis shall be made in full accordance with AWWA Manual C651 and the appropriate FDEP permit. If necessary, the Contractor will be required to re-chlorinate.

5. Sampling and analysis shall be done by the County.

D. Approval: The line shall not be placed in service until the requirements of the State and County Public Health Department are met and the bacteriological test results are approved by the Department of Environmental Protection.

3.06 CONNECTION TO EXISTING SYSTEM

A. All connections to existing mains shall be made after complete disinfection of the proposed system and shall be made under the direction of the County. Valves separating the mains being installed from existing mains shall be operated by or under the direction of the County. The cost of the Work in making the connections shall be paid for by the Contractor.

B. In the event the proposed main is to be connected to a main which has one or more active services between the point of connection and the first existing line valve, a temporary plug or cap shall be installed on the new main until the pressure tests and disinfecting are completed. Upon satisfactory completion, the cap or plug shall be removed from both mains and the connection made with pipe which has been swabbed out with a solution of chlorine and water. The connection shall be made as swiftly as possible and any water in the ditch shall be kept below the level of the pipe. The pipeline shall then be placed in service by the County's personnel.

C. In the event any existing users will be without water while a connection is being made, the Contractor shall notify the County 72-hours prior to disconnection. The County shall notify the affected user(s) when the water will be turned off and when the service is estimated to be resumed. In some instances, these connections may have to be made at night. No user shall be without water service for more than 3-hours.

3.07 SUPPLIER'S FIELD SERVICE:

A. The Contractor shall, at no additional cost to the County, arrange for a pipe supplier's field representative to be on-site to provide instruction to each crew working on the installation for a minimum of 4 push-on joints (PVC, DIP). The supplier's field representative shall certify that the installations observed were satisfactorily completed and all pipe installation crews were familiar with the proper methods and procedures for the pipeline installations.

3.08 WATER FOR USE IN FLUSHING, TESTING, AND DISINFECTION:

A. The Contractor shall arrange with the County for water required for pressure testing, flushing, and disinfection required by the Contractor. The Contractor shall provide meter and backflow preventer.

END OF SECTION

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SECTION 02661
WASTEWATER FORCE MAINS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work under this Section includes providing a complete system for wastewater transmission pressure piping and appurtenant items including large diameter Raw Sewage (RS) pipelines and connections to existing pipelines.

1.02 QUALITY ASSURANCE

A. Design Requirements

1. Piping shall be laid with a minimum cover of 36-inches below finished grade, unless otherwise indicated.

2. Pipelines shall be constructed of the materials indicated on the Drawings.

3. All force mains shall be installed with a continuous insulated 10-gauge copper wire. Wire shall terminate at the top of each valve and be capable of extending 18-inches above the top of the box.

4. All PVC force mains shall be solid green. All lettering shall appear legibly on the pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use.

5. Flanged ductile iron used in valve vaults or above ground piping at pump stations shall be Protecto 401 lined and coated per specification Section 09901, "Coatings and Linings." Flanged DIP shall be epoxy coated from the factory and shall not be coated with bitumastic or asphaltic exterior coatings.

B. Pipe Inspection: The Contractor shall obtain from the pipe manufacturers a certificate of inspection to the effect that the pipe and fittings supplied for this contract have been inspected at the plant and that they meet the requirements of these specifications. All pipe and fittings shall be subjected to visual inspection at time of delivery and just before they are lowered into the trench to be laid. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor. The entire product of any plant may be rejected when, in the opinion of the County, the methods of manufacture fail to secure uniform results, or where the materials used produce inferior pipe or fittings.

C. Prevention of Electrolysis: Where shown on Drawings or deemed necessary, electrolytic action through the contact of dissimilar metals shall be prevented by either;

1. The separation of one material from the other by means of an insulating or dielectric coupling (polyethylene wrap), or

2. The use of alternative materials, as directed by the County

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Certified test reports on pipe
2. Details of restrained and flexible joints
3. Detailed laying schedule for pipe
4. Valves and valve boxes
5. Details of methods and materials for tapping, tapping valves and linestops.

B. Acceptance of Material: The County reserves the right to sample and test any pipe or fitting after delivery and to reject all pipe and fittings represented by any sample which fails to comply with the specified requirements.

1.04 JOB CONDITIONS

A. Water in Excavation: Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The Contractor shall not open more trenches than the available pumping facilities are able to dewater to the satisfaction of the County. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately blocked during construction by the use of acceptable stoppers and not by improvised equipment. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the Work any such material has entered the pipelines, it must be cleaned as directed by the County so that the entire system will be left clean and unobstructed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Pipe Fittings, Valves, and Ancillary Equipment shall be installed as shown on the Drawings and as specified in Division 15.

B. Additional Work: Additional items of construction, necessary for the complete installation of the systems, shall conform to specific details shown on the Drawings and shall be constructed of first-class materials conforming to the applicable portions of these specifications.

PART 3 - EXECUTION

3.01 PREPARATION

A. Bedding: Upon satisfactory installation of the pipe bedding material as specified in Section 02220 "Excavating, Backfilling and Compacting", a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging. The pipe shall be laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.

B. Cleanliness: The interior of the pipes shall be thoroughly cleaned of all foreign matter before being gently lowered into the trench and shall be kept clean during laying operations by means of plugs or other methods acceptable by the County. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.

3.02 INSTALLATION

A. Pipe Identification/Location

1. All PVC wastewater mains shall be solid green in color. All lettering shall appear legibly on the pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use.

2. All HDPE wastewater mains shall be either a solid green or black with four co-extruded equally spaced green stripes of the same material as the pipe. Stripes painted on the pipe outside surface shall not be acceptable.

3. If main is located over 30-feet from the edge of the pavement or in an easement, the Contractor shall install 4-inch diameter schedule 80 PVC utility pipe line markers over the pipe alignment at 1,000-feet intervals, at all valves, and at all locations where fittings deflect the pipe alignment in the horizontal plane. Utility pipeline markers shall include a decal and shall be colored purple for reclaimed water service.

4. All mains (PVC and HDPE) shall be installed with a continuous, insulated 10-gauge copper wire installed directly above the pipe for location purposes. Locate wire shall terminate in a test station box and be capable of extending 12-inches above the top of the box. Directionally drilled pipe shall be installed with two insulated 10-gauge copper wires.

B. Pipe:

1. Gradient: Lines shall be laid straight, and depth of cover shall vary to provide uniform gradient or slope to pipe, whether grading is completed or proposed at time of pipe installation. When a grade or slope is shown on the Drawings, batter boards with string line paralleling design grade, or other previously approved means, shall be used by the Contractor to assure conformance to required grade.

2. Pipe Joint Deflection: No joint deflection or pipe bending is allowed in PVC pipe. The maximum allowable tolerance in the joint due to variances in installation is 0.75° (degrees), (3-inches per joint per 20-ft stick of pipe). No bending tolerance in the pipe barrel shall be acceptable. Alignment changes shall be made with sleeves and fittings as shown in Drawings. Deflection in fittings and sleeves shall not exceed 75% of the limits recommended by the fitting manufacturer.

3. Rejects: Any pipe found defective shall be immediately removed from the site and replaced with sound pipe at the Contractor's expense.

4. Joint Compounds: No sulfur base joint compound shall be used.

5. Thrust restraints shall be accomplished by the use of mechanical restraining devices unless specifically identified otherwise on the Drawings or herein. Restraining devices are specified in Section 15064 "Polyvinyl Chlorine Pipe and Fittings", respectfully.

C. Installing Valves and Boxes

1. Valves: Valves shall be carefully inspected, opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Plug valves shall have the disc shaft installed horizontally with the plug rotating upward to the top of the valve. Any valve that does not operate correctly shall be removed and replaced.

2. Valve Boxes: Valve boxes and riser shall be centered over the operating nuts of the valves with a centering ring or disc so as to permit a valve key to be fitted easily to the operating nut. In unpaved areas, valve boxes shall be set to conform to the level of the finished surface and held in position by a concrete collar placed under the support flange as shown on the Drawings. The valve box shall not transmit surface loads to the pipe or valve. Extensions or risers for valve boxes shall be an integral part of the box. No cut sections of D.I. or PVC pipe shall be used in extending the box to its proper height. Care shall be taken to prevent earth and other material from entering the valve box. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug out and reset. Before final acceptance of the Work all valve boxes shall be adjusted to finish grade.

D. Concrete Encasement

1. Concrete encasement shall be constructed in accordance with details shown on the Drawings and shall be constructed of Class C concrete. Encasement shall be constructed where

2. As indicated on the Drawings

3. As directed by the County

4. The points of beginning and ending of pipe encasement shall be not more than 6-inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

5. Concrete Collar: Each valve installed in an unimproved area (outside of pavement, driveways or sidewalks) shall require a 24-inch x 24-inch x 6-inch concrete pad or collar as shown in the Drawings.

E. Flush Out Connections: Flush out connections shall be installed at the locations as determined by the County and be full pipe size to accommodate a full diameter flush for pipes 12-inches and smaller or a swab for pipes greater than 12-inches.

F. Backfilling: Backfilling shall be in accordance with Section 02220 "Excavating, Backfilling and Compacting" of these specifications.

G. Installation of Tapping Sleeve for Connections, By-pass or Linestop on Existing Pipe: The Contractor shall determine the exact type and size of the existing pipe material in the field. The Contractor shall prepare a submittal for materials to be used. Tapping methods shall comply with standards of pipe manufacturer's and associations of DIP, PCCP, PVC or Steel pipe as applicable. The Tapping submittal shall be coordinated with by-pass plans and shall indicate pipe lay-out and configuration of by-passing as much as possible for the County's review. The submittal shall be provided to the County for coordination and approval. Tapping Sleeves shall be as specified in Section 15100. Tapping sleeves shall be encased in concrete after connections have been completed or following installation of the completion plug and blind flange. See section 02282, Connections to Existing Buried Pipelines for additional requirements.

3.03 CLEANING

A. General: At the conclusion of the Work the Contractor shall thoroughly clean the new pipe lines by flushing with water or other means to remove all dirt, stones or other material which may have entered the line during the construction period.

B. Flushing 12-inch pipes and less: Flushing to remove all sand and other foreign matter from pipelines shall only be permitted for mains 12-inches and smaller. Flushing shall be accomplished through full pipe size connections at full pipe depth. The velocity of the flushing water shall be at least 4-feet per second. Flushing shall be terminated at the direction of the County. The Contractor shall dispose of the flushing water without causing a nuisance or property damage. The Contractor shall arrange and pay for the source of flushing water with the County or others.

C. Swabbing in lieu of flushing: New mains may be hydraulically or pneumatically cleaned with a polypropylene swabbing device to remove dirt, sand and debris from main. If swabbing access and egress points are not provided in the design drawings, it will be the responsibility of the Contractor to provide temporary access and egress points for the cleaning, as required. Passage of cleaning poly swabs through the system shall be constantly monitored, controlled and all poly swabs entered into the system shall be individually marked and identified so that the exiting of the poly swabs from the system can be confirmed. Cleaning of the system shall be done in conjunction with the initial filling of the system for its hydrostatic test. After initial slow-fill, pipe shall sit full for 24 hours to facilitate cleaning and collection of debris from interior of pipe. The Contractor shall insert flexible polyurethane foam swabs (2-pounds per cubic foot density) complete with rear polyurethane drive seal, into the first section of pipe. The swabs shall remain there until the pipeline construction is

completed. The line to be cleaned shall only be connected to the existing distribution system at a single connection point. Locate and open all new in-line valves beyond the point of connection on the pipeline to be cleaned during the swabbing operation. At the receiver or exit point for the poly swab, the Contractor is responsible for creating a safe environment for collection of debris, water and the swab. Considerations shall be made for protecting surrounding personnel and property and safe retrieval of the swab. Only County personnel shall operate the supply valve from the existing distribution system. Cleaning and flushing shall be accomplished by propelling the swab down the pipeline to the exit point with potable water. Flushing shall continue until the water is completely clear and swab is retrieved.

3.04 FIELD QUALITY CONTROL

A. Correction of Non-Conforming Work: All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the County. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of this Project Manual and/or the Drawings, including but not limited to pipe not laid true to the lines and grades as shown on the Drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, visible or detectable leakage and failure to pass any specified test or inspection.

B. Pressure and Leakage Tests of Pressure Piping

1. General: The Contractor shall perform hydrostatic pressure and leakage tests on all pressure piping. Tests shall be conducted on segments between valves and no more than 2,000 linear feet is to be tested at one time unless otherwise acceptable by the County.

2. Standard: AWWA C600, Section 5 (DI pipe) and AWWA C605 Section 7 (PVC pipe) with the exceptions required herein and the exception that the Contractor shall furnish all gauges, meters, pressure pumps and other equipment needed to test the lines.

3. Hydrostatic Pressure Test

a. Test Pressure: Test pressure will be 50% above the normal working pressure, but not less than 100-psi, unless otherwise noted on the Drawings.

b. Test Duration: Test shall be for a period of 2-hours. If during the test, the integrity of the tested line is in question, the County may require a 6-hour pressure test.

c. Air Release: Corporation cocks at least 3/4-inch in diameter, pipe riser and angle globe valves shall be provided at each dead-end to bleed air from the line.

4. Hydrostatic Leakage Test

a. General: Following the pressure test, the Contractor shall perform the leakage test. The line shall be filled with water and all air removed for the test. The Contractor shall provide a pump to maintain the test pressure for the entire test period.

b. Test Pressure: Maximum operating pressure as determined by the County but not less than 100-psi unless otherwise noted.

c. Test duration: 2-hours.

d. Allowable leakage: $L = \frac{SD(P)^{0.5}}{148{,}000}$

L = Allowable leakage (gallons per hour)
S = Length of pipe tested (feet)
D = Nominal diameter of pipe (inches)
P = Average test pressure maintained (psig)

e. Visible Leakage: All leaks evident at the surface shall be repaired and leakage eliminated regardless of the measured total leakage.

f. Leakage Measurement: The amount of water required to maintain the test pressure is the leakage.

END OF SECTION

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SECTION 02662
RECLAIMED WATER TRANSMISSION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide a complete system for reclaimed water transmission/distribution pressure piping and appurtenant items.

B. Related Work Described Elsewhere

1. Section 02220 - Excavating Backfilling and Compacting.

1.02 QUALITY ASSURANCE

A. Design Requirements

1. Piping shall be laid with a minimum cover of 36-inches below finished grade for mains sized 12-inch and below and a minimum cover of 48-inches for mains sized 16-inch and greater. Pipe located within Local roadways (subdivisions) or within an easement, shall be laid with a minimum cover of 30-inches.

2. Pipelines shall be constructed of the materials indicated in this specification and on the Drawings.

B. Pipe Inspection

1. The Contractor shall obtain a certificate of inspection from the pipe manufacturer stating that the pipe and fittings supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications.

2. The entire product of any plant may be rejected when, in the opinion of the County, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce inferior pipe or fittings.

3. All pipe and fittings shall be subjected to a visual inspection at the time of delivery and before being lowered into the trench. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

4. The County reserves the right to sample and test any pipe or fitting after delivery and to reject all pipe and fittings represented by any sample which fails to comply with the specified requirements.

C. Prevention of electrolysis is required in accordance with AWWA C105 and when crossing, or adjacent to, a power easement, gas easements, any location where induced currents may be present, in areas where aggressive soils exist, and where shown on Drawings. Electrolytic action through the contact of dissimilar metals shall be prevented by either:

1. The separation of one material from the other by means of an insulating or dielectric coupling (polyethylene wrap), or

2. The use of alternative materials, as directed by the County

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Mill test certificates or certified test reports on pipe

2. Details of restrained and flexible joints

3. Detailed laying schedule for pipe

4. Valves and valve boxes

1.04 JOB CONDITIONS

A. Water in Excavation

1. Dewatering shall be in accordance with Section 02140 "Dewatering." Water shall not be allowed in the trenches while the pipes are being laid and/or tested. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the County. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.

2. In no case shall the pipelines being installed be used as drains. The ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment.

3. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the Work any such material has entered the pipelines, it must be cleaned as directed by the County so that the entire system will be left clean and unobstructed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Pipe, Fittings, Valves, and Ancillary Equipment shall be installed as shown on the Drawings and as specified in Division 15.

B. Additional Work: Additional items of construction, necessary for the complete installation of the systems, shall conform to specific details shown on the Drawings

and shall be constructed of first-class materials conforming to the applicable portions of these specifications.

PART 3 - EXECUTION

3.01 PREPARATION

A. Bedding

1. Pipe Cradle: Upon satisfactory installation of the pipe bedding material as specified in Section 02220 "Excavating, Backfilling and Compacting", a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.

2. Cleanliness: The interior of the pipes shall be thoroughly cleaned of all foreign matter before being gently lowered into the trench and shall be kept clean during laying operations by means of plugs or other methods approved by the County. During suspension of Work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.

3.02 INSTALLATION

A. Pipe Identification/Location

1. All PVC reclaimed water mains shall be solid pantone purple (522-C) in color. All lettering shall appear legibly on the pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use.

2. All ductile iron reclaimed water mains shall be color-coded pantone purple with tape. The tape (minimum 2-inches) shall be permanently affixed to the top and each side of the pipe (3 locations parallel to the axis of the pipe). For pipes less than 24-inches in diameter, a single tape may be used along the top of the pipe.

3. All HDPE reclaimed water mains shall be either a solid purple or black with 4 co-extruded equally spaced purple stripes of the same material as the pipe. Stripes painted on the pipe outside surface shall not be acceptable.

4. If main is located over 30-feet from the edge of the pavement or in an easement, the Contractor shall install 4-inch diameter schedule 80 PVC utility pipe line markers over the pipe alignment at 1,000-feet intervals, at all valves, and at all locations where fittings deflect the pipe alignment in the horizontal plane. Utility pipeline markers shall include a decal and shall be colored purple for reclaimed water service.

5. All mains (PVC, HDPE, and DI) shall be installed with a continuous, insulated 10-gauge copper wire installed directly above the pipe for location purposes. Locate wire shall terminate in a test station box and be capable of

extending 12-inches above the top of the box. Directionally drilled pipe shall be installed with 2 insulated 10-gauge copper wires.

B. Pipe: The color stripe and pipe text shall be located at the top of the pipe when installed. When installing PVC pipe, no additional joints will be installed until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

1. Gradient: Pipe shall be laid straight and depth of cover shall vary to provide uniform gradient or slope to pipe, whether grading is completed or proposed at time of pipe installation. When a grade or slope is shown on the Drawings, batter boards with stringline paralleling design grade, or other previously approved means, shall be used by the Contractor to assure conformance to required grade.

2. Pipe Joint Deflection

a. Ductile Iron Pipe: Whenever it is desirable to deflect pipe, the amount of deflection shall not exceed 75% of the maximum limits as shown in AWWA Standard C600 for ductile iron pipe.

b. PVC Pipe: Joint deflection or pipe bending shall not be permitted. The maximum allowable tolerance in the joint due to variances in installation is 0.75° (degrees), (3-inches per joint per 20-foot stick of pipe). No bending tolerance in the pipe barrel shall be acceptable. Alignment change shall be made only with sleeves and fittings.

3. Rejects: Any pipe found defective shall be immediately removed and replaced with sound pipe at the Contractor's expense.

4. Joint Compounds: No sulfur base joint compound shall be used.

5. Thrust restraints shall be accomplished by the use of mechanical restraining devices unless specifically identified otherwise on the Drawings or herein. Restraining devices shall be specified in Sections 15062 "Ductile Iron Pipe and Fittings" and 15064 "Polyvinyl Chlorine (PVC) Pipe and Fittings", respectfully.

C. Installing Valves and Boxes

1. Valves: Valves shall be carefully inspected, fully opened, and then tightly closed and the various nuts and bolts shall be tested for tightness. Any valve that does not operate correctly shall be removed and replaced.

2. Valve Boxes: Valve boxes shall be carefully centered over the operating nuts of the valves so as to permit a valve key to be fitted easily to the operating nut. In unpaved areas, valve boxes shall be set to conform to the level of the finished surface and held in position by a concrete collar placed under the support flange as shown on the Drawings. The letter "V" shall be etched in the curb at each valve location. The valve box shall not transmit surface loads to the pipe or valve but be supported by bedding rock as shown on the Drawings. Extensions or risers for valve boxes shall be an integral part of the box. No cut sections of D.I. or PVC pipe shall be used in extending the box to

its proper height. Care shall be taken to prevent earth and other material from entering the valve box. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug out and reset. Before final acceptance of the Work all valve boxes shall be adjusted to finish grade.

3. Concrete Collar: Each valve installed in an unimproved area (outside of pavement, driveways or sidewalks) shall require a 24-inch by 24-inch by 6-inch concrete pad or collar as shown in the Drawings.

4. Identification Disc: Each 16-inch or larger valve (unless otherwise shown on the Drawings) installed shall be identified by a 3-inch diameter bronze disc anchored in the concrete pad or collar in unimproved areas and/or anchored on a 4-inch by 4-inch by 18-inch long concrete post set flush with the pavement surface in improved areas. The disc shall be stamped with the following information as shown on the Drawings:

   a. Size of the valve
   b. Type of valve
   c. Service
   d. Direction and number of turns to open

D. Concrete Encasement

1. Concrete encasement shall be constructed in accordance with details shown on the Drawings and shall be constructed of Class C concrete. Encasement shall be constructed where:

   a. Indicated on the Drawings
   b. The County orders the pipe encased

2. The points of beginning and ending of pipe encasement shall be not more than 6-inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

E. Flush Out Connections: Flush out connections shall be installed at the locations as determined by the County and be full pipe size.

F. Service Connections: Service connections shall be installed at the locations determined by the County and in the manner shown on the Drawings. No service line shall terminate under a driveway.

G. Backfilling: Backfilling shall be in accordance with Section 02220 "Excavating, Backfilling and Compacting" of these specifications.

3.03 CLEANING

A. General: At the conclusion of the Work, the Contractor shall thoroughly clean the new pipelines by flushing with water or other means to remove all dirt, stones, or other material which may have entered the line during the construction period. Flushing is permitted for pipes less than or equal to 12-inch diameter.

B. Correction of Non-Conforming Work: All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the County. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of this Project Manual and/or the Drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the Drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, visible or detectable leakage, or failure to pass any specified test or inspection.

3.04 FIELD QUALITY CONTROL

A. Flushing

1. All pipelines less than or equal to 12-inches shall be flushed to remove all sand and other foreign matter. After initial slow-fill, pipe shall sit full for 24-hours to facilitate cleaning and collection of debris from interior of pipe. Flushing shall be accomplished through full pipe size connections at full pipe depth. The velocity of the flushing water shall be at least 2.5-feet per second. Flushing shall be terminated at the direction of the County. The Contractor shall dispose of the flushing water without causing a nuisance or property damage. The Contractor shall arrange with the County and pay for the source of flushing water.

2. In lieu of flushing, new reclaimed water mains may be hydraulically or pneumatically cleaned with a polypropylene swabbing device in accordance with "Orange County Utilities Standards and Construction Specifications Manual."

   a. The Contractor is responsible to provide temporary access and egress points.
   b. Passage of the cleaning swabs through the system shall be constantly monitored, controlled, and all poly swabs entered into the system shall be individually marked and identified.
   c. Cleaning of the system shall be done in conjunction with the initial filling of the system for its hydrostatic test.
   d. The Contractor is responsible for collection of debris, water, and the swab. Considerations shall be made for protecting surrounding property and personnel.
   e. Swabbing speed shall range between 2 and 5-feet per second.

B. Pressure and Leakage Tests of Pressure Piping

1. General: The Contractor shall perform hydrostatic pressure and leakage tests on all pressure piping. Tests shall be made between valves and shall not exceed 2,000-feet. Each side of all valves shall be pressure tested. Multiple sections of main may be tested simultaneously providing there are non-pressurized sections in between each pressure tested section.

2. Standard: AWWA C600, Section 4, with the exceptions required herein and the exception that the Contractor shall furnish all gauges, meters, pressure pumps, and other equipment needed to test the lines.

3. Hydrostatic Pressure Test

a. Test Pressure: Test pressure will be 50% above the normal working pressure, but not less than 150-psi, unless otherwise noted on the Drawings.
b. Test Duration: Test Duration is 2-hours. If during the test, the integrity of the tested line is in question, the County may require a 6-hour pressure test.
c. Air Release: Corporation cocks at least 3/4-inch in diameter, pipe riser, and angle globe valves shall be provided at each dead-end to bleed air from the line.

4. Hydrostatic Leakage Test

a. General: Following the pressure test, the Contractor shall perform the leakage test. The line shall be filled with water and all air removed for the test. The Contractor shall provide a pump to maintain the test pressure for the entire test period.
b. Test Pressure: Maximum operating pressure as determined by the County but not less than 150-psi unless otherwise noted.
c. Test duration: 2-hours.
d. Allowable leakage:

$$L = \frac{SD(P)0.5}{148{,}000}$$

L = Allowable leakage (gallons per hour)
S = Length of pipe tested (feet)
D = Nominal diameter of pipe (inches)
P = Average test pressure maintained (psig)

e. Visible Leakage: All leaks evident at the surface shall be repaired and leakage eliminated regardless of the measured total leakage.
f. Leakage Measurement: The amount of water required to maintain the test pressure is the leakage.

C. Wire Continuity Check: The Contractor shall perform a continuity check of the 10-gauge locating wire for the entire length of the main by performing a continuity test at each valve test station box.

3.05 SUPPLIER'S FIELD SERVICE

A. The Contractor shall, at no additional cost to the County, arrange for a pipe supplier's field representative to be on-site to provide instruction to each crew working on the installation for a minimum of 4 push-on joints (PVC, DIP). The supplier's field representative shall certify that the installations observed were satisfactorily completed and all pipe installation crews were familiar with the proper methods and procedures for the pipeline installations.

3.06 WATER FOR USE IN FLUSHING, TESTING, AND DISINFECTION

A. The Contractor shall arrange with the County for water required for pressure testing and flushing required by the Contractor. The Contractor shall provide meter and backflow preventer.

END OF SECTION

SECTION 02774
WASTEWATER GRAVITY COLLECTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Construction of sanitary sewers, sewer connections and appurtenances as shown on the Drawings or specified herein.

B. Related Work Described Elsewhere

1. Section 02220 - Excavating Backfilling and Compacting.

1.02 QUALITY ASSURANCE

A. Storage: PVC pipe shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the PVC pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

B. Tests: Certified records of tests made by the manufacturer or by a reliable commercial laboratory shall be submitted with each shipment of pipe. All pipe shall be inspected upon delivery and that which does not conform to the requirements of these specifications shall be rejected and must be immediately removed by the Contractor. The Contractor shall furnish and provide samples of pipe for the performance of such additional tests as the County may deem necessary.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1. Precast manholes
2. Manhole frames, covers, and other castings
3. Manufacturer's certified test report on castings
4. Certification of admix installation from pre-caster
5. Certified test records for polyvinyl chloride pipe
6. Mill Test Certificates on ductile iron pipe
7. Manhole pipe connections
8. Coal tar epoxy
9. Special interior linings

B. Record Information: The Contractor shall submit to the County the elevations of the center of the manhole covers and inverts of all pipes in the manholes.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Ductile Iron Pipe and Fittings: Ductile iron pipe shall meet the requirements of Section 15062 "Ductile Iron Pipe and Fittings."

B. Polyvinyl Chloride Pipe and Fittings: Polyvinyl Chloride (PVC) Pipe shall meet the requirements of Section 15064 "Polyvinyl Chloride Pipe and Fittings."

C. Precast Concrete Manholes

1. Precast manholes shall conform to the requirements of ASTM Designation C 478.

   a. The minimum shell thickness shall be 5-inches.
   b. Lifting holes through the structures are not permitted.
   c. The design of the structure shall include a precast base of not less than 8-inches in thickness poured monolithically with the bottom section of the manhole walls.
   d. Where drop structures are required, the design of the structure shall include a precast base, for the drop structure, of not less than 8-inches in thickness poured monolithically with the bottom section of the manhole walls.
   e. New manholes shall contain a crystalline waterproofing concrete admix. Crystalline waterproofing concrete admix shall be added to the concrete during the batching operation. Admix concentration shall be added based upon manufacturer design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admix was added to the concrete for all precast manholes. Colorant shall be added and provided at the admix manufacturing facility, not at the concrete batch plant. Contractor shall provide certification from the pre-caster that the admix was installed in accordance with the manufacturers recommendations.

2. Top sections shall be eccentric, except that concrete top slab shall be used where shallow cover requires a top section less than 3-feet deep.

3. New manholes shall be lined with Interior Linings where shown on the Drawings.

D. Concrete and Reinforcing Steel: Concrete and reinforcing steel shall conform to the requirements of Division 3 - Concrete. Concrete classes for the various purposes shall be as follows:

1. Manhole bottoms, Class A
2. Precast manholes, Class A (4,000-psi)
3. Pipe and riser encasement, Class C
4. Protective slabs, Class C

E. Castings: Gray iron castings for manhole frames, covers, adjustment rings, and other items shall conform to the ASTM Designation A 48, Class 30. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects in positions which would impair their strength, or otherwise make them unfit for the service intended. No plugging or filling will be allowed. Lifting or "pick" holes shall be provided, but shall not penetrate the cover. Casting patterns shall conform to those shown or indicated on the Drawings. The words SANITARY and ORANGE COUNTY, FLORIDA shall be cast in all manhole covers as shown on the Drawings. All manhole frames and covers shall be traffic bearing to meet AASHTO H-20 loadings unless otherwise specified.

F. Brick: Brick for manhole construction shall be dense, hard burned, shale, or clay brick conforming to ASTM Designation C 32, Grade MM or C 62, Grade MW, except that brick absorption shall be between 5 and 25-grams of water absorbed in 1-minute by dried brick, set flat face down, in 1/8-inch of water.

G. Cement Mortar: Cement mortar for manhole construction shall comply with ASTM Designation C 270, Type M, except that the cement shall be Portland Type II only. No mortars that have stood for more than 1-hour shall be used.

H. Pipe Adapter: Connection of PVC gravity sewer lines to precast manholes and wetwells shall be made by using a flexible boot type manhole coupling adapter.

I. Interior Linings (existing structures): Interior surfaces of existing manholes and wetwells shall be coated or lined to resist corrosion where shown on the Drawings. Coatings and linings shall meet the requirements of Section 09901 Coatings and Linings.

J. Interior Linings (proposed structures): Interior surfaces of new wetwells shall be lined. Interior surfaces of new manholes shall be lined where shown on the Drawings. Coatings and linings shall meet the requirements of Section 09901 Coatings and Linings.

K. Joint Sealer: Joint sealer material for precast manhole structures shall be pre-formed flexible plastic conforming to Federal Specification SS-S-00210 (GSA-FSS). Seal all exterior joints with Portland Type II cement after setting of joint sealer and placement of manhole section to form a watertight joint.

L. Non-Shrink Mortar: Non-shrink mortar shall be used for filling annular spaces and holes in precast manholes and wetwells.

M. Manhole Encapsulation: Manhole cones, riser rings, iron frame, cover, and all joints shall be encapsulated with a heat shrink-wrap with a minimum thickness of 98-mils (2.5-mm).

1. Wrap shall have a cross-linked polyolefin backing coated with a protective heat activated adhesive. The wrap shall effectively bond to the substrate via primer provided by the manufacturer. The wrap shall be applied with a high intensity propane torch.

2. Heat shrink-wrap for all barrel section joints of manholes shall be a minimum 9-inch width. Corbel section, riser rings, and ring and cover shall have a minimum 12-inch width wrap.

3. Adhesive tap materials shall not be allowed.

PART 3 - EXECUTION

3.01 PREPARATION

A. Upon satisfactory excavation of the pipe trench, as specified in Section 02220 "Excavating, Backfilling and Compacting" a continuous trough for the pipe barrel and recesses for the pipe bells shall be excavated by hand digging so that, when the pipe is laid in the trench, true to line and grade, the pipe barrel will receive continuous uniform support and the bell will receive no pressure from the trench bottom.

B. The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered in the trench and shall be kept clean during laying operations by means of plugs or other approved methods.

3.02 INSTALLATION

A. Sewer Pipe

1. General

a. Laying of pipe shall proceed upgrade with spigot ends pointing in the direction of flow. Before pipe is joined, gaskets shall be cleaned of all dirt, stones, and other foreign material. The spigot ends of the pipe and/or pipe gaskets shall be lubricated lightly with a lubricant as specified by the pipe manufacturer and approved by the County. Sufficient pressure shall be applied to the pipe so as to properly seat the socket into the bell of the pipe. Any damage to the pipe due to over-exertion shall be replaced at the Contractor's expense. All pipe shall be laid straight, true to the lines and grades shown on the Drawings.

b. Variance from established line and grade, at any point along the length of the pipe, shall not be greater than 1/32-inch per inch of pipe diameter and not to exceed 1/2-inch, provided that any such variation does not result in a level or reverse sloping invert.

c. Any pipe, which is disturbed or found to be defective after installation, shall be taken up and relayed or replaced at the Contractor's expense.

d. Approved utility crossing signs shall be placed on the pipe alignment at each side of any waterway crossing.

2. PVC Pipe

a. Handling PVC pipe: The handling of PVC pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Sections of pipe with deep cuts and gouges shall be removed and discarded at no expense to the County.

b. Lowering pipe into trench: Care shall be exercised when lowering pipe into the trench to prevent damage to or twisting of the pipe.

3. Building Laterals/Service Connections

a. Service connections shall be constructed in accordance with the details as indicated on the Drawings.

b. Sewer lateral pipe shall be extended to the right-of-way and plugged at the right-of-way line to avoid leakage (unless otherwise indicated on the Drawings). All connections and changes of direction shall be made using standard fittings designed for that purpose.

c. Locator balls shall be placed under all sanitary sewer service cleanouts.

d. On curbed streets, the exact location for each service connection shall be marked by etching or cutting an "S" in the concrete curb. Where no curb exists or is planned, locations shall be marked by a method approved by the County.

4. PVC C-900 DR 14 Pipe Section: PVC C-900 DR 14 pipe shall be substituted for the specified PVC pipe where:

a. The sewer or service pipe is to be constructed with less than 30-inches of cover between the top of the pipe and the final top of pavement or ground line.

b. The PVC sewer main crosses over a water main, or is at a depth which results in less than 18-inches clear distance between pipes when crossing under a water main. The DR 14 pipe shall extend a minimum of 10-feet on each side of the point of crossing.

c. The lateral separation of the sewer pipe and potable water piping is less than 10-feet.

B. Manholes:

1. Manhole excavation and bedding at manhole junctions shall be performed in accordance with the provisions of Section 02220 "Excavating, Backfilling and Compacting" of these specifications.

2. The invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the inside of the adjacent sewer section using 2,500-psi concrete. Steep slopes outside the invert channels shall be avoided. Changes

in size and grade shall be made gradually and evenly. Changes in the direction of the sewer or entering branch shall be a smooth curve with radius as long as practicable. Invert channels shall also be formed for pipe stubouts.

3. The first pipe joint outside the manhole shall be located a minimum distance of 24-inches from the outside surface of the manhole.

4. Precast manhole tops shall terminate at such elevations to permit laying brick courses under the manhole frame to make allowance for future street grade adjustments.

5. Frames and covers shall be set accurately to conform to the finished grade.

6. Outside drop connections shall be made in accordance with the details shown on the Drawings.

7. Drop connection base slab extensions on precast manholes shall be manufactured monolithically with the manhole elements at the casting yard. The manufacturer shall submit for approval the method of drop manhole construction.

8. Where additional pipe connections or modifications of existing factory made openings are required on new or existing precast concrete manholes or wetwells, all cutting relative thereto shall be performed only by a power driven abrasive wheel or saw. It is specifically noted that such connections to existing manholes or wetwells shall be installed in accordance with the details for new units shown on the Drawings, and shall be caulked watertight with non-shrink grout.

9. Connection of the pipe entering the manhole shall be made by using a flexible boot type manhole coupling adapter. At the entry into the manhole, no part of the horizontal pipe shall rest against the concrete.

10. Manholes shall be completed as the work progresses so that testing may be conducted as prescribed in paragraph 3.03 Field Quality Control.

C. Concrete encasement: Class C concrete encasement shall be constructed in accordance with details shown on the Drawings.

1. The County may order the line encased when:

a. The sewer main crosses over a water main, or is at a depth which results in less than 18-inches clear distance between pipes when crossing under a water main. Encasement shall extend a minimum of 10-feet on each side of the point of crossing. In lieu of encasement, the sewer line may be constructed of PVC DR 14 pipe and shall be laid such that both joints will be a distance of 10-feet from the crossing.

b. The maximum width for trench excavations is exceeded. The Contractor shall construct concrete encasement around the pipe for the length of the excessive excavation. No payment will be made for the concrete encasement required due to excessive trench widths.

2. The points of beginning and ending of pipe encasement shall be not more than 6-inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

D. Concrete protective slabs: Concrete protective slabs as shown on the Drawings shall be constructed over gravity sewers that have less than 3-feet of cover from finished grade.

E. Connections to existing structures: Proposed sewer lines shall be connected to the existing manholes by core drilling the proper size opening and installing a flexible boot type manhole adapter as specified in paragraph 2.01.H of this Section.

F. Invert channels (benching) shall be provided for all new manholes and existing manholes which are connected into. No brick shall be allowed in construction of the manhole invert. Inverts shall be poured using 2,500-psi concrete.

3.03 FIELD QUALITY CONTROL

A. Workmanship: Sewers and appurtenances shall be built watertight. The sewage must be pumped for disposal and special care and attention must be paid to securing watertight construction. Upon completion, the sewers, or sections thereof, will be tested and gauged and if leakage is above the allowable limits specified, the sewer will be rejected.

B. Inspection: On completion of each block or section of sewer, or such other times as the County may direct, the block or section of sewer shall be cleaned, tested, and inspected.

1. Each section of the sewer shall show, on examination from either end, a full circle of light between manholes.

2. Each manhole or other appurtenance to the system shall be of the specified size and form, be watertight (no leakage allowed by visual inspection), and be constructed with the top set permanently to specified position and grade. All repairs shown necessary by the inspection shall be made; broken or cracked pipe replaced; all deposits removed and the sewer left true to line and grade, entirely clean and ready for use.

3. No pipe shall exceed a deflection of 5%. After the final backfill has been in place at least 30-days, the Contractor shall perform deflection testing using a rigid ball or mandrel with a diameter of not less than 95% of the base inside diameter or average inside diameter of the pipe, depending which is specified in the ASTM standard to which the pipe is manufactured. If the mandrel does not pass the completed section of sewer, the entire section of sewer will be rejected.

C. Closed Circuit Television Inspection:

1. Internal gravity sewer video inspection shall be performed by the Contractor to check for alignment and deflection. The television inspection shall also be

used to check for cracked, broken, or otherwise defective pipe and overall pipe integrity.

2. The video internal inspection will be performed in 2 stages. The first inspection shall be within 30-days after the installation of the gravity sewer pipe provided the road base is in place and the manhole rings and covers are to grade. The second inspection of the gravity sewer pipe shall be before the end of the 1-year warranty period.

3. If the first or second video inspection reveals cracked, broken, or defective pipe, or pipe misalignment resulting in vertical sags in excess of 1-1/2-inch or a ring defection in excess of 5%, the Contractor shall be required to repair or replace the pipeline. Successful passage of both the low-pressure air exfiltration test and video inspection is required before acceptance by the County.

4. Prior to repair or replacement of failed sewer pipe, the method of repair or replacement shall be submitted to the County for approval. Pressure grouting of pipe or manholes shall not be considered as an acceptable method of repair.

D. Low Pressure Air Exfiltration Testing:

1. The Contractor shall provide all labor, equipment, and materials and shall conduct all testing required under the direction of the County

2. Low pressure air testing shall conform to the requirements of UNI-B6-79 "Recommend Practice for Low-Pressure Air Testing of Installed Sewer Pipe", as published by UNI-Bell Plastic Pipe Association.

3. During sewer Construction, all service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged so as not to allow for air loss that could cause an erroneous air test result. Where necessary, the Contractor shall restrain caps, plugs, or short pipe lengths such that blowouts are prevented.

4. Each test section shall not exceed 400-feet in length and shall be tested between adjacent manholes.

5. Before testing, Contractor shall install monitoring wells at each manhole to determine groundwater level and adjust test pressure accordingly. In no case shall the test pressure exceed 9.0-psig. All pressurizing equipment shall include a regulator or relief valve set no higher than 9.0-psig to avoid over-pressurizing.

6. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0-psig greater than the average backpressure of any groundwater above the invert of the pipe, but not greater than 9.0-psig.

7. When temperatures have been equalized and pressure stabilized at 4.0-psig greater than the average groundwater backpressure, the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the

pressure is decreased to no less than 3.5-psig greater than the average groundwater backpressure. At a reading of 3.5-psig greater than the average groundwater backpressure, timing shall commence with a stopwatch or other timing device that is at least 99.8% accurate.

8. If the time shown in the table, for the designated pipe size and length, elapses before the air pressure drops 1-psig; the section under-going test shall have passed. The test may be discontinued once the prescribed time has elapsed.

9. If the pressure drops 1-psig before the appropriate time shown in the table has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

10. Should the section fail to meet test requirements, the Contractor shall determine the source or sources of leakage, and make all necessary repairs and shall repeat the test until the test section is within established limits. All corrective work shall be at the Contractor's expense.

E. Correction of Non-Conforming work:

1. All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the County. Non-conforming work shall be defined as failure to adhere to any specified or implied directive of these technical special provisions and/or the Drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the Drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, water standing in any pipe segment or structure, visible or detectable leakage, and failure to pass any specified test or inspection.

Table 02774-1
Test Time Table

TEST TIME:
For sewer diameter between 8 inches and 36 inches inclusive, the pipe shall be tested between adjacent manholes. The test time for the air pressure to drop the specified one pound shall be as listed below:

SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP

1 Pipe Dia. (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Feet							
				100	150	200	250	300	350	400	450
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.148 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:26	71:13	89:02	106:50	124:38	142:26	160:15
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

END OF SECTION

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SECTION 02775
WASTEWATER MANHOLE REHABILITATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Sanitary sewer manhole rehabilitation including:

1. Rehabilitation and leak proofing of manholes by lining with spray applied or centrifugally cast light-weight structural reinforced concrete, spray applied epoxy resin systems, or equal as determined by County.

2. The repair and sealing of the manhole base, bench, invert, walls, corbel/cone, and chimney of brick, block, or precast manholes, including the removal of any unsound material.

3. The inspection and testing of the various types of work to insure compliance.

1.02 REFERENCES

A. Codes, Specifications, and Standards (Not Used)

B. Testing and Materials Standards

1. American Society of Testing and Materials (ASTM)

C. Related Sections

1. Section 01516 "Collection System Bypass"

2. Section 02774 "Wastewater Gravity Collection Systems"

3. Section 09900 “Coatings and Linings”

4. Section 09910 “Prefabricated Fiberglass Liners”

1.03 DEFINITIONS (NOT USED)

1.04 RESPONSIBILITY FOR OVERFLOWS AND SPILLS

A. It shall be the responsibility of the Contractor to schedule and perform his work so as to result in no overflows or spills of sewage from the system. If sewage flows are such that they interfere with the Contractor’s ability to perform work, the Contractor shall be responsible for scheduling his work during low flow periods or provide bypass pumping. Bypass pumping shall be provided only with the specific written approval of the County.

B. In the event of overflows caused by the Contractor’s work activities, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify County in a timely manner.

C. Contractor will indemnify and hold harmless the County for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor. Should fines subsequently be imposed as a result of any overflow for which the Contractor is fully or partially responsible, the Contractor shall pay all such fines and all of the County's legal, engineering, and administrative costs in defending such fines and claims associated with the overflow.

1.05 SHOP DRAWINGS AND SUBMITTALS

A. Shop Drawings shall be submitted to the County for review and acceptance prior to starting construction in accordance with the General Conditions and 01300 "Submittals" for the following:

1. Manhole Liner

B. Submittals shall be submitted to the County for review and acceptance at least 14-days prior to starting manhole rehabilitation in accordance with the General Conditions and Division 1 for the following:

1. Manufacturers' Certificate of Compliance certifying compliance with the applicable Specifications and Standards. The certifications shall list all materials furnished under this Section.

2. Certified copies of factory tests required by the applicable Standards, the Manufacturer, and this Section.

3. Manufacturer's handling, storage, and installation instructions and procedures.

4. Recommended lining thickness design to withstand groundwater pressure as specified in Part 3 of this Section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials

1. All materials furnished for this work shall be in accordance with the "List of Materials and Approved Manufacturers" as appended to these Specifications.

2. The materials used shall be designed, manufactured, and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages clearly labeled with the manufacturer's identification and printed instructions. All materials shall be stored and handled in accordance with recommendations of the manufacturer. All materials shall be mixed and applied in accordance with the manufacturer's written instructions.

3. The Contractor shall warrant and hold harmless the County against all claims for patent infringement and any loss thereof.

4. Handle and store all materials and dispose of all wastes in accordance with applicable regulations.

5. Each lining system shall be designed for application over wet surfaces (but not active running water) without degradation of the final product and/or the bond between the product and the manhole surfaces.

B. The following shall be used for stopping active leaks in concrete and masonry manholes:

1. A premixed fast-setting, volume-stable waterproof cement plug consisting of hydraulic cement, graded silica aggregates, special plasticizing, and accelerating agents. It shall not contain chlorides, gypsum's, plasters, iron particles, aluminum powder, or gas-forming agents, or promote the corrosion of steel it may come in contact with. Set time shall be approximately 1-minute. Ten (10) minute compressive strength shall be approximately 500-psi.

2. A siliconate-based liquid accelerator field mixed with neat Portland cement. The set time shall be approximately 1-minute.

3. The elastomeric polyurethane resin-soaked method, using dry twisted jute oakum, or resin-rod with polyurethane resin (water activated).

C. The following shall be used for patching, repointing, filling, and repairing non-leaking holes, cracks, and spalls in concrete and masonry manholes:

1. A premixed non-shrink cement-based patching material consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, which has been formulated for vertical or overhead use. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas-forming agents or promote the corrosion of steel with which it may come into contact. Set time (ASTM C-191) shall be less than 30-minutes. One-hour compressive strength (ASTM C-109) shall be a minimum of 200-psi and the ultimate compressive strengths (ASTM C-882-Modified) shall be a minimum of 1,700-psi.

D. Spray applied or centrifugally cast structural reinforced cement manhole lining

1. The material applied to the surface of the manhole shall be a cementitious blend of calcium aluminate cement and manufactured calcium aluminate aggregates for constructing a liner that is impervious to the flow of water, is resistant to sulfide attack, and restores structural integrity to existing manhole walls.

2. A monolithic liner shall be formed which covers all interior manhole surfaces and shall have the following minimum requirements at 28-days:

Compressive Strength (ASTM C-579B)	3,000-psi
Tensile Strength (ASTM C-496)	300-psi
Flexural Strength (ASTM C-293) (Modified)	600-psi
Shrinkage (ASTM C-596)	0% at 90% R.H.

Bond (ASTM C-321)	130-psi
Density, when applied	105± pcf

E. Spray applied epoxy resin system manhole lining.

1. The material sprayed onto the surface of the manhole shall be an epoxy resin system formulated for application within a sanitary sewer environment. The resin will exhibit suitable corrosion resistance and enhance the structural integrity of the existing manhole.

F. Multi-component stress skin panel liner system.

1. The material applied onto the surface of the manhole shall be a multi-component stress skin panel liner system designed to withstand the effects of hydrogen sulfide without any deterioration to the liner. The liner shall be a solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the wastewater environment.

2. The cured epoxy resin system shall conform to the following minimum Structural Standards:

Table 02775-1
Minimum Structural Standards

Cured Product	Test Method	Results
Tensile Stress	ASTM D-638	7,000-psi
Flexural Stress	ASTM D-790	13,000-psi
Flexural Modulus	ASTM D-790	500,000-psi
Compressive Strength	ASTM D-695	13,000-psi

PART 3 - EXECUTION

3.01 REHABILITATION OF MANHOLE STRUCTURE

A. General Procedures

1. Safety: The Contractor shall perform all work in strict accordance with all applicable OSHA, state, local, and manufacturer's safety standards. Each method of manhole rehabilitation in this Section requires some degree of manhole entry by workers. Particular attention is drawn to those safety requirements regarding confined space entry and respiratory protection from airborne particulate materials during cleaning, product mixing, and application.

2. Cleaning: All concrete and masonry surfaces to be rehabilitated shall be clean. All grease, oil, laitance, coatings, loose bricks, mortar, unsound brick or concrete, and other foreign materials shall be completely removed. Water blasting utilizing a 210°F steam unit and proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers, or mechanical means may be required to properly clean the surface. All surfaces on which these methods are used

shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not discharged downstream.

3. Stopping Infiltration: After surface preparation and prior to the application of mortars and coatings, infiltration shall be stopped either by plugging with a waterstop compound or chemical grout sealing.

4. Patching: All large holes or voids around joints, or pipes and all spalled areas and all holes caused by missing or cracked brick shall be patched. All missing mortar shall be repointed using a non-shrink patching mortar. All cracked or disintegrated material shall be removed from the area to be patched or repointed, exposing a sound sub base. All cracks not subject to movement and greater than 1/16-inch in width shall be routed out to a minimum width and depth of 1/2-inch and patched with non-shrink patching mortar.

5. Flow Control: The Contractor shall be responsible for plugging or diverting the flow of sewage as needed for repair and lining of manhole inverts and benches.

6. Remove all loose grout and rubble from existing channel. Rebuild channel if required by reshaping and repairing slope of shelves or benches. Work shall include aligning inflow and outflow ports in such a manner as to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve with the largest possible radius and shall be shaped to allow easy entrance of maintenance equipment including buckets or T.V. camera.

7. Each lining system shall be installed in accordance with the manufacturer's recommendation to withstand groundwater pressures. For manholes greater than 12-feet in depth, the lining shall withstand the pressures associated with a groundwater depth equal to the manhole depth. Linings for all other manholes shall withstand the pressures associated with groundwater depth of 12-feet. Measure groundwater depth from manhole bench to top of ground surface.

8. Application of products shall be by factory certified applicators.

3.02 SPRAY APPLIED LIGHT-WEIGHT STRUCTURAL REINFORCED CEMENT

A. The surface prior to spraying shall be damp without noticeable free water droplets or running water. Materials shall be spray-applied to a minimum uniform thickness to insure that all cracks, crevices, and voids are filled and a somewhat smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.

B. The first application shall have begun to take an initial set (disappearance of surface sheen, which could be 15-minutes to 1-hour depending upon ambient conditions) before the second application to assure a minimum total finished thickness of 1/2-inch. The final finished thickness may need to be greater than 1/2-inch as

recommended by the manufacturer to withstand groundwater pressures. A depth gauge shall be used during application, at various locations, to verify the required thickness. The surface then shall be trowelled to smooth finish with care taken not to over trowel so as to bring additional water to the surface and weaken it. Manufacturer's recommendations shall be followed whenever more than 24-hours have elapsed between applications.

C. The bench covers used to catch debris shall be removed and the bench and invert sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/2-inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

D. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24-hours after application. If ambient temperatures are in excess of 95°F, precautions shall be taken to keep the mix temperature at time of application below 90°F, using ice if necessary.

E. The final application shall have a minimum of 4-hours cure time before being subjected to active flow.

3.03 CENTRIFUGALLY CAST STRUCTURAL REINFORCED CEMENT

A. Application procedures shall conform to the recommendations of the manufacturer.

B. The rotating casting applicator shall be positioned to evenly apply the material and be withdrawn at a rate to assure a final minimum thickness of 1-inch. The final finished thickness may need to be greater than 1-inch as recommended by the manufacturer to withstand groundwater pressures. A depth gauge shall be used during application, at various locations to verify the required thickness.

C. The bench covers used to catch debris shall be removed and the bench and invert sprayed or hand applied so that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/2-inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

D. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24-hours after application. If ambient temperatures are in excess of 95°F, precautions shall be taken to keep the mix temperature at time of application below 90°F.

E. The final application shall have a minimum of 1-hour cure time as recommended by the manufacturer before being subjected to active flow.

3.04 SPRAYED APPLIED EPOXY RESIN SYSTEM

A. Application procedures shall conform to the recommendations of the manufacturer.

B. The epoxy resin shall be sprayed onto the surfaces of the manhole walls, benches, and inverts to produce a smooth coating and yield the required structural integrity and

corrosion resistance. A depth gauge shall be used during application at various locations to verify the required thickness.

C. The epoxy resin shall be applied to a minimum thickness of 0.125-inches (125-mils) at the top of the manhole and gradually thickened in accordance with manufacturer's recommendations to withstand groundwater pressures. The application shall have a minimum cure time as recommended by the manufacturer before being subjected to active flow.

D. The sloped surface of the manhole bench shall be made non-skid by broadcasting aluminum oxide or sand into the surface prior to gelatin/set.

3.05 MULTI-COMPONENT LINER SYSTEM

A. Application procedures shall conform to the recommendations of the manufacturer.

B. The liner system shall be sprayed onto the surfaces of the manhole walls, benches, and inverts to produce a smooth surface. The spray equipment shall be specifically designed to accurately ratio and apply the liner system.

C. Final installation shall be a minimum of 500-mils.

D. The application shall have a minimum cure time as recommended by the manufacturer before being subjected to active flow.

3.06 SANITARY SEWER LATERAL CONNECTIONS TO MANHOLES

A. Sanitary sewer lateral connections to rehabilitated manholes shall be reinstated to provide a seamless, leak free, and unobstructed flow connection between the new manhole lining or coating system and the lateral connection per 3.01A.

B. Sanitary sewer laterals requiring rehabilitation shall be renewed per Section 02772 "Cured-In-Place Pipe (CIPP) For Lateral Renewal."

3.07 MANHOLE REHABILITATION ACCEPTANCE

A. Test all rehabilitated manholes using the vacuum test method as per ASTM C 1244 "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test", following the manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Any visible leakage in the manhole or structure before, during, or after the test shall be repaired regardless of the test results.

B. All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole. A vacuum of 10-inches of mercury (5.0-psi) shall be drawn on the manhole, and the time shall be measured for the vacuum to drop to 9-inches of mercury (4.5-psi). Manholes will be considered to have failed the air test if the time to drop 1-inch of mercury is less than what is shown in the following table:

Table 02775-2
Vacuum Test Timetable

Vacuum Test Timetable Manhole Diameter – Inches				
Depth – feet	48-inches	60-inches	72-inches	96-inches
4	30 sec.	30 sec.	30 sec.	30 sec.
8	30 sec.	30 sec.	32 sec.	38 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.
24	60 sec.	78 sec.	96 sec.	114 sec.
+ Each 2’	+5 sec.	+6.5 sec.	+8.0 sec.	+9.5 sec.

C. Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 24-feet, add the values listed in the last line of the table for each 2-feet of additional depth.

D. If the manhole or structure fails the vacuum test, the Contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

E. After the manhole rehabilitation work has been completed, the manhole shall be inspected by the Contractor in the presence of the County and the work shall be accepted if found satisfactory to the County. No evidence of visible leaks shall be allowed. Non-uniformity, sagging, lamination, holidays or other defects will be cause for rejection of the coating. All surfaces shall be tested for the presence of holidays and pinholes via spark testing at 100-volts per millimeter. The Contractor shall provide the testing equipment and perform the testing in the presence of the County. Any holidays or pinholes found during the testing shall be repaired and the surface re-tested until the surfaces are completely free of holidays and pinholes.

3.08 CLEANUP

A. After the installation work has been completed and the testing is acceptable, the Contractor shall clean up the entire project area. The Contractor shall dispose of all excess material and debris. The work area shall be left in a condition equal to or better than the prior condition.

3.09 WARRANTY

A. The Contractor shall guarantee his work for a warranty period of 1-year from the date of acceptance.

B. If at anytime during the warranty period any leakage, cracking, loss of bond, or other discontinuity is identified, the Contractor shall remove and replace the manhole liner with new material at no cost to the County. No field repair shall be approved.

C. Furnish an extended warranty for manhole rehabilitation materials from the Contractor and liner manufacturer for a total of 5-years from date of final completion.

END OF SECTION

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SECTION 02776
PACKAGED METERING MANHOLE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes all Packaged Metering Manholes required for the complete installation of the work.

1.02 RELATED WORK

A. Refer to Section 13315 for Ultrasonic level/flow meter.

1.03 REFERENCE STANDARDS AND REQUIREMENTS

A. Design, fabricate packaged metering manholes and materials in accordance with manufacturer's recommended procedures and the following codes and standards:

1.	ASTM A193	-	Stainless Steel Anchor Bolts
2.	ASTM D 256	-	Izod Impact Strength
3.	ASTM D 570	-	Water Absorption Rate
4.	ASTM D 638	-	Tensile Strength
5.	ASTM D695	-	Compressive Properties of Rigid Plastic
6.	ASTM D 696	-	Coefficient of Linear Expansion
7.	ASTM D 790	-	Flexural Properties
8.	ASTM D792	-	Density and Specific Gravity at 230 C
9.	ASTM D2563-0	-	Visual Defects
10.	ASTM D 2583	-	Indentation Hardness
11.	ASTM D2584	-	Resin, Glass & Filler Content
12.	ASTM D3753-12	-	Polyester Manholes
13.	ISO1438/1-1980	-	Open Channel Flow Measurement
14.	OSHA 1910.27	-	Fixed Ladders

B. Composition of the packaged metering manhole laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI), and the Material Technology Institute (MTI) of the Chemical Process Industry for "Hand Lay-Up Laminates," and shall meet the specifications for Type I, Grade 10.

C. Manufacturer shall be experienced in the design and manufacture of specific packaged metering manholes and accessories for a minimum period of 10 years.

D. Manufacturer must provide warranty for 10 years against failure due to corrosion.

1.04 SUBMITTALS

A. Approval Drawings:

1. Showing all critical dimensions.

2. Showing principal parts and materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ship all packaged metering manholes with suitable packaging to protect products from damage.

B. Protect packaged metering manhole flanges, tabs and accessories from damage.

C. The packaged metering manhole shall be stored on a smooth flat surface, free of sharp objects, and if laid horizontally, shall be placed in such a way as to avoid structural damage.

1.06 WARRANTY AND GUARANTEES

A. Provide equipment warranty in accordance with Sections 01600 and 01740.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Packaged metering manholes body shall be:

1. Engineered composite fiberglass reinforced plastic (FRP).

a. Molded in one piece to create a seamless corrosion barrier impervious to moisture.
b. FRP resin shall be polyester.

2. Packaged metering manholes hardware: T-316L stainless steel.

2.02 PACKAGED METERING MANHOLES

A. Acceptable Manufacturers:

1. Plasti-Fab.

a. Shall be Model packaged metering manhole 60”x 15’ (diameter x depth)

2. The packaged metering manholes fabrication, flume, engineering and customer support shall all be provided by the same company.

3. To assure quality control and single source accountability the same manufacturer shall fabricate and fully assemble the packaged metering manholes and all components.

4. Or approved equal.

2.03 PACKAGED METERING MANHOLES

A. Packaged metering manholes shall conform to ASTM D3753-12.

B. Composition of the packaged metering manholes laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermostat Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI) and the Material Technology Institute of the Chemical Process Industries, Inc. (MTI) for "Hand Lay-up Laminates" and shall meet the specifications for Type 1, Grade 10 laminates.

1. Visual inspection for defects shall be made without the aid of magnification and defects shall be classified as to type and level as shown in Table 1 of ANSI/ASTM D2563-0, approved 1977, (or any subsequent revision). Allowable surface tolerances are as follows:

Table 1

Defects	Allowable Tolerance
Cracks Crazing Blisters Chips Pits Dry Spots Fish Eyes Burned Areas Entrapped Air	None
Wrinkles and solid blisters, not to exceed 1/8"	Maximum Deviation: 10% of thickness
Structural horizontal and vertical level tolerance	1/8"
Surface porosity (pinholes or pores in the laminate surface)	None
Exposed Glass Exposure of cut edges	None
Scratches	Not more than 0.002" deep (0.05mm)
Foreign Matter	None

2.04 CONSTRUCTION

A. Packaged metering manholes

1. Each packaged metering manhole shall be a complete integral unit consisting of: a corrosion resistant fiberglass reinforced plastic (FRP) manhole with sealed fiberglass bottom, fiberglass access ladder, metering flume and accessories as required.

2. Packaged metering manhole body shall be totally manufactured of fiberglass reinforced polyester.

3. Each packaged metering manhole shall be molded individually to the exact dimensions specified.

4. The thickness of the walls and floor of the packaged metering manhole shall be not less than 1/2" (12mm) thick.

5. Packaged metering manhole shall be manufactured of reinforced thermoset plastic in one integral piece that is structurally strong, lightweight, watertight and corrosion resistant to salt water, ground water, corrosive soil conditions and many commonly encountered industrial chemicals.

6. Packaged metering manhole inside surface shall be smooth, isophthalic gelcoat of 10 - 20 mil (0.25 - 0.51mm) thickness. Exterior Surface shall be grey gel coat 15-20 mil (0.25 – 0.51mm) thickness for UV protection.

7. The surface shall be free of exposed reinforcing fibers.

8. The minimum glass content shall be 30% exclusive of gelcoat surfaces.

9. Any portion of the flume or end adapters extending outside the manhole shall have a reinforced cover.

10. The manhole sides, bottom and external flume sections shall be designed to withstand a static load of 150 lb./ft. per foot (68 kg/305mm) of depth with less than l/4" (6mm) deflection.

11. There shall be no light duty angles of flanges protruding beyond the flume or manhole that can be damaged by shear or load forces.

12. Inlet and Outlet Pipes: The FRP manhole and flume shall be provided with 38-19/64 inch O.D. pipe stubs for connection to 36 inch O.D. incoming and outgoing HDPE pipe. Flume end adapters shall allow a smooth flow transition between pipe and flume.

    a. Two neoprene boots with stainless steel clamping bands shall be supplied and sized to connect inlet and outlet pipe stubs to the pipeline.

13. Cover

    a. The packaged metering manhole will be furnished with a fiberglass cover equipped with heavy duty stainless steel hinges having l/2" (12mm) diameter hinge pins and stainless steel hasp for locking. The cover shall be sufficient strength to withstand a distributed 1,000 lbs. (454kg) top load. The cover shall overlap the manhole and seat on a neoprene seal to prevent dirt, rain and debris from getting into the manhole.

    b. The packaged metering manhole shall have a concentric manway designed to withstand a 16,000 lb. (7,257kg) vertical dynamic wheel load (H-20), plus lateral forces from earth loading, ground water and

frozen soil. The manhole opening shall be a 36” manway for use with a cast iron cover, suitable for H-20 highway loading.

c. The Packaged Metering Manhole shall have aluminum hatch access 36” round casting.

14. Internal Ladder: The ladder rungs shall be constructed of non-corrosive material and have a non-slip traction surface and internal stainless steel safety bar. The ladder shall meet or exceed OSHA General Industry Standards, Part 1910.27 for "Fixed Ladders".

15. Utility Tap: The manhole barrel shall be fitted with 2" (51mm) FRP through-wall utility tap(s) having threaded connections to permit sub-grade entrance for power, sample or recording lines without damaging the watertight integrity of the manhole.

16. An l/2” (12mm) thick expanded polystyrene bead board will be supplied for placement on the concrete slab under the manhole.

17. The manhole shall be equipped with hold-down brackets for anchoring the manhole to a concrete slab. The hold-down brackets on the manhole shall be fixed on the manhole by the manufacturer and the other brackets for anchoring the manhole to a concrete slap shall be provided by the manhole manufacturer. The brackets shall be corrosion resistant.

18. Options

a. Flume / Whole Bottom Cover: Fiberglass grating shall be installed over the flume to provide a walking surface and to prevent debris from falling into the flume.

b. Head deflector / lid warning sign / ladder up with safety track.

c. Vent piping.

d. Ultrasonic sensor mounting bracket

2.05 PHYSICAL PROPERTIES

A. Structural characteristics for a 1/8” (3mm) glass mat laminate shall meet the following minimum physical properties:

Tensile strength	15,000 psi (1,034 ksc)
Flexural Modulus	1,000,000 psi (70,307 ksc)
Flexural Strength	20,000 psi (1,406 ksc)
Compressive Strength	22,000 psi (1,547 ksc)
Impact Strength	9.0 ft-lbs/in. (1.24 kgf/m)
Water absorption	0.13% (in 24 hours)

2.06 DIMENSIONS

A. Fiberglass barrel shall be 72” diameter.

B. Manhole depth shall be per drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Packaged metering manholes too large to ship in one piece shall be shipped in flanged and match-drilled sections along with stainless steel fasteners for onsite assembly.

B. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Thoroughly clean and remove all shipping materials prior to setting.

D. Install products in accordance with the engineer's specifications, local codes, general comments below and the Manufacturer's recommendations.

E. Care shall be taken in the handling, storage and placement of the packaged metering manhole in preparation for installation. The contractor shall become familiar with the recommended handling and installation procedures used with fiberglass metering manholes to insure that the manhole is not damaged, and that the flume is installed in a manner that is consistent with obtaining good open channel flow results.

F. Slinging shall be accomplished using nylon or other fabric material. Under no circumstances shall cable or chain slings be used in direct contact with fiberglass surfaces

G. The packaged metering manhole shall be installed level end-to-end and side-to-side, and must remain level throughout installation. The flume is factory installed in the metering manhole so that it is absolutely level from front to back and from side to side, and must remain level after installation.

H. The site shall be excavated wide enough to accommodate the manhole and to provide a safe working environment for workers.

I. The contractor shall provide a level concrete slab with a smooth troweled surface. The slab elevation shall be as shown on the drawings, and positioned so that the invert of manhole piping matches that of the pipeline. Prior to manhole placement the slab shall be cleaned of all sharp objects and debris.

J. The foam pad supplied with the manhole shall be placed in the proper position.

K. If the pipe is already in place the neoprene boots and stainless steel bands shall be slipped onto the pipe ends before lowering manhole onto concrete slab. The neoprene boots can be slipped over pipe ends and the stainless steel clamps tightened securely. Under no circumstances shall petroleum lubricants of any type be used to install neoprene boots.

L. Packaged metering manhole shall be lowered onto pad in accordance with the manufacturer's written recommendations.

M. Flume level shall be checked and packaged metering manhole adjusted if necessary.

N. After the level is confirmed all anchor bolts shall be securely tightened.

O. On larger flumes all open spaces under the flume shall be filled with grout to provide adequate structural support.

P. Backfill

1. Care shall be taken to avoid uneven backfill loads on the FRP manhole and flume.

2. Groundwater or surface water runoff shall not be allowed to accumulate in the open excavation around a manhole that has not been completely backfilled.

3. Backfill materials shall be placed evenly around the packaged manhole in approximately 12” (305mm) lifts.

4. If materials other than pea gravel or sand are to be used as fill there shall be no soil lumps or sharp objects such as rocks or concrete, or other debris larger than 1” (25mm) in size.

5. All fill work will be in compliance with local codes, and shall meet the inspection standards established by the engineer.

6. Stable Soils: Bearing capacity greater than 2,000 lbs./ft^2 (186 kg/m^2). Native soil, 1/4" x 3/8" (6mm x 9.5mm) round aggregate gravel or sand shall be used as backfill material, and placed in accordance with the above specifications.

7. Unstable Soils and High Water Tables: Bearing capacity less than 2,000/lbs./ft^2 (186 kg/m^2). Sand or 1/4" x 3/8" (6mm x 9.5mm) rounded aggregate, compacted, shall be used in unstable soils such as expansive clays, marsh and/or where the water table may be less than 5’ (1524mm) from finished grade. Selected backfill shall be placed in maximum 12” (305mm) lifts, a minimum of 24” (610mm) surrounding the manhole, and compacted to 85% Standard Proctor Density.

8. Finish to Grade: For concentric top, contractor shall finish to grade using brick and mortar or precast concrete rings to construct chimney of required height. Mortar bed and first grade ring shall be firmly supported on flat, bearing shoulder of the packaged manhole.

3.02 ADJUSTMENT AND START UP

A. Check Flume for being level both directions and packaged metering manhole for meeting dimensional requirements and cleaned per manufacturer’s instructions.

B. Start-up / calibration of meter per section 01650

C. Site to be left clean and free of any debris.

D. Representative shall complete a Certification of Proper Installation and provide copies to the Owner, Engineer, Contractor and Manufacturing Facility.

END OF SECTION

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SECTION 02930
TREES, SHRUBS, GROUND COVERS AND SOD

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish all labor, materials, equipment and incidentals required to complete the installation of all plantings and other items necessary to complete the landscape work as shown or implied by the Drawings or in the Specifications. Work under this Section shall include labor and materials for final fine grading and raking to prepare the site for landscape material installation and sodding so finished planting beds and lawn surfaces will appear even and uniform, will drain adequately, and will comply with the intent of the landscape drawings.

B. The Contractor shall cooperate with and coordinate with all other trades whose work is built into or affects the Landscape and irrigation construction. Refer to irrigation specifications and plans for coordination with landscape specifications and plans.

C. If underground construction, utilities conflicts or other obstructions are encountered in excavation of planting areas or pits, the contractor shall contact the Project Manager immediately (during business hours) to select a relocated position for any materials necessary.

D. Contractor is responsible for protecting utilities, paving, light fixtures, piping, conduit, equipment and other facilities from damage during landscape installation.

E. Contractor must provide tree protection within the scope of work as shown on the plans. Special tree permits are required to be obtained by the contractor. Refer to Orange County, FL Land Development Code Chapter 15 and these specifications for specific requirements.

1.02 DEFINITIONS

A. "Final Acceptance" shall mean that point in time when all requirements of project drawings are completed, including any punch-list items, to the satisfaction of the Owner. The Contractor shall be notified in writing of final acceptance by the Owner's representative.

B. "Maintenance Period" or "Warranty Period" shall begin when plant material is installed and continue for a twelve- (12) month period after notification of Final Acceptance.

C. "Final Maintenance Inspection" by Orange County representative shall occur at the end of the twelve (12) month maintenance warranty period.

D. "Nursery-grown" shall mean grown in the nursery from liners or collected and then grown in a nursery at least two years.

E. "Healthy, vigorous condition" shall mean live foliage out to the tips of all branches and stems (except during winter if deciduous), and a trunk caliper that is bigger, 12 months after planting, than at planting. There are no signs of insect or disease

infestations on the plant. Roots are not “root bound” circling around the trunk. Healthy, vigorous palms have new fronds developing with no necrosis or chlorosis and are green in color.

1.03 QUALITY ASSURANCE

A. The landscape installation shall be done by a single experienced Landscape Contracting firm specializing in landscape horticulture and site construction. The Landscape Contractor shall be responsible for ensuring the accuracy, proficiency and quality of the sub-contractor’s work.

B. The Contractor shall carefully examine the site and all existing conditions affecting the work, such as: soil, obstructions, existing trees, above and below grade utilities, drainage, slopes, etc. Report any conditions in conflict with the work to the Project Manager and Project Engineer.

C. The Contractor shall be responsible for ensuring that the trees to be protected are found to be in good, healthy condition at the time of final inspection. .

D. All work of this Section shall conform to the highest standards of landscape practices. Landscape installation standards of practice can be found at the University of Florida IFAS Extension Service http://edis.ifas.ufl.edu/, and Florida Friendly Landscape Guidelines from the State of Florida Dept. of Environmental Protection and Florida’s Water Management Districts http://www.dep.state.fl.us/water/waterpolicy/docs/LandscapeIrrigationFloridaFriendlyDesign.pdf. Best Practices, Training and Certifications in landscape contracting may be obtained from the Florida Nursery, Growers and Landscape Association http://www.fngla.com/certifications/FCLC/ and the Professional Landcare Network https://www.landcarenetwork.org/certification/index.cfm. Safety standards for arboricultural workers shall be per ANSI Z133.1 Safety Regulations and ANSI A300 Tree Care Regulations.

E. Equipment necessary to perform the contract is to be kept clean and in good working order. The site is to kept neat and orderly with a daily clean up detail to pick up and dispose of containers, unused materials and debris.

F. The Plant Material Schedule (Plant List) included with these Plans is provided only for the Contractor’s convenience; it shall not be construed as to conflict or predominate over the Plans. If conflict between the Plans and Specifications exists, the Plans shall predominate and be considered the controlling document.

G. Plant names shall comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed there shall conform generally with names accepted by the nursery trade. Stock provided shall be true to its botanical name and legibly tagged.

H. Plants shall comply with sizing and grading standards of the latest edition of Florida Grades and Standards for Nursery Plants from the State of Florida Dept. of Agriculture http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry. All plant material shall be "Florida Fancy" or "Florida #1".

I. Substitutions shall not be accepted and will constitute an unresponsive bid. The Project Manager or the Landscape Architect reserves the right to reject any and all plant material. The contractor shall provide an acceptable replacement at no additional charge.

1.04 MAINTENANCE

A. Begin maintenance immediately after planting. Maintain all plant material until final acceptance and then for a maintenance and warranty period of twelve (12) months after final acceptance.

B. The Contractor shall maintain all plant materials in a first class condition from the beginning of landscape construction until Final Acceptance and then through the warranty period of 1 year.

C. Maintenance shall include, but not be limited to, watering of turf and planting beds, mowing, fertilizing, cultivation, weeding, pruning, disease and pest control, replacement of dead materials, straightening, turf or planter settlement corrections, replacement of rejected materials, staking repair and tightening, wash-out repairs and regrading, and any other procedures consistent with the good horticultural practice necessary to insure normal, vigorous and healthy growth of all work under the Contract. Maintain mulched areas and plant beds surface weed-free.

D. Mowing shall be consistent with the recommended height for St. Augustine turf per the University of Florida Cooperative Extension Service. Mow new sod for the first time only after it is firmly knitted into the soil. Neatly trim edges. Avoid using weed-whackers near trees to mow edges, instead pull by hand. Immediately remove clippings; do not blow into gutters or storm drains.

E. Contractor shall guarantee all sod work up until the end of the maintenance period. Contractor shall replace any defective or distressed grass materials at no additional cost to the Owner. During the guarantee period, it shall be the Contractor's responsibility to immediately replace any dying or dead material.

F. The Project Manager or Orange County Staff will periodically inspect the site to ensure warranty work is being done to their specifications. They will instruct the Contractor to correct defective work. Remove and replace rejected material within one (1) week from notification. The site should be left ready to be safely used by County employees.

G. Within the warranty period, the Owner shall notify the Contractor of any maintenance practices being followed or omitted which would be detrimental to the healthy, vigorous growth of the landscape.

H. The contractor is entirely responsible for the irrigation through final acceptance and twelve (12) month warranty period. Plant material shall receive water in accordance with the following water schedule:

Size of nursery stock	Irrigation schedule for vigor
< 2 inch caliper trees, all shrubs and groundcovers	Daily for 2 weeks; every other day for 2 months; weekly until established.
2-4 inch caliper	Daily for 1 month; every other day for 3 months; weekly until established.
> 4 inch caliper	Daily for 6 weeks; every other day for 5 months; weekly until established.

I. Irrigation frequency can be reduced slightly (e.g. 2-3 times each week instead of every other day) when planting hardened-off, field-grown trees that were root-pruned during production. Establishment of trees takes 4 (in hardiness zone 9) months per inch trunk caliper, thus a 3" tree takes 12 months to become established. Take into consideration natural rainfall amounts and adjust irrigation rates accordingly. At each irrigation period for trees, apply 2-3 gallons per inch trunk caliper to the root ball. Apply it in a manner so all water soaks into the root ball. Do not water if root ball is wet/saturated on the irrigation day. Irrigate more during drought and the following spring and summer. Once the tree is established, watering may be reduced. Rain or Soil Moisture Sensors may be specified with the irrigation system and will shut off the irrigation system automatically during a rain event. Trees need to be monitored if automatic rain shut off technology is used. The Saint Johns River Water Management District has watering restrictions:

http://www.sjrwmd.com/wateringrestrictions/restrictions.html

that allow the use of reclaimed water anytime.

J. At any time during the warranty period any tree, shrub or groundcover is dead or showing indication of probable non-survival; does not exhibit the characteristics to qualify for the minimum grade as originally specified as determined by the Owners' representative; shall be promptly replaced. Replacement trees shall be warranted as specified for new trees, and shall be subject to original specifications and warranty.

K. All replacements, which are the responsibility of the Contractor, shall be trees of the same kind and size as specified in the Plant List or by change order and in these specifications and shall be planted as specified. The cost of the replacement and all items necessary to replace the tree shall be the responsibility of the Contractor.

1.05 WARRANTY INSPECTIONS

A. Maintenance Inspections during the warranty period shall be made by the Owner's Representative to insure that proper maintenance is being performed by the Contractor or Contractor's sub-contractor. The Contractor shall monitor all other work in the area which may affect the plant materials for which he is responsible by guarantee, to assure that maintenance being performed by others will not jeopardize the condition and quality of the work and materials guaranteed by the Contractor. Any inadequate or damaging maintenance practices by others shall be reported immediately in writing to the Owner, so that appropriate measures may be taken to correct the condition. Failure to so notify the Owner of damage to trees will invalidate any later claim of negligence or malpractice in maintenance.

B. At the end of the Warranty period, the contractor shall contact the County to request a warranty inspection, giving at least 10 business days' notice. The County representative will re-inspect all plants and turf at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turf immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification to the satisfaction of the County staff. Upon satisfactory completion of maintenance period as determined by the maintenance inspection and the completion of any outstanding issues found, the Owner's Representative shall provide a letter of final acceptance.

1.06 PAYMENT

A. All work, labor, materials, operations, methods and other items necessary to complete the work as specified or implied in the contract documents under this Section shall be considered to be incidental to the cost of the job.

B. Final payment will be made after the Owner's acceptance letter has been given to the contractor at the end of the warranty period.

PART 2 - PRODUCTS

2.01 TREES, SHRUBS AND GROUNDCOVERS

A. Nomenclature shall conform to the names given in "Standardized Plant Names", 1942 Edition, prepared by the American Joint Committee on Horticulture Nomenclature, or by the Bureau of Plant Industry, State of Florida. All plants shall be true to botanical, common, and variety name. Botanical names have precedence over common names.

B. Plants shall be provided in the species, size, and quantities indicated on the drawings. All sizes specified are minimum dimensions.

C. Do not make substitutions. If specified landscape material is not available, submit to the Landscape Architect proof of it not being available and a written request for a substituted species. The Contractor must have written approval by the Landscape Architect for any substitutions not previously agreed to in the purchase agreement: Installation of substitutes without approval is prohibited and entirely at the Contractor's risk.

D. Provide vigorously living plant stock grown under climatic conditions similar to conditions in the locality of the project. Plants shall have a habit of growth that is normal for the species and shall be sound, healthy and free from insects, pests, diseases, injuries, and structural defects. Tree trunks shall be free of fresh pruning cuts, planting scars or shipping damage. Trees must be healthy, vigorous and full with good branch distribution.

E. Each tree shall have a minimum of three main structural roots reasonably distributed around the trunk. Trees with less than three or with main roots on only one side shall be rejected. Trees shall not have roots circling the trunk or have a top system too large for the size of container.

F. All shrub and groundcover plants shall be container grown. Trees may be either container grown, Roots-plus grown or ball and burlap (B&B) from a licensed Florida nursery. Plants shall be obtained within horticultural zone 9B). Any plants from outside this area must have prior approval from the Landscape Architect.

G. All shrub measurements shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not extreme branch, tip to tip.

H. All container grown plants including groundcovers shall be well rooted (but not root bound) and established in the container in which they are delivered to the site. The plants shall have been in that container sufficiently long for the fibrous roots to hold the soil together when the plant is removed from the container. Root-bound plants will not be accepted.

I. All material acquired through additions or substitutions shall be subject to all conditions and warranties stated herein.

J. The caliper of a new tree four (4) inches or less in size shall be measured six (6) inches above grade. New trees greater than four (4) inches in caliper shall be measured at twelve (12) inches above grade.

K. Field-grown trees and palms shall be nursery-grown (not collected) and hardened off (pre-dug) for a minimum of six (6) weeks prior to delivery to job site.

L. Root balls of field-grown trees must be intact and protected from desiccation with burlap and/or black plastic wrap. Container trees must have the container on the root ball or the root ball must be appropriately protected from desiccation with a wrap. Trees with root balls that have excessively rootbound, circling or girdled roots shall be rejected. Synthetic burlap will not be accepted. The top of the first major root originating from the tree trunk must be in the top 1 inch of the root ball soil. If the first root is deeper than this, the tree will be rejected. Brush away debris to expose the root collar to check if it is above the soil. Then cut away any roots that grow over the collar. Also cut any roots that circle or mat along the sides and bottom of the root ball.

M. Container trees should have few, if any, roots on the outside surface of the media. Trees must have green, live foliage. Shocked plants (i.e. those with dead or dying leaves) will be rejected.

N. Groundcover plants shall be furnished in one gallon containers as specified on the plans. The plants shall be at least one year-old, and have sufficient root development and new top growth to ensure survival and future growth.

2.02 SOD

A. Solid sod shall be of even thickness and with a robust root structure, 98% free of noxious weeds, freshly mowed before cutting, moist yet not wet and in healthy condition when delivered and laid. Sod shall be Florida Standard Grade, a minimum age of 18 months, with root development that will support its own weight without tearing when suspended vertically by holding up the upper two corners. Sod pads shall be 18 by 24 inches +/- 5% and 1" of soil on the roots. Sod shall be uniform in green color, leaf texture and density. Brown or yellow sod shall not be accepted.

B. Turf shall be grown in Florida by a sod farm that is a member of the Turfgrass Producers of Florida, specializing in sod production and harvesting, with a minimum of five years' experience and certified by the State of Florida. The sod shall be certified by the grower to be true to botanical variety Paspalum notatum "Argentine" / Bahia Argentine Sod or equal. Sod shall be certified to be free of diseases, nematodes, pests, fire ants, and pest larvae as well as free of weeds and weed seeds.

2.03 MULCH

A. Cypress mulch will not be accepted.

B. It is preferred that Mulch be derived from an exotic invader tree species, e.g. Melaleuca, Eucalyptus, Florimulch or equal, or a Florida resource. Fine shredded bark/wood or small pine bark is acceptable. The mulch shall be its natural color and not dyed. Mulch is to be approved by the Landscape Architect.

C. Mulch shall be clean and free from weeds and other debris.

2.04 FERTILIZER

A. Fertilizer shall comply the laws of the State of Florida.

B. Granular fertilizer shall be uniform in composition; free flowing; received at the site in full, labeled, unopened bags bearing the name, trade name or trademark and warranty of the producer; fully conforming to State of Florida fertilizer laws.

C. All fertilizer shall bear the manufacturer's statement of analysis and shall contain the appropriate minimum amounts of elements for the type of use specified herein.

D. Scotts Agriform 20-10-5 21 gram fertilizer tablets or approved equal shall be placed in planting pit for new trees at time of installation and prior to completion of pit backfilling.

E. Ground cover areas shall receive fertilization with Osmocote Time Release Fertilizer or equal according to product instructions and rate.

F. If indicated by soil test results provided by the contractor, the pH of soil in planting beds may be adjusted with the appropriate amounts of soil amendments.

G. Fertilizer for sodded areas shall be commercial grade, mixed granules, with 50% of the nitrogen being in slow or controlled release form. The ratio of nitrogen to potash will be 1:1 or 2:1 for complete fertilizer formulations. Phosphorus shall be no more than ¼ the nitrogen level. They shall also contain magnesium and micronutrients (i.e. manganese, iron, zinc, copper, etc.). The Contractor shall obey local and state laws that may regulate the seasonal use of nitrogen in fertilizers.

H. Biostimulants, if used, shall contain soil conditioners, VAM, and endomycorrhizal and ectomycorrhizal fungi spores and soil bacteria appropriate for existing soil conditions. These materials may be used as an optional soil treatment.

2.05 HERBICIDE/ PESTICIDE

A. "Round-Up" (higher ground areas) or "Rodeo" (for areas near lakes) or equal may be used sparingly in small areas only upon written approval of the Project Manager.

B. Fire ants may be controlled with Amdro Firestrike Fire Ant Mound Killer or equal.

2.06 SOIL

A. Unless stated on the plans or in the specifications, install tree and shrub plant material in tilled and loosened native soil and use the same to backfill planting pits. Groundcover beds are to receive 3" deep dark topsoil tilled into the native soil.

B. Native top soil stripped from the site where building and utility construction is about to occur shall be stock piled on site to be used in landscape installation activities. Such soil shall be covered and conserved so as not to be lost to erosion.

C. It is the responsibility of the Landscape Contractor to examine and test, prior to planting and at no additional cost to the Contract, native soils where planting areas are to occur. The Contractor shall identify which areas of soils appear to be unsuitable for the vigorous growth of plants (e.g. hardpan clay or pure white sand). Unsuitable conditions shall be reported to the Owner's representative immediately in writing. Good native soils should have a slight acid reaction (about 6.0 – 6.5 pH) with no excess calcium or carbonate.

D. When required for substitution of unsuitable native soils, planting soil media shall be provided by the Contractor and shall consist of 1/3 topsoil and 2/3 sandy loam, with no lumps over 1". Backfill soil provided by the Contractor shall be in a loose, friable soil condition. It shall be free from weeds, clay lumps, stones, stumps, roots, construction debris, toxic substances or any other materials that might be harmful to plant growth or a hindrance to grading, planting, and maintenance procedures and operations. No heavily organic soil, such as muck or peat, shall be used as backfill dirt. Soil shall neither be wet or dry, but be slightly moist.

2.07 TREE PROTECTION FENCE

A. Tree protection fencing shall be 4 foot wide heavy duty high density polyethylene fence fabric, orange in color. Fence stakes shall be 2 inch by 6 foot long steel posts 8 feet on center, with 2-3 feet buried. Fence fabric shall be securely fastened to the posts.

B. The tree protection fence is to be installed prior to the start of any work and shall remain intact and in place until final completion, when he fence will be removed by the contractor.

2.08 TREE STAKES

A. New container trees may be staked as needed with untreated spruce or pine wood 2 inch x 2 inch x 4+ foot long 'beams' or spans laid across the top of the root ball and held down by in-ground vertical 2 inch x 2 inch 4 foot long untreated spruce or pine wood stakes. Each stake is pounded in the ground adjacent to the 'beam' and screwed to the 'beam' with 2.5 inch drywall screws. The vertical stakes shall have one end tapered to a point. This pointed end goes down and the flat end goes up.

B. Other tree staking systems may be acceptable if approved by the Landscape Architect. The Contractor shall submit a written request for the change with a detail drawing, product sample and product literature. The substitution will be made without change in contract price. The Landscape Architect will respond in writing either with a denial or with approval via a change order.

PART 3 - EXECUTION

3.01 TREE PROTECTION & REMOVAL

A. Tree protection fencing is to be installed at the dripline around the trees to be preserved prior to the start of any work, before or along with installation of erosion control measures and project limits delineation. Fencing shall be maintained at 4 feet in height. The fencing shall be maintained in good repair throughout the duration of the project until Substantial Completion, and shall not be removed, relocated, or encroached upon without permission of the Project Manager.

B. The tree protection fence barricade shall be placed so as to protect the critical root protection zone area of trees to remain as shown on the plans. All development activities are prohibited within the tree protection areas except as directed in accordance with Chapter 15 of the Orange County Code.

C. Trees shown to be removed on the plans shall be removed without damaging surrounding trees to be protected, especially the tree roots, by keeping vehicles and equipment out of the root zone.

D. The Contractor is required to obtain all Tree Removal Permits from Orange County if trees are to be removed prior to beginning work and shall pay the associated fees. The County may impose requirements on the Contractor in addition to specifications to save the trees.

E. The contractor is responsible for neatly maintaining, mowing the grass around and within tree protection areas and caring for the trees during the construction period.

F. Pruning of the tree canopies and branches should be done only at the direction of the County's designated Arborist to remove any dead or broken branches, compensate for root loss and to provide the necessary clearances for the construction equipment.

G. There shall be NO storage of materials or supplies of any kind nor parking of vehicles or equipment within the area of the tree protection barriers. Concrete and cement materials, block masonry units, stone, lumber, sand and soil shall not be placed within the protected areas the trees. Debris and waste from construction or other activities shall NOT be permitted within tree protected areas.

H. Fuel storage shall NOT be permitted within 100 feet of any tree to be preserved. Refueling, servicing and maintenance of equipment and machinery shall NOT be permitted within 100 feet of protected trees unless it is on existing pavements and precautions have been made to prevent spills.

I. Wash-down of concrete or cement handling equipment, in particular, shall NOT be permitted within 50 feet of protected trees. Concrete and limestone products are harmful to trees must be kept away from tree root zones.

J. Trenching and grade changes can be particularly damaging to trees. Any grade changes, trenching or digging proposed near the tree protected area should be done with precautions to avoid potential injuries to trees. Work within the tree protection zone will be under the direction of the County's designated Arborist, who shall be given at least two weeks' notice to schedule the visit.

K. Any damages or injuries to protected trees should be reported to the County Project Manager.

3.02 TRANSPORT & DELIVERY OF PLANT MATERIAL

A. Transport and movement of the plants shall comply with the regulations of all applicable federal, state and local regulations, and all required inspections.

B. Do not prune plants prior to delivery. Tree/ plant root balls shall be irrigated just prior to shipping. Trees shall have the north side of the trunk marked at the nursery. During loading and transportation of plant material, the contractor shall exercise care to prevent injury and drying out of the trees and plants. Should the roots be dried out, main branches broken, root balls of earth broken or loosened, or areas of bark torn, Project Manager may reject the injured tree(s) and order them replaced at no additional cost to the owner. Trees shall be loaded carefully for stable transport and shall be secured in the truck so as not to roll. Do not allow closed trucks packed with plants to remain standing in the sun in hot weather unless they are air-conditioned. Ball & Burlap (B&B) trees shall have their root balls shrink-wrapped in plastic or securely tied in natural burlap and twine wrapping prior to transporting them from the nursery. If plant delivery is made in open vehicles, the entire load shall be suitably covered with woven shade tarp during transport. Plants must be protected at all times from sun, heat or drying winds. Keep plants and trees moist until installation.

C. Deliver trees and shrubs after preparations for planting have been completed and then plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, cover and keep the roots moist. Irrigate trees and plants as soon as they arrive at the planting site.

3.03 UNLOADING AND HANDLING PLANT MATERIAL

A. Container grown, Balled and burlapped (B&B) and boxed trees shall be lifted with a forklift under the container/ root ball. Smaller container plants may be carried by hand by the lip or bottom of the container. Trees may be lifted by wire loops if provided inside the container/ wire basket. Trees may not be lifted by the trunk. Balled and burlapped trees shall be handled by the root ball in a manner that does not deform the shape of the root ball.

B. Trees will be rejected if they are dropped to the ground suddenly and the soil of the root ball disturbed. Cracked or broken root balls of trees and container plants shall not be planted and are rejected. Plants shall not be pulled or lifted by the branches, tops or trunk/stems, nor handled in a rough or careless manner at any time.

C. After trees are unloaded from the truck, they shall be stood upright and stored in the erect position and irrigated once every four hours until planted. Plant on the same day as delivery.

3.04 GRADING AND PREPARATION FOR PLANT MATERIALS AND SOD

A. The Contractor shall verify the location of underground / overhead utilities, irrigation lines, heads and valves, and provide markers or other suitable protection, where necessary, to prevent damage to the utilities and irrigation system.

B. Remove 100% of existing weeds/turf before new plant materials are installed in new planting beds. All pulled out material shall be disposed of properly off-site.

C. Monsanto's "Round-Up" and/or "Rodeo" or equal may NOT be used unless and only with the written approval of the Project Manager in limited areas. It is to be used only where absolutely necessary and may only be applied by workers certified by the State of Florida to do so. Should any plant material in the same, adjacent beds or nearby be damaged by these herbicide chemicals, the same size, quantity and quality of plants shall be immediately replaced by the Contractor at no cost to the Owner. The areas treated with Round-Up shall not be planted until sufficient time has elapsed to permit dissipation of all harmful materials (see manufacturers recommendations for re-entry date calculation). The general contractor shall assume full responsibility for any loss or damage to sod or plantings arising from improper use of chemicals or due to the failure to allow sufficient time for dissipation of chemical residues, whether or not such materials are specified herein.

D. Fire Ant mounds within the site work limits may be treated prior to landscape preparation work.

E. Soil amendments may be added to adjust the pH of native soil while preparing the planting beds. After amendments have been mixed and tilled in with the native soil, then the Contractor will conduct another pH test to ensure the desired pH has been met. To make the soil more acidic, depending on the measured and desired soil pH, elemental sulfur should be added to sandy soils at a rate of 4 to 7 lbs. of sulfur per 1000 square feet. Soil pH will not remain adjusted and repeated amendments over time may be required.

F. The Contractor shall remove debris (clumps of dead grass or weeds, debris, rubble, sticks, stones, roots, rubbish) over 1½ inches in any dimension from individual tree, shrub and groundcover planting pits or beds as well as sod areas and dispose of the unwanted excavated material off the site.

G. Necessary corrections or repairs to the finish grades shall be accomplished by the Contractor prior to planting. All planting areas shall be carefully graded and raked to smooth and even finish grade, free from depressions, lumps, stones, sticks or other debris. The grade shall conform to the required finish grades as shown on the plans and shall provide uniform and satisfactory surface drainage without puddling. The soil shall be loose and friable, not compacted.

H. Soil preparation, mechanical tilling and rough grading shall not occur within tree protection zones. These areas should remain undisturbed.

3.05 PREPARATION FOR GROUNDCOVER BED PLANTING

A. Prepare native subgrade by rototilling or loosening by hand with shovels and rakes, removing existing vegetation and turf. Do not disturb, till or rototill within the tree protection zones and around all preserved trees to be retained so as to protect surface roots. Instead, work carefully around and preserve tree roots, planting groundcover in small holes dug between roots.

B. Bed preparation for 1 gallon container size groundcover plants shall consist of 3" depth of dark topsoil spread over full length and width of the planting area. Rototill the new topsoil layer 6 to 8 inches into native soil, rake smooth and moisten with sprinkled water prior to planting.

C. Grade the planting bed by 'crowning' or sloping for drainage away from walls to insure that surface drainage, percolation, and aeration occur. Add a time-release fertilizer according to product instructions and rate.

3.06 PREPARATION OF SOD AREAS

A. Limit preparation to areas which will be planted promptly. Loosen sub-grade of sod areas to a minimum depth of 4 inches, rake smooth. Prepared soils shall be friable and not compacted. Stockpiled topsoil may be added back in to the prepared soils. Topsoil and sod shall not be placed when temperatures are below freezing, when conditions are muddy or when the subgrade is excessively wet.

B. A complete fertilizer shall be applied to the soil at a rate of one (1) pound of nitrogen per 1000 square feet. Thoroughly work fertilizer into the top 4 inches of soil prior to fine grading and sodding. Do not lay sod directly on fertilizer without tilling into the soil. The fertilizer must be thoroughly mixed into the soil.

C. Immediately prior to any turf work, the Contractor shall finish/ fine grade the soil to a smooth, even surface assuring positive drainage away from buildings/ walls and the subsequent turf can be placed flush to the tops of adjacent curbs and sidewalks. The surface shall be sloped to meet existing drainage pathways and proposed grades per plans. Smooth soil to prevent the formation of depressions or water pockets. Cut

down soil level 1 to 1-1/2 inches below top of sidewalks and curbs prior to laying sod so the sod will be even with the pavement when completed. Flag irrigation heads.

D. Moisten prepared sod areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting sod lawns. Do not create a muddy soil condition. Do not plant if soil is saturated with standing water.

3.07 LAYOUT OF PLANT MATERIALS AND PLANTING BEDS

A. Plant materials and beds shall be located as shown on the plans by using scale measurements from the plans transferred to the ground by tape measured distances using established building, columns, curbs, screen walls, light poles, existing trees etc. as the measuring reference points. Bed lines shall use curves and tangents for layout as drawn on the plans. Slight shifting of plants up to a foot may be required to stay clear wires, prevent blockage of signage, driveway sight lines, etc.

B. Shrubs and ground covers shall be located and spaced as noted on the plans, details and plant list. Plant spacing shall be "on center. Space the same variety of plant equally in the planting areas. Shrubs and ground covers adjacent to straight or curved edges shall be triangular – spaced in rows parallel to those edges. Provide a minimum of 18 inches of mulched space from the back of the wall or pavement to the outside edge of the plants.

C. Planting area layouts shall be carefully coordinated with the layout of the irrigation system.

D. Trees shall be located so the north side is facing north per the mark on the tree indicating which side faced north at the nursery.

3.08 PLANTING PROCEDURES FOR TREES, SHRUBS, GROUNDCOVERS

A. Plant the material as soon as possible after delivery. Excessive delay between delivery and planting may be cause for rejection. The Contractor shall pre-locate all plants on the site as specified on the plans prior to installation. Plant the trees and shrubs after final grades are established and prior to the planting of lawns, protecting trees and materials during planting operations and promptly repairing damages.

B. All trees, shrubs and ground covers shall be planted in pits generally circular in outline. Prepare the plant pit for trees by digging a hole at least 3 times the size of the root ball/ container. Large trees 4" caliper and up should have a plant pit 3–5 times the size of the root ball. Trees under 4" caliper shall have a plant pit 2-3 times the size of root ball. Shrubs may have a pit 2+ times the size of the container. Groundcovers may have pits the same size as the container. Dig the planting pit so it has relatively straight sides. Place the excavated soil nearby so it can be used to backfill the planting holes after the plant has been placed.

C. Remove all wood, plastic wrap, plastic container material or gro-bags from the root ball. Remove all twine, string or wire wrapped around the trunk and branches of trees. Remove all straps, rope, cable or string used to lift the root ball. Cutting off the top tier of the wire basket of B&B trees will make it easier to remove burlap. Thoroughly wet root ball prior to planting.

D. For planting trees, prepare a firm, flat bottom to the hole. Check for good drainage in the plant pit. Check to make sure the water drains from the hole within a reasonable time. If water fills the bottom of the planting hole, check deeper for a "hardpan" clay layer and break through it, then add soil back in to the bottom of the hole until the water is covered or drained. Pack this added soil firmly.

E. For all plantings, dig the hole only just deep enough to position the top of the root ball slightly higher than the surrounding landscape soil surface. The root collar/ top surface root of the plant should be 1-2" higher than the adjacent soil surface after backfilling and watering in the plant/ tree. As backfilling proceeds, do not cover the top of the root ball with soil; add backfill soil to the sides. Add water to the root ball and soil after adding the backfill soil and repeat until the planting hole is filled.

F. Backfilling for trees: Back fill the planting pit with the soil removed from the hole. Fill soil is placed around the sides of the root ball a layer at a time. Add water to the layer of backfill. Add fertilizer tablets (see I. below). Repeat. After partially filling the planting hole with backfill soil, slice a shovel or one-inch PVC pipe into the soil 20 to 30 times all around the tree as you add more backfill soil to remove large air pockets. Do NOT step firmly on the backfill soil because this could compact it and restrict root growth. When the planting hole is filled with soil, the top root of the root ball should remain 1-2 inches above the backfill soil. Add 10 to 20 gallons of water to the root ball area. Fill in any holes or depressions with additional backfill soil.

G. Plants shall be set straight and plumb, in the locations shown on plans, and level with the ground surface. If plant settles too low then replant it. Plants set too low will be rejected.

H. Plants in containers shall be carefully removed from the containers in a sliding manner next to the prepared planting pit so that the motion will not to break the ball of soil formed by the container. Place the plant/tree horizontal to the ground near the planting hole and roll it toward the planting hole while simultaneously pulling the container from the root ball. The container may also be cut off if necessary.

I. All tree pits shall receive 21 gram Agriform 20-10-5 planting tablets (or approved equal), on the bottom half (but not under the root ball) of the pit around all sides of the root ball at time of installation and prior to completion of pit backfilling. Agriform planting tablets shall be placed uniformly around the root mass at a depth that is between the middle and the bottom of the root mass. Trees receive 3 tablets for each ½" (12 millimeters) caliper. For example, a 3" caliper tree needs 18 tablets.

J. Native soil shall be used in back-filling plant pits as specified. The Contractor shall be responsible for providing any additional soil needed for planting and building tree saucers.

K. When planting on a slope, the top-most main root in the root ball shall be even with the grade on the uphill side of the tree. Soil will need to be added on the downhill side to cover the sides of the root ball and to construct the soil berm to hold water. The amount of soil added on the downhill side will depend on the slope and size of the root ball. The root ball surface shall be level.

L. Goundcovers shall be planted in a triangular pattern with spacing as directed on the plant list. Hand trowel a planting hole. Plant each plant and cover the roots with soil, pressing firmly around the plant. Water the plants in.

M. After planting trees, provide approximately 5 gallons of water per inch of trunk caliper to the root ball once all backfill is filled in around the root ball.

N. Water rings for trees are not required and should only be used when irrigation tree bubblers are not available. If the bubblers are not available, build a 6" high water ring berm on the surface around the outside of the root ball and provide water within the ring. Repair any breaks in the ring that occur. Apply mulch after building the berm.

O. Tree irrigation bubblers can be critically inadequate for establishing container grown trees if they are not designed, installed and maintained correctly. The tree bubblers are on a completely separate zone from the rest of irrigation system. The contractor is responsible for proper maintenance and function of the bubblers throughout the contract period.

P. The Owner's representative retains the right to reject plants with cause at any point in the course of the work even after final inspection, if s/he deems it necessary, due to a change in the condition of the plant. The Owner's Representative reserves the right to reject with cause any materials at any time during the construction process as it becomes necessary.

3.09 SODDING

A. The contractor is to confirm the good condition of the sod prior to shipping. Time delivery so that sod will be planted immediately upon arrival at the site and can be completed within twenty-four (24) hours after stripping at the sod farm. Protect unplanted sod against drying and breaking by lightly moistening sod, placing it in a shaded area and covering the palettes with a cloth. These precautions are required especially in hot or dry weather.

B. The ground shall be wetted down before the sod is laid in place. This should be done prior to sod delivery.

C. Install sod in dry or slightly moist weather conditions. Do not install sod during rain or on saturated soils.

D. Start laying sod along the longest straight line such as a sidewalk or curb. Solid sod shall be laid tightly against and closely abutting the adjacent piece of sod without stretching. Adjacent rows should have staggered joints. Sod shall be laid with an even surface edge and sod edge, in a neat and clean manner to the edge of all the paving and planting/ shrub bed areas. Avoid narrow strips at outside edges. On slopes, place sod perpendicular across (right angles) the slope rather than up and down the slope. Use a sharp knife to cut sod to fit corners and bed shapes. Cut sod in from planting beds in a neat clean smooth and attractive manner with bed lines as shown on plans. Cut out holes in the sod around irrigation heads to allow immediate operation of the irrigation system. Avoid walking, kneeling or storing material on newly placed sod.

E. Within ½ hour to 2 hours after installing sod and prior to rolling, irrigate the sod. Apply at least 1" of irrigation water on new sod. Sufficient water shall be applied to wet the sod thoroughly to a depth of 2 inches. Watering shall be done in a manner that will avoid erosion or waste.

F. After initial watering and a period to allow the soil to dry, the sod shall be pressed firmly into contact with the sod bed using a turf roller or other approved equipment (except pegged sod on slopes per "I" below) so as to eliminate air pockets, provide a true and even surface and insure knitting of sod pieces without any displacement of the sod or deformation of the surfaces of sodded areas. Finish rolling within 7 days of sod installation. Check and adjust the edges of sodded areas so bed lines are as shown on plans. After the sodding operation has been completed, the edges of the sod area shall be smooth and shall conform to the outlines and grades indicated on the plans.

G. Watering shall be repeated daily and as necessary to keep sod moist until rooted to the subgrade, usually in about two weeks. Natural rainfall may take the place of artificially irrigating the sod if sufficient rainfall occurs. Extra watering will be required during hot, dry and / or windy conditions. After the third week, keep up irrigation to supplement rainfall at 2" per week. Keep sod moist until final completion.

H. If, in the opinion of the Owner's representative, top dressing is necessary after rolling due to settling, clean silica sand shall be used to fill voids. Evenly apply sand over the entire surface to be leveled, filling-in dips and voids and thoroughly washing into the sod areas.

I. On slopes steeper than 2:1 and where necessary, the sod shall be fastened in place with suitable wooden pegs or by other approved method.

J. Avoid allowing any use of newly sodded areas for a period of at least two weeks, including construction equipment. Erect signs or barriers against vehicular or pedestrian traffic.

K. All areas disturbed by the construction work shall be restored with plantings or sod.

3.10 TREE STAKING

A. Tree staking/ bracing of new trees is needed to maintain a plumb position in areas exposed to winds until a tree is established. Stake as follows: One horizontal 2 inch x 2 in. wood piece, 4 foot long or enough to extend beyond the root ball edge by at least 6 inches both sides, is placed on top of the ground across the root ball. This wood span is attached to two vertical 4 foot long 2 inch x 2 inch wood stakes pounded at least18 inches into the ground at the outside the edge of the root ball and screwed to the horizontal piece with drywall screws. A second set of stakes is used on the other side if needed for larger trees 3" or more in caliper. Ball and burlap trees are usually not staked. Do not use steel guy wires or twisted cable and tree stakes as this method is outdated

B. Contractor shall remove all tree staking from trees just prior to the date of final warranty acceptance of the landscape work.

3.11 MULCHING

A. All planting beds shall be weed-free and smooth prior to mulching.

B. All curb, roadway, and bed line edges will be slightly "trenched" to help contain the applied mulch so it doesn't wash over pavement. The desired result is a clean line between mulched beds and sodded areas.

C. All plant beds and tree rings shall be mulched evenly with a minimum 2 inch deep layer of mulch as specified on the Plans and details.

D. Mulch shall not be placed directly against the trunks of plant materials or foundations of buildings or walls. Maintain mulch with a 3 inch clearance for trees and shrub trunks and a minimum 6 inch clearance away from walls of buildings. Place 1 inch of mulch on top of the root ball, gradually thickening to 2 or 3 inches at the edge of the root ball and throughout the planting bed.

E. Trees up to 4" caliper standing alone not in a planting bed are to receive a 2-3 inch layer of mulch spread out to an 6-foot diameter circular area around the trunk (remove sod first). On larger caliper trees, apply a 2-foot diameter mulch area for each inch of trunk caliper.

F. Keep the planting areas properly mulched during the maintenance period.

3.12 PRUNING

A. Pruning of existing preserved trees may be necessary if construction work impacts the tree as determined by the Owner's Representative. Pruning shall be done by an experienced certified Arborist to maintain the natural shape and form of the tree or plant or to correct poor structural form or damage.

3.13 CLEAN-UP

A. During landscape work, stage and store materials and equipment where directed by the Owner. The Contractor shall promptly remove any materials and equipment used on the job, keeping the area neat at all times. Upon completion of all planting, dispose of all excess soil and debris leaving pavements and work areas in safe, clean and orderly condition. Burying debris on site is prohibited. Remove from work site all excess materials (e.g., soil, debris and equipment) daily through duration of project. Surplus excavated materials from plant holes shall be disposed of in a manner not to affect the soil levels in the planting beds and may have to be removed from the site by the Contractor at no extra cost to the Owner. All debris and other objectionable materials shall be removed from the site and the entire area cleaned up and left in neat condition daily.

B. Trees and plants to be removed shall have all parts removed from the site and disposed of properly without causing damage to the site grades, soil surfaces, plants or structures.

C. Protect adjacent walls, walks, and utilities from damage or staining by the soil. Use 12-mm (1/2 in.) plywood and/or plastic sheeting as directed to cover existing concrete, metal, masonry work, and other items as directed during the progress of the

work. Clean up any soil or dirt spilled on any paved surface at the end of each working day.

D. Any damage to the paving or architectural work caused by the planting/ soils installation contractor shall be repaired by the contractor at contractor's expense.

3.14 PROTECTION OF WORKERS, PROPERTY AND PUBLIC

A. The Contractor shall provide safeguards for the protection of workers and others on, about, or adjacent to the work, as required under the parameters of the Occupational Safety and Health Administration (O.S.H.A.) standards.

B. The Contractor shall protect the County's and adjacent property from damage.

C. The Contractor shall protect the landscape construction work and materials from damage due to construction operations and the work of others. Maintain protection during installation and maintenance periods.

3.15 ACCEPTANCE

A. Inspection to determine acceptance of planted areas will be made by the County's Project Manager or his/her designee at substantial completion. Provide notification a minimum of five (5) business days before the requested inspection date.

B. Planted areas may be accepted provided all requirements, including maintenance, have been satisfied and plant materials are in a healthy, vigorous condition.

C. The Orange County representative will prepare a "punch list" of those items which must be corrected before re-inspection for final acceptance. The County representative will determine an appropriate time period for corrections. Contractor must request re-inspection at least five (5) working days in advance.

D. The Contractor shall return all areas impacted by the work, including sodded areas, in good and orderly condition prior to acceptance inspections. If a bare area was previously grassed, it will be repaired, re-sodded, and watered until well-rooted. Sidewalks and other paved area shall be swept clean. All refuse, debris, and scrap materials generated by the construction activity shall be removed from the site.

E. The Contractor shall repair all damage caused by his operations to other materials, property, or trades to a level equal in quality to the existing condition prior to damage.

F. The Contractor shall be held responsible for all damage done by his work or employees to other materials or trades' work. Patching and replacement of damaged work may be done by others, at the Owner's direction, but the cost of same shall be paid by the Contractor who is responsible for the damage.

END OF SECTION

SECTION 02931
RIPRAP

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work specified in this section shall consist of the placing of all riprap, including geotextile layer and bedding stone where indicated on the Drawings.

1.02 WORK INCLUDED

A. The Contractor shall furnish all materials, equipment, tools and labor necessary for the placing of the riprap including geotextile layer and bedding stone as shown on the Drawings.

1.03 REFERENCE SPECIFICATION

A. Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", latest edition".

PART 2 - PRODUCTS

2.01 MATERIALS

A. Riprap: Provide Rubble Riprap (Ditch Lining) meeting the requirements of Section 530-2.2.2 FDOT Specifications.

B. Bedding Stone: Provide Bedding Stone meeting the requirements of Section 530-2.3 FDOT Specifications.

C. Geotextile Fabric: Provide Geotextile Fabric meeting the requirements of Sections 530-2.4 and 514 FDOT Specifications.

PART 3 - EXECUTION

3.01 GENERAL

A. Construction methods shall be in accordance with the details shown on all the Drawings, and Section 530-3 FDOT Specifications.

PART 4 - MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Measurement and payment shall be in accordance with Sections 530-4 and 530-5 FDOT Specifications.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

B. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts and other items furnished under other Sections and required to be cast into concrete, or approved in advance by the Engineer.

1.02 RELATED WORK

A. Concrete Reinforcement is included in Section 03200.

B. Concrete Joints and Joint Accessories are included in Section 03250

C. Cast-in-Place Concrete is included in Section 03300.

D. Grout is included in Section 03600.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Form release agent
2. Form ties

B. Samples

1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise finished and will not affect the forming materials.

C. Certificates

1. Certify that form release agent is suitable for use in contact with potable water after 30 days (non-toxic and free of taste and odor).

1.04 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete
2. ACI 318 - Building Code Requirements for Reinforced Concrete

3. ACI 347 - Formwork for Concrete

B. American Plywood Association (APA)

1. Material grades and designations as specified

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 SYSTEM DESCRIPTION

A. General: Architectural Concrete is wall, slab, beam or column concrete which will have surfaces exposed to view in the finished work. It includes similar exposed surfaces in water containment structures from the top of walls to 2-ft below the normal water surface in open tanks and basins.

B. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

PART 2 - PRODUCTS

2.01 GENERAL

A. The usage of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

A. Forms for cast-in-place concrete shall be made of wood, metal, or other approved material. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.

B. Wall Forms

1. Forms for all exposed exterior and interior concrete walls shall be "Plyform" exterior grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group, or equal acceptable to the Engineer. Provide B grade or better veneer on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.

2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging.

C. Rustication strips shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and corner strips shall be of a nonabsorbent material, compatible with the form surface and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.

D. Form Release Agent

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non-toxic and free of taste or odor and meet the requirements of NSF/ANSI Standard 61. Form release agent shall be Farm Fresh by Unitex or approved equal.

E. Form Ties

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a wood or metal cone at least 1/2-in diameter and 1-1/2-in long. Form ties in concrete exposed to view shall be the cone-washer type.

2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.

3. Flat bar ties for panel forms, if used, shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.

4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.

5. Common wire shall not be used for form ties.

6. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non-shrink cement grout. A vinyl plug shall be inserted into the hole to serve as a waterstop. The Contractor shall be responsible for water-tightness of the form ties and any repairs needed.

PART 3 - EXECUTION

3.01 GENERAL

A. Forms shall be used for all cast-in-place concrete including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions and appearance indicated on the Drawings.

B. Forms for walls shall have removable panels at the bottom for cleaning, inspection and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete inspection, to prevent segregation and to prevent the accumulation of hardened concrete on the forms above the fresh concrete.

C. Molding, bevels, or other types of chamfer strips shall be placed to produce block outs, rustications, or chamfers as shown on the Drawings or as specified herein. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a 3/4-in chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.

D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.

E. Before form material is re-used, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

3.02 FORM TOLERANCES

A. Forms shall be surfaced, designed and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.

1. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/16-in and forms for plane surfaces shall be such that the concrete will be plane within 3/16-in in 4-ft. Forms shall be tight to prevent the passage of mortar, water and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-in from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.

2. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.

3. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1-in.

3.03 FORM PREPARATION

A. Wood forms in contact with the concrete shall be coated with an effective release agent prior to form installation.

B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

3.04 REMOVAL OF FORMS

A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03300 and a curing compound applied.

3.05 INSPECTION

A. The Engineer on site shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.

B. Failure of the forms to comply with the requirements specified herein or to produce concrete complying with requirements of Section 03300 shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section and approval of the Engineer.

END OF SECTION

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SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Cast-in-place Concrete is included in Section 03300.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Reinforcing steel. Placement drawings shall conform to the recommendations of ACI 315. All reinforcement in a concrete placement shall be included on a single placement drawing or cross referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc) shown on the standard detail sheets. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified. For all cast-in-place concrete tanks, retaining walls, building stem walls, wall sections shall be included in the drawings.

2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.

3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.

B. Submit Test Reports, in accordance with Section 01300, of each of the following items.

1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.

2. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement required.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

3. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement

5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

6. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

7. ASTM A616 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

8. ASTM A617 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

9. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

10. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

11. ASTM A775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

12. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.

13. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.

B. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete

2. ACI 315 - Details and Detailing of Concrete Reinforcement.

3. ACI 318 - Building Code Requirements for Structural Concrete

4. ACI SP-66 - ACI Detailing Manual

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

D. American Welding Society (AWS)

1. AWS D1.4 - Structural Welding Code Reinforcing Steel

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

1.06 DELIVERY, HANDLING AND STORAGE

A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.

B. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.

C. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be new, of domestic manufacture and shall comply with the following material specifications.

B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706.

D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.

E. Welded Deformed Steel Wire Fabric: ASTM A497.

F. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.

G. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.

H. The following alternate materials are allowed:

1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:

a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3000 psi.

b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.

c. The carbon equivalency (CE) of bars shall be 0.55 or less.

I. Reinforcing Steel Accessories

1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.

2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.

3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.

4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.

J. Tie Wire

1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire or stranded wire.

K. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to manufacturer's recommended value.

1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the rebar.

2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.

L. Fiber Reinforcement

1. Synthetic reinforcing fiber for concrete shall be 100 percent polypropylene collated, fibrillated fibers as manufactured by Propex Concrete Systems Chattanooga, TN - Propex or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

2.02 FABRICATION

A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice.

B. Bars shall be cold bent. Bars shall not be straightened or rebent.

C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.

D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded, shall have the applicable end(s) saw-cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Surface condition, bending, spacing and tolerances of placement of reinforcement shall comply with the CRSI Manual of Standard Practice. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.

B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:

1. Concrete cast against and permanently exposed to earth: 3-in
2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2-in (Including bottom cover of slabs over water or sewage)
3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
    a. Slabs (top and bottom cover), walls, joists, shells and folded plate members – 3/4-in
    b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1-1/2-in

C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.

D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.

E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.

F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.

G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING OF REINFORCEMENT

A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters, but not less than 12-in. The lap splice length for column vertical bars shall be based on the bar size in the column above.

B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.

C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.

D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than 12-in. The spliced fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.

E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

3.04 ACCESSORIES

A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.

C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified herein.

D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and Owner's R.P.R. and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

END OF SECTION

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SECTION 03250
CONCRETE JOINTS AND JOINT ACCESSORIES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Concrete Reinforcement is included in Section 03200.

C. Cast-In-Place Concrete is included in Section 03300.

D. Concrete Finishes are included in Section 03350.

E. Grout is included in Section 03600.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data. Submittals shall include at least the following:

1. Standard Waterstops: Product data including catalogue cut, technical data, storage requirements, splicing methods and conformity to ASTM standards.

2. Special Waterstops: Product data including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions and conformity to ASTM standards.

3. Premolded joint fillers: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.

4. Bond breaker: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.

5. Expansion joint dowels: Product data on the complete assembly including dowels, coatings, lubricants, spacers, sleeves, expansion caps, installation requirements and conformity to ASTM standards.

6. Compressible joint filler: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.

7. Bonding agents: Product data including catalogue cut, technical data, storage requirements, product life, application requirements and conformity to ASTM standards.

B. Certifications

1. Certification that all materials used within the joint system is compatible with each other.

2. Certifications that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

2. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

3. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

4. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types).

5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. U.S. Army Corps of Engineers (CRD).

1. CRD C572 - Specification for Polyvinylchloride Waterstops.

C. Federal Specifications

1. FS SS-S-210A - Sealing Compound for Expansion Joints.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.

C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

2.02 MATERIALS

A. Standard Waterstops

1. PVC Waterstops - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. The waterstop shall be Greenstreak Group, Inc. model No. 679 or approved equal for construction joints. The waterstop shall be Greenstreak Group Inc. model No.732 or approved equal for control joints and Greenstreak Group Inc. Model No. 738 for expansion joints. Provide grommets or pre-punched holes spaced at 12 inches on center along length of waterstop.

2. Factory Fabrications: Provide factory made waterstop fabrications for all changes of direction, transitions, and intersections, leaving only straight butt joints of sufficient length for splicing in the field.

B. Special Waterstops

1. Base Seal PVC Waterstop - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. Waterstops shall be style 925 for expansion joints, style 928 for control joints, and style 927 for construction joints by Greenstreak Plastic Products, St. Louis, MO or equal.

2. Hydrophillic Waterstop (Swelling) – Hydrotite as manufactured by Sika Greenstreak, or approved equal.

3. Preformed adhesive waterstops - The waterstop shall be a rope type preformed plastic waterstop meeting the requirements of Federal Specification SS-S-210A. The rope shall have a cross-section of approximately one square inch unless otherwise specified or shown on the Drawings. The waterstop shall be Synko-Flex waterstop as manufactured by Synko-Flex Products of Houston, TX, Lockstop by Greenstreak Group Inc., or equal. Primer for the material shall be as recommended by the waterstop manufacturer.

C. Premolded Joint Filler

1. Premolded joint filler - Structures. Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4-in unless shown otherwise on the Drawings.

2. Premolded joint filler - sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt-impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4-in unless otherwise shown on the Drawings.

D. Bond Breaker

1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.

2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

E. Expansion Joint Dowels

1. Dowels shall be smooth steel conforming to ASTM A675, Grade 70. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-in on the diameter of the dowel and extends no more than 0.04-in from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end. Caps shall allow for at least 1-1/2-in of expansion.

2. Dowel Bar Sleeves: Provide Greenstreak two component Speed Dowel System, to accept 1" diameter x 12" long slip dowels. The Greenstreak Group, Inc. Speed Dowel System is comprised of a reusable base and a plastic sleeve. Both pieces shall be manufactured from polypropylene plastic.

F. Bonding Agent

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, N.J.; Concresive Liquid (LPL) by Master Builders of Cleveland, OH or equal. Acrylic may be used if approved by the Engineer.

G. Compressible Joint Filler

1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evasote 380 E.S.P, by E-Poxy Industries, Inc., Ravena, NY , Sikaflex 1a by Sika or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Standard Waterstops

1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.

2. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).

3. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.

4. Waterstops shall be terminated 3-in below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1-in deep, at point of termination.

B. Special Waterstops

1. Install special waterstops at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.

2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified herein.

3. Waterstops shall be terminated 3-in below the exposed top of walls.

C. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written approval.

2. Additional or relocated joints should be located where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.

3. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.

4. Provide sealant grooves for joint sealant where indicated on the Drawings.

5. At all construction joints and at concrete joints designated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately 1/4-in to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by water-blasting or sandblasting and prepare for bonding.

6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.

7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

D. Expansion Joints

1. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.

2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal all expansion joints.

3. Expansion joints shall be 3/4-in in width unless otherwise noted on the Drawings.

4. Where indicated on Drawings, install smooth dowels at right angles to expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement. Unless otherwise shown on the Drawings, apply oil or grease to one end of all dowels through expansion joints. Provide plastic expansion caps on the lubricated ends of expansion dowels.

5. Provide center bulb type waterstops in all wall and slab expansion joints in liquid containment structures and at other locations shown on the Drawings.

E. Control Joints

1. Provide sealant grooves, sealants and waterstops at control joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab control joints in water containment structures and at other locations shown on the Drawings.

2. Control joints may be sawed if specifically approved by the Engineer. If control joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during sawcutting.

3. Extend every other bar of reinforcing steel through control joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide cast-in-place concrete as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. 117: Specifications for Tolerances for Concrete Construction and Materials and Commentary.
2. 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
3. 214R: Recommended Practice for Evaluation of Strength Test Results of Concrete
4. 301: Standard Specifications for Structural Concrete
5. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
6. 304.2R: Placing Concrete by Pumping Methods
7. 305R: Hot Weather Concreting
8. 306R: Cold Weather Concreting
9. 308: Standard Practice for Curing Concrete
10. 309R: Guide for Consolidation of Concrete
11. 311.4R: Guide for Concrete Inspection
12. 318: Building Code Requirements for Structural Concrete
13. 350: Code Requirements For Environmental Engineering Concrete Structures

B. American Society for Testing and Materials International (ASTM):

1. A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field
3. C33: Standard Specification for Concrete Aggregates

4. C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
5. C40: Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
6. C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
7. C87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
8. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
9. C94: Standard Specification for Ready-Mixed Concrete
10. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or Cube Specimens)
11. C123: Standard Test Method for Lightweight Particles in Aggregate
12. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
13. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
14. C143: Standard Test Method for Slump of Hydraulic Cement Concrete
15. C150: Standard Specification for Portland Cement
16. C157: Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete
17. C171: Standard Specification for Sheet Materials for Curing Concrete
18. C172: Standard Practice for Sampling Freshly Mixed Concrete
19. C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
20. C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
21. C260: Standard Specification for Air-Entraining Admixtures for Concrete
22. C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
23. C295: Standard Guide for Petrographic Examination of Aggregates for Concrete
24. C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
25. C311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete

26. C494: Standard Specification for Chemical Admixtures for Concrete

27. C595: Standard Specification for Blended Hydraulic Cements

28. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

29. C881: Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete

30. C882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear

31. C1017: Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

32. C1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

33. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

34. C1116: Standard Specification for Fiber Reinforced Concrete

35. D75: Standard Practice for Sampling Aggregates

36. E154: Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

37. E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

38. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

1.03 TOLERANCES

A. Conform to ACI 117.

B. Concrete slabs for buildings shall be within 3/16 inch of 10 ft straightedge in each direction except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 in.

C. Pitch floor to floor drains minimum of 1/8 inch/ft or as shown on Drawings. Minimum thickness of slabs and depth of beams shall be as dimensioned on Drawings. Pitch bottom of slab or beam to match top slope of slab or beam to maintain thickness or depth noted. As an alternate, bottom of slab or beam may be poured level provided that minimum thickness or depth is maintained.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data:

1. Manufacturer's specifications and instructions including Material safety Data Sheets (MSDS) for admixtures and curing materials.

2. Manufacturer’s certification of compatibility of all admixtures.

C. Shop Drawings:

1. Provide certificate that cement used complies with ASTM C150 and these specifications.

2. Provide certificates that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.

3. Provide certificate of compliance with these specifications from the manufacturer of the concrete admixtures.

4. For each formulation of concrete proposed, provide concrete mix designs and laboratory 7-day and 28-day compressive tests, or submit test results of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects in the past twelve months.

5. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

D. Test and Evaluation Reports

1. Provide results of drying shrinkage tests from trial concrete mixes by the Contractor's testing laboratory firm.

E. Manufacturers' Instructions

1. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's data sheets as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.

F. Field Quality Control Submittals

1. Provide delivery tickets for ready-mix concrete or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate.

1.05 SHRINKAGE TESTS:

A. The testing laboratory shall perform drying shrinkage tests for the trial batches as specified herein.

B. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows:

1. Remove specimens from molds at an age of 23 hours ± 1 hour after trial batching, place immediately in water at 70 degrees F ± 3 degrees F for at least 30 minutes, measure within 30 minutes thereafter to determine original length, and then submerge in saturated lime water at 73 degrees F ± 3 degrees F. At age seven days, make measurement to determine expansion, expressed as a percentage of original length. This length at age seven days shall be the base length for drying shrinkage calculations (zero days' drying age).

2. Then, store specimens immediately in a humidity-controlled room maintained at 73 degrees F ± 3 degrees F and 50 percent ± 4 percent relative humidity for the remainder of the test. Make and report measurements to determine shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

C. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at zero days' drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of the shrinkage test to the nearest 0.001 percent of shrinkage. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project.

D. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036 or 0.042 percent, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to Class A concrete.

E. If the trial batch specimens do not meet the shrinkage requirements, revise the mix design and/or materials and retest.

1.06 QUALITY CONTROL:

1. Provide in accordance with Section 01400.

2. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

3. Preinstallation Conference for Concrete Work:

4. Held at Project Site to review and discuss inspection, delivery, and testing procedures, concrete mix design, cement, fly ash, aggregates size and gradation, admixtures, placement methods, pour sizes, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, control joints locations, waterstop requirements, concrete repair procedures, backfilling limitations around structures, testing for water tightness, steel reinforcements installation, floor slopes and flatness requirements, forms and form removal limitations and concrete protection.

5. Representatives of each entity directly concerned with cast-in-placed concrete shall attend, including following:

   a. Contractor's superintendent.
   b. Testing agency.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.

B. Unless otherwise indicated, materials, workmanship, and practices shall conform to the following standards:

1. FBC 2014.

2. ACI 301, "Structural Concrete for Buildings."

3. ACI 318, "Building Code Requirements for Reinforced Concrete."

4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures."

C. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions govern.

D. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

E. Perform concrete work in conformance with ACI 301 unless otherwise specified.

F. Do not use admixtures including calcium chloride which will cause accelerated setting of cement in concrete.

G. Do not place concrete until design mix, material tests and trial concrete batch mix compression test results are accepted by the Engineer.

H. The Contractor shall employ an independent testing laboratory, acceptable to the Engineer, to test conformity of materials to specifications. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. Allow free access to obtain test samples.

I. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C172
2. Specimen Preparation: ASTM C31
3. Compressive Strength: ASTM C39
4. Air Content: ASTM C231
5. Slump: ASTM C143
6. Temperature: ASTM C1064
7. Unit Weight: ASTM C138
8. Obtaining Drilled Cores: ASTM C42
9. Drying Shrinkage: ASTM C157

J. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.

K. Hot weather concrete to conform to ACI 305R and as specified herein.

L. Cold weather concrete to conform to ACI 306R and as specified herein.

M. Reject concrete delivered to job site that exceeds the time limit or temperature limitations specified.

N. Do not place concrete in water or on frozen or uncompacted ground.

O. Workability

1. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.
2. Adjust the proportions to secure a plastic, cohesive mixture, and one that is within the specified slump range.
3. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. Comply with the requirements in sections 01612 and 01614.

B. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

C. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

1.08 SITE CONDITIONS:

A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C 31 and as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Cement:

1. Portland Cement, ASTM C150, Type I or Type II, or type II in concrete exposed to wastewater.
2. Shall be one brand from one source. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.
3. Maximum tricalcium aluminate shall not exceed 8 percent, or 6 percent in concrete exposed to wastewater. The maximum percent alkalies shall not exceed 0.6 percent.

B. Fly Ash:

1. Provide fly ash conforming to the following requirements:
   a. Class F fly ash conforming to ASTM C 618 for chemical and physical properties.
   b. Supplemental requirements in percent:
      i. Maximum carbon content: 3 percent
      ii. Maximum sulfur trioxide (SO_3) content: 4 percent
      iii. Maximum loss on ignition: 3 percent
      iv. Maximum water requirement (as a percent of control): 100 percent
      v. Fineness, maximum retained on No. 325 sieve: 25 percent

C. Fine Aggregates:

1. Clean, sharp, natural sand conforming to requirements of ASTM C33 with a fineness modulus between 2.0 and 3.0.

D. Coarse Aggregate:

1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.

2. Limit deleterious substances in accordance with ASTM C33, Table 3, Severe Weathering Regions, limit clay lumps not to exceed 1.0 percent by weight, and limit loss when tested for soundness using magnesium sulfate to 12 percent.

E. Water and Ice:

1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C94.

2. Water shall not contain more than 500 mg/L of chlorides nor more than 500 mg/L of sulfate.

3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305R and ACI 306R.

F. Color Additive for Exterior Electrical Duct Encasement:

1. For exterior electrical duct concrete encasements, use a color additive for identification purposes. Red iron oxide powder sprinkled on top of concrete duct bank immediately after concrete is placed shall be acceptable for identification purposes.

G. Concrete Admixtures:

1. Maintain compressive strength and maximum water-cement ratios specified in Table 03300-1 when using admixtures. Include admixtures in solution form in the water-cement ratio calculations.

2. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.Use admixtures in compliance with the manufacturer's printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix.Do not use admixtures in greater dosages than recommended by manufacturer.

5. Air Entrainment:

a. Class A concrete; an air-entraining admixture conforming to ASTM C260.

b. Products:

i. BASF Corporation; MB-AE 90.
ii. Sika Corporation, AER.

c. Adjust the admixture content to accommodate fly ash or pozzolan requirements, and other admixtures when used, in order to obtain the specified air content.

6. Water Reducing:

a. Class A concrete; a water-reducing admixture conforming to ASTM C494, Type A and compatible with the air-entraining admixtures. The

amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

i. BASF Corporation; Polyheed Series
ii. Sika Corporation, Plastocrete 161
iii. WR Grace & Co.;Darex II-AEA
iv. Euclid Chemical Company; Eucon NW

7. Water Reducing and Retarding:

a. Class A concrete; a water-reducing and retarding admixture conforming to ASTM C494, Type D and compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

i. BASF Corporation; Pozzolith Series
ii. Sika Corporation; Plastiment
iii. Euclid Chemical company; Eucon WR-91

8. High-Range Water-Reducing Admixture (Superplasticizer):

a. Class A concrete; a High-Range water-reducing admixture conforming to ASTM C494, Type F or ASTM C1017, Type I.

b. Products:

i. BASF Corporation; Glenium Series
ii. WR Grace & Co.; Daracem 100
iii. Euclid Chemical company; Eucon SPC

9. Integral Waterproofing Admixture

a. Class A concrete for water retaining structures; a Crystalline waterproofing admixture shall be added to the concrete mixes used in walls and slabs of water retaining structures at manufacturer’s recommended dosage rates.

b. Products:

i. BASF Corporation; Rheomac 300D
ii. Xypex Corporation; xypex Admix C-1000
iii. Kryton International, Inc.; Krystol Internal Membrane (KIM)

10. High Performance Concrete Moisture Vapor Reducing Admixture

a. This admixture shall be applied to all concrete in the Electrical Building. See section 03510.

H. Fiber Reinforcement:

1. Fiber reinforcing shall conform to ASTM C 1116, Type III.

2. Fibers shall be macro fibers. Micro fibers are prohibited.

3. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement

4. Volume of fibers shall be a minimum of 1-1/2 pounds per cubic yard.

5. Physical Characteristics:

   a. Specific gravity: 0.91
   b. Tensile strength: 40,000 to 110,000 psi
   c. Fiber length: 1/2-inch to 3/4-inch

6. Fibrous concrete reinforcement materials provided in this section shall produce concrete conforming to the requirements for strength of concrete specified.

I. Epoxy Bonding Agent:

1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives. The class of epoxy bonding agent shall be suitable for ambient and substrate temperatures.

2. Products:

   a. Sika Corp.; Sikadur 32
   b. Euclid Chemical Company; Duralcrete
   c. BASF Corporation, Concresive Liquid LPL

J. Vapor Retarder:

1. 10 mil polyethylene sheet conforming to ASTM E1745.

K. Curing Compound:

1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C309.

2. Products:

   a. Euclid Chemical Company: Aqua-Cure VOX
   b. BASF Construction Chemicals: Kure-N-Seal W
   c. SpecChem LLC: Cure & Seal WB.

L. Burlap Mats:

1. Conform to AASHTO M182.

M. Sisal-Kraft Paper and Polyethylene Sheets for Curing:

1. Conform to ASTM C171.

2.02 MIXES:

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231:

1. 2 ± 1 percent for all aggregate sizes.

C. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03300-1.

Table 03300-1

Class	Type of Work	28-Day Minimum Compressive Strength (psi)	Minimum Cementitous Content (lbs per C.Y.)	Maximum Water/ Cement Ratio
A	Concrete for all structures, concrete topping over prestressed concrete, and concrete not otherwise specified.	4,000	560	0.44
B	Pavement, pipe encasement	3,000	500	0.54
C	Miscellaneous unreinforced concrete, concrete grout, mud slab.	2,000	376	0.60
D	Prestressed concrete	5,000	630	0.40
E	Precast concrete	5,000	630	0.40

D. Measure slump in accordance with ASTM C143:

1. Proportion and produce the concrete to have a maximum slump of 4±1 inches.

2. Mixes containing water reducers shall have a maximum slump of 6 inches after the addition of a mid-range water reducer and maximum slump of 8 inches after the addition of a high range water reducer.

E. Pozzolan Content:

1. Water to cementitious ratio shall not exceed water to cement ratio given on table.

2. Fly Ash use is optional. Combine fly ash with cement at rate of 1.0 lb fly ash/lb reduction of cement. Fly ash shall not be less than 15 percent nor more than 25 percent of the total cementitious content given in table.

F. Aggregate Size:

1. Aggregate size shall be 3/4-inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1-1/2 inches maximum for all thicker slabs and sections. Aggregate size for floor topping shall be maximum 3/8-inch.

2. Combined aggregate grading shall be as shown in the following table:

Table 03300-2				
Maximum Aggregate Size	1-1/2 inch	1 inch	3/4-inch	3/8-inch
Aggregate Grade per ASTM C33	467	57	67	8

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine the subgrade and the conditions under which work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected to comply with specified subgrade conditions in a manner acceptable to the Engineer.

3.02 MIXING AND TRANSPORTING CONCRETE:

A. General: Conform to concreting procedures set forth in ASTM C94, ACI 304R and as specified herein.

1. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

2. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.

3. Do not add water at the jobsite unless allowable jobsite water is shown on delivery ticket.

4. Do not add water to concrete containing high range water reducing admixture. Do not add water to concrete in delivery equipment not acceptable for mixing.

5. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery slips certifying the contents of the pour.

6. Discharge of concrete shall be completed within the limits set out in Table 03300-3.

Table 03300-3	
Maximum Time to Concrete Discharge	
Concrete Temperature	Limit
Over 90 Degree F	Remove concrete from jobsite and discard concrete
86 to 90 Degree F	45 minutes
81 to 85 Degree F	60 minutes
70 to 80 Degree F	75 minutes
Below 70 Degree F	90 minutes

B. Conveying: Convey concrete from agitator or mixer truck to place of final deposit in forms by one of the following methods:

1. Buckets or hoppers with discharge gates having a clear opening equal to not less than one-third the maximum interior horizontal area or five times the maximum aggregate size being used, whichever is greater, and side slopes of not less than 60 degrees to horizontal.
2. Buggies or wheelbarrows equipped with pneumatic tires.
3. Round bottom, metal or metal-lined chutes with inclined slope of between 2 to 3 feet horizontally to 1 foot vertically and of sufficient capacity to avoid overflow.
4. Circular drop pipes with a top diameter of at least eight times the maximum aggregate size, but not less than 6 inch, or tapered to not less than six times maximum aggregate size.

3.03 CONCRETE ACCEPTANCE:

A. Accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. Sign delivery batch tickets to indicate concrete acceptance.

B. Reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Engineer.

C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified. Slump and air content of pumped concrete will be tested at pipe discharge.

D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Reject concrete that exceeds the maximum barrel revolution of 300, the time limits in Table 03300-3 or concrete that has water content exceeding the specified water-cement ratio.

E. Reject concrete not conforming to specification before discharging into the forms.

3.04 PREPARATION AND COORDINATION:

A. Contractor shall notify the Engineer of readiness to place concrete in any portion of the work a minimum of 5 working days prior to concrete placement. Failure to provide this notification could be cause for delay in placing concrete.

B. Reinforcement, installation of waterstop, positioning of embedded items, and condition of formwork will be observed by the Engineer prior to concrete placement.

C. Coordinate the sequence of placement such that construction joints will occur only as designed.

D. Schedule sufficient equipment for continuous concrete placing. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide backup concrete vibrators at the project site. Test concrete vibrators the day before placing concrete.

E. Compact the subgrade and/or bedding. Saturate the subgrade approximately eight hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used. Remove standing water, mud, and foreign matter before concrete is deposited.

F. Where shown on contract drawings, intentionally roughen surfaces of set concrete in a manner to expose bonded aggregate uniformly at joints.

G. Place vapor barrier under structural slabs and buildings and where shown on contract drawings. Install material with 6 inch lap at joints and seal joints with tape as recommended by the vapor barrier manufacturer. Tape material cut for slab penetrations to the pipe, conduit or other items passing through the slab. Use tape recommended by the vapor barrier manufacturer.

H. Install vapor barrier without punctures or tears and protect against punctures and breaks.

I. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

J. Contractor shall name a representative for all concrete pours and provide a pour release form filled out for each pour.

3.05 CONCRETE PLACEMENT:

A. Placement shall conform to ACI 304R as modified by these specifications.

B. Do not place concrete unless the Owner’s R.P.R. has been given a minimum of 24 hours of notice prior to pour.

C. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls and slabs until seven days after placement of first placed concrete.

D. Do not place concrete until free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.

E. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.

F. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.

G. Deposit concrete continuously and in level layers. Place in lifts not exceeding 24 inches. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.

H. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove partially hardened concrete from site at no additional compensation.

I. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Limit maximum free fall of concrete to 4 feet. Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.

J. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.

K. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.

L. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.

M. Conduct vibration in a systematic manner with regularly maintained vibrators. Use vibrators having minimum frequency of 8,000 vibrations per minute and of sufficient amplitude to consolidate concrete.

N. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.

O. Use additional vibration with pencil vibrators on vertical surfaces and on exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete:

1. Reduce distance between internal vibration insertions and increase time for each insertion.
2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.
3. Thoroughly vibrate area immediately adjacent to waterstops without damaging the waterstop.
4. Use spading as a supplement to vibration where particularly difficult conditions exist.

P. Pumping Concrete:

1. Conform to the recommendations of ACI 304.2R except as modified herein.
2. Base pump size on rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.
3. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 2 inches.
4. Do not use aluminum pipes for delivery of concrete to the forms.

Q. Waterstops:

1. Prevent displacement of waterstops during concrete placement,

3.06 CURING AND PROTECTION:

A. General:

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.
2. Comply with curing procedures set forth in ACI 301, ACI 308 and as specified herein.
3. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.
4. Perform cold weather concreting in conformance with ACI 306R.

5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration:

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.

2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10 days.

3. Avoid rapid drying at the end of the final curing period

C. Curing Requirements:

1. Unformed Surfaces: Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.

2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm water spray or warm water saturated fabric immediately following form removal.

3. Water containment and below Grade Structures: Moist cure by the application of water to maintain the surface in a continually wet condition. Use water that is free of impurities that could etch or discolor exposed concrete surfaces.

4. Other concrete: Moist cure by moisture-retaining cover curing, or by the use of curing compound.

D. Curing Methods:

1. Water Curing: Use water curing for unformed surfaces. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods:

   a. Keeping the surface of the concrete continuously wet by ponding or immersion.
   b. Continuous water-fog spray or sprinkling.
   c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide

coverage of the concrete surfaces and edges, with a 4 inch lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface.

2. Sealing Materials:

   a. Use common sealing materials such as plastic film or waterproofing (kraft) paper.
   b. Lap adjacent sheets a minimum of 12 inches. Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.
   c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.
   d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.

3. Membrane Curing Compound:

   a. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment.
   b. Do not use curing compounds on construction and expansion joints or on surfaces to receive liquid hardener, dustproofer/sealer, concrete paint, tile, concrete fills and toppings or other applications requiring positive bond.
   c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.

E. Protection from environmental conditions: Maintain the concrete temperature above 50 degrees F continuously throughout the curing period. Make arrangements before concrete placing for heating, covering, insulation or housing to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.

2. Protect the concrete continuously for the entire curing period.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.

4. Avoid temperature changes in concrete that exceed 5 degrees F in any one hour and 50 degrees F in any 24-hour period.

F. Protection from physical injury: Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.

G. Protection from Deicing Agents: Do not apply deicing chemicals to concrete.

3.07 FIELD QUALITY CONTROL:

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305R and the following.

2. When the weather is such that the temperature of the concrete as placed would exceed 80 degrees F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 80 degrees F.

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306R and the following.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F. Materials shall be free from ice, snow, and frozen lumps before entering the mixer.

4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F for the first five days after placing, and above 35 degrees

F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Backfill Against Walls

1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

2. Do not backfill the walls of structures that will be laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

D. Pour Release Form

1. Contractor shall keep a record of all pour release forms and if requested by the Engineer or Owner furnish copies of said forms.

E. Concrete Testing

~~1.~~ Concrete quality testing will be performed on the concrete by independent testing agency retained by the Owner.

2. The testing agency will use concrete samples provided by the Contractor at the point of agitator or mixer truck discharge to perform slump (per ASTM C143) , air content (per ASTM C231), and temperature tests (per ASTM C1064) and for field control test specimens.

3. The testing agency will submit test reports of concrete field measurements specified above to the Contractor and to the Engineer.

4. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

5. Concrete Quality Test Specimen:

   a. Perform sampling and curing of test specimen in accordance with ASTM C31.
   b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.
   c. The testing agency will cast a minimum of one set of 8 test specimens, each 4inch diameter by 8 inch long cylinders, for each 50 cubic yard of each mix design of concrete but not less than once a day.
   d. Test cylinders in accordance with ASTM C39. Test two cylinders at 7 days for information; test three cylinders at 28 days for acceptance; and hold three reserve cylinders for verification. Strength acceptance will be based on the average of the strengths of the three cylinders

tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use a reserve cylinder for the test result

6. The Contractor may take field control test specimens for small quantities of concrete.

7. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.

8. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.

9. Concrete Coring:

   a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Engineer detects deficiencies in the concrete, the Contractor will take concrete cores at least 2 inches in diameter from the structure in conformance with ASTM C 42 at locations determined by the Engineer.
   b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.
   c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.
   d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C39 and submit test strength test results of cores specified above to the Contractor and to the Engineer.
   e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 03310
CONCRETE FLOOR TOPPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, equipment and incidentals required to prepare existing floor surface and place and cure the high strength concrete floor topping and all work related to the application of this topping. The nominal thickness of the floor topping shall be no less than 1.5 inches, however actual thickness may vary slightly across the entire tipping floor based on the level of wear that has occurred over the existing concrete slab. Topping thickness may exceed 1.5 inches in areas of excess wear.

B. Finished tipping floor shall conform to approximate original finish floor elevations. Contractor shall coordinate with owner regarding proposed final elevations of tipping floor. The existing transfer station floor slope shall be maintained after placement of the concrete topping in order to provide positive drainage to existing trench drains.

C. Limits of area to receive floor topping are as shown on the structural drawings.

1.02 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 117 – Specifications for tolerances for concrete construction and materials and commentary.
2. ACI 301-10 Specifications for structural concrete.
3. ACI 305.1 – Specification for hot weather concreting.
4. ACI 306.1 – Standard specification for cold weather concreting.
5. ACI 308.1 – Specification for curing concrete.

B. American Society for Testing Materials

1. ASTM C31 – Standard practice for making and curing concrete test specimens in the field.
2. ASTM C33 – Standard specification for concrete aggregates.
3. ASTM C94 – Standard specification for ready-mixed concrete.
4. ASTM C150 – Standard specification for Portland cement.
5. ASTM C-171-97a – Standard specification for sheet materials for curing concrete.
6. ASTM C172-99 – Standard practice sampling for sheet materials for curing.
7. ASTM C494 – Standard for specification for chemical admixtures for concrete.
8. ASTM C173 – Standard test method for air content of freshly mixed concrete.

9. ASTM C309-98a – Standard specification for liquid membrane forming compounds for curing concrete.

10. ASTM C881 – Standard specification for epoxy-resin-base bonding systems for concrete.

11. ASTM C882 – Standard test method for bond strength of epoxy-resin systems used with concrete by slant shear.

12. ASTM C920 – Standard specification for elastomeric joint sealants.

13. ASTM C1017 – Standard specification for chemical admixtures for use in producing flowing concrete.

14. ASTM C1116 – Standard specification for fiber-reinforced concrete and shotcrete.

15. ASTM D570 – Standard test method for water absorption of plastics.

16. ASTM D638 – Standard test method for tensile properties of plastics.

17. ASTM D695 – Standard test method for compressive properties of rigid plastics.

18. ASTM D695M – Standard test method for compressive properties of rigid plastics.

19. ASTM D994 – Standard specification for preformed expansion joint filler for concrete (bituminous type).

20. ASTM D1190 – Standard specification for concrete joint sealer, hot-applied elastic type.

21. ASTM C1315-00 – Standard specification for liquid membrane forming compounds having special properties for curing concrete.

22. ASTM D1752 – Standard specifications for preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.

C. International Concrete Repair Institute (ICRI)

1. Guideline 03732 – Selecting and specifying concrete surface preparation for sealers, coatings, and polymer overlays.

1.03 QUALITY ASSURANCE

A. The Contractor or their installer shall have a minimum of 10 years experience with concrete slab repairs for transfer stations or similar uses and have completed at least three similar floor toppings projects within the last five years with the product to be used for this project.

B. The acceptance of the floor topping products shall be determined prior to the placement of concrete topping by means of laboratory tests. The specific floor topping mixture to be used shall be tested in accordance with these specifications and provide the OWNER laboratory test results, and history of mix used on similar projects. The Contractor shall arrange for and pay the cost of all required testing.

1.04 SUBMITTALS

A. Manufacturers Product Data

1. Complete materials list showing all items proposed to be furnished and delivered under this section.

2. Technical data and manufacturer's specifications to demonstrate that all items meet or exceed the specifications.

3. Manufacturer's installation instructions.

B. Certified Test Reports

1. Provide testing from an independent materials testing laboratory that confirms the products to be installed conform to these specifications.

C. List of Completed Projects

1. Contractor shall provide to the OWNER a list of completed projects that are similar in scope to this project.

1.05 WARRANTY

A. The manufacturer shall provide a one year material and labor warranty signed jointly by the manufacturer and installer of the floor topping. The warranty shall include the following:

1. Suitability of topping for intended use.

2. Surface preparation and bonding of topping for one year.

3. Wear failure. The topping shall not wear through to substrate during the warranty period.

4. Excessive cracking or other modes of failure that would require repair or replacement of the floor surface.

PART 2 - PRODUCTS

2.01 CEMENT:

A. Cement for all cast-in-place concrete shall be Portland cement, ASTM C150, type I or II.

2.02 AGGREGATES:

A. Natural aggregates consisting of aluminum oxide and ferric oxide based minerals or similar type materials that will achieve the performance characteristics as set forth in these specifications. Metallic aggregates shall be free of rust and will conform to manufacturer's specification for use in the topping.

2.03 WATER:

A. Potable, clean and not detrimental to concrete.

2.04 ADMIXTURES:

A. Not allowed unless specified by the manufacturers' mix design and approved by OWNER.

2.05 BONDING AGENT:

A. Apply bonding agent approved by topping manufacturer.

2.06 CONCRETE TOPPING:

A. High strength metallic or natural concrete floor topping that is pre-formulated and factory mixed and packaged by the manufacturer. The cured floor topping shall conform to the following performance requirements:

Minimum Compressive Strength:

3 Day	6000psi
7 Day	8000psi
28 Day	10000psi

Minimum Flexural Strength:

7 Day	1000psi
28 Day	1500psi

Abrasion Resistance (ASTM C779 or C944)

Depth in 60 min.	0.0026 in.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. The OWNER will remove all trash and clean the surface of the floor with a pressure washer. The existing transfer station floor slab shall be scarified to the required deoth necessary to receive a 1.5 inch nominal thickness topping and restore the floor to approximately original surface elevations. Shot-blasting, milling machines or other suitable methods shall be used to prepare the floor as required. The prepared surface should be irregular with at minimum the top layer of aggregate exposed with a minimum amplitude of ¼ inch between peaks and valleys. The Contractor shall avoid damaging existing rebar during the preparation process where possible. Surface preparation must meet the minimum requirements set forth in ICRI CSP 7-9. In addition, the Contractor shall coordinate any other surface preparation requirements with the manufacturer.

B. Contractor shall survey the floor to determine if any existing cracks or other defects exist that will compromise the integrity of the floor topping. Repair any existing cracks in accordance with the manufacturer's recommendations prior to proceeding with topping application. The Contractor shall inform the OWNER of any such defects prior to proceeding with application of the topping.

C. The Contractor shall demonstrate to the OWNER the soundness of all remaining concrete to receive concrete overlay prior to applying bonding agent.

D. Any reinforcing steel that has been damaged to the extent that the steel's usefulness is destroyed as a result of the Contractor's operations shall be repaired or replaced by the Contractor at the Contractor's own expense.

E. Immediately prior to applying the bonding agent, the concrete surface to receive the topping shall be dry and blown clean by compressed air to remove accumulated dust and any other loose material. If the surface becomes contaminated at any time prior to placing the bonding agent or concrete topping, the surface shall be cleaned by abrasive blasting. The surface temperature of the areas to be covered shall be 40 degrees Fahrenheit or above when the bonding agent and the concrete topping are applied/placed.

3.02 CLEANING

A. Following the abrasive cleaning, the existing concrete surface(s) shall be thoroughly washed to remove all residuals from the abrasive cleaning process and allowed to dry to manufacturer's specifications prior to placing bonding agent.

B. All surfaces shall be clean, sound, free of dust, oil, or other deleterious material at time of placement of bonding agent and concrete floor topping.

3.03 BONDING AGENT APPLICATION

A. A bonding agent recommended by the manufacturer for the intended use shall be applied per manufacturer's specifications prior to placement of the concrete fkoor topping.

3.04 PLACEMENT OF FLOOR TOPPING

A. The bonding agent shall be applied to existing concrete surfaces pursuant to manufacturers recommendations prior to placing the concrete topping.

B. Floor topping shall not be retempered.

C. No traffic shall be permitted on the new concrete topping until at least seven days after final set and then only after Contractor's approval.

D. Finished surfaces of the concrete topping shall not vary more than 3/16 inch (4.8mm) from the lower edge of a 10 ft. (3.0m) straightedge placed in any direction.

E. At the interface of concrete topping surfaces to existing concrete slabs where no mechanical edge device exists, a 1 ½ inch deep sawcut shall be made and a minimum of 1 ½ inch of existing concrete shall be removed in the end 6 feet (or more as required) such that the new concrete topping can be a minimum of 1 ½ inch thick and

tapered as required to be flush with the existing adjoining surface at the interface. DO NOT FEATHER THE CONCRETE TOPPING.

3.05 JOINTS AND EDGES

A. All efforts shall be made to avoid cold joints. The Contractor shall schedulej an appropriate crew and coordinate with the supplier to ensure no cold joints are made. A formed construction joint shall be used wherever cold joints may be required such as at existing expansion joints, end of day's pour, etc.

B. Joints shall be located in topping at all existing joints in existing slab below.

C. Construction joints shall only be placed if approved by the OWNER, and then only at designated locations.

D. Hardened concrete surfaces at construction joints that do not line up with existing joints in the base concrete slab shall be coated with epoxy bonding agent prior to placing plastic concrete topping adjacent to the joint.

E. Where concrete topping butts up against existing hardened concrete or other structures, ¼ inch thick preformed expansion joint material shall be placed from the base concrete slab surface to within ½ inch of the topping surface. The top ¼ inch wide by ½ inch deep space shall be filled with joint sealant specified herein or equivalent sealant.

F. Provide joint sealant at all joints.

3.06 FINAL GRADE

A. The finish grades shall conform to approximate original transfer station floor grades that were established by the Contractor and agreed upon by the OWNER prior to construction and after the survey performed by the Contractor under section 3.1 of this specification and shall not vary by 3/16 inch within 10 feet in any direction.

3.07 CONCRETE FINISH

A. Concrete topping shall receive a finish as recommended by manufacturer without local depressions or high points.

B. Floated Finish: After the concrete topping has been placed, consolidated, struck off and leveled, it shall not be worked further until water sheen has disappeared and the surface has hardened sufficiently to permit floating. The planeness of the topping shall be checked frequently with a 10 foot straightedge applied at no less than two angles approximately 90 degrees apart. The topping shall be refloated to a uniform smooth texture.

C. Finishing Tolerance: Surface shall be true planes within the following limits:

1. 3/16 inch in 10 feet as determined by a 10 foot straightedge placed anywhere on the slab in any direction.

3.08 CURING AND PROTECTION

A. Protect all concrete topping work against damage from elements and defacement of any nature during construction operations.

B. Curing shall be in accordance with the concrete topping manufactureer's recommendations.

C. Concrete topping surfaces shall be protected from the direct rays of the sun to prevent checking and crazing.

3.09 FIELD TESTING

A. A minimum of two sets of four (4) control cylinder specimens shall be taken of the concrete floor topping placed over the existing concrete floor. No less than one set of cylinders shall be taken per day. One slump test shall be performed for each set of cylinders taken. All specimens shall be taken in conformance with ASTM C31. One cylinder from each set shall be tested at 3 days, the second at 7 days and third at 28 days and the fourth held in reserve unless otherwise directed by OWNER.

B. The Contractor shall engage an independent concrete testing laboratory to provide services as stated in Section 3.10.A above. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities for his testing agencies. The Contractor shall cooperate in making of such tests to the extent of allowing free access to the work for the selection of samples.

C. The Contractor shall engage a testing agency to test the bond between the concrete topping and the existing concrete base slab. Provide one test for every 750 to 1000 square feet of slab. Where tests result in failure of the bond interface between concrete layers or the concrete topping (i.e. the existing base slab concrete should fail before the epoxy joint or the concrete topping), the Contractor, at his own expense, shall:

1. Perform sufficient additional tests to define the area of failure.

2. Remove the concrete topping and bonding agent from the failure area.

3. Apply new bonding agent and concrete topping as directed by the OWNER.

D. The following is an acceptable test procedure for testing the bond between the concrete topping and the existing concrete base slab:

1. Bond Pull-Off Testing:

   a. Field testing shall be performed pursuant to ACI 503R – Use of Epoxy Compounds with Concrete, Appendix A – Test Methods, Section A.1 – Field Test for Surface Soundness and Adhesion.
   b. Acceptance criteria for the concrete topping bond pull-off testing shall be failure in the existing base slab concrete (cohesive concrete failure) as indicated in Section A.1.5 of ACI 503R Appendix A.
   c. Test sites shall be repaired by placing epoxy-bonding agent and concrete topping in the core holes as directed by the OWNER.

2. Acceptance of bonded concrete overlay placement shall be evaluated in accordance with the following criteria:

   a. Results of bond pull-off tests shall satisfy criteria established by the ENGINEER as indicated in Section D.1.b above.
   b. Sounding and visual inspections shall indicate a sound bond between the concrete topping and existing base slab concrete and there shall be no excessive cracking in any area of the tipping floor.
   c. Results of compressive strength tests of concrete cylinders shall satisfy the requirements specified herein.

3. Other surface soundness and adhesion test methods may be used subject to documented evidence of equivalence and written approval by the OWNER.

END OF SECTION

SECTION 03350
CONCRETE FINISHES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Cast-In-Place Concrete is included in Section 03300.

C. Grout is included in Section 03600.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C33 - Standard Specification for Concrete Aggregates.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Finishes

1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.

2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.

3. Services of Manufacturer's Representative

a. Make available at no extra cost to the Owner, upon 72 hours notification, the services of a qualified field representative of the

manufacturer of curing compound, sealer or hardener to instruct the user on the proper application of the product under prevailing job conditions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Chemical hardener shall be Lapidolith by Sonneborn; Hornolith by A.C. Horn; Penalith by W.R. Meadows or equal fluosilicate base material.

B. Concrete sealer shall be "MasterKure CC 180 WB", by Master Builders Solutions, Shakopee, MN or equal.

PART 3 - EXECUTION

3.01 FORMED SURFACES

A. Forms shall not be removed before the requirements of Section 03300, have been satisfied.

B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or performing any other work adjacent thereto.

C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

D. Rough-Form Finish

1. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.

2. Promptly fill holes left by tie cones and defects as specified in Section 03300.

E. Rubbed Finish

1. Immediately upon stripping forms and before concrete has changed color, carefully remove all fins. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.

2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.

3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be

scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)

4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.

5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.

6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

7. It is the intent of this finish to provide a surface that is uniform in appearance with no blemishes, imperfections, discolorations, etc.

F. Abrasive Blast Finish

1. Coordinate with Rubbed Finish application. Do not begin until Rubbed Finish operation is complete or before concrete has reached minimum 7-day strength. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality. Apply the abrasive blast finish only where indicated on Drawings.

2. Prepare a sample area of minimum 4-ft high by 16-ft wide Blast Finish as directed by Engineer on a portion of new wall construction which will not be exposed in the final work. Sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials and blasting techniques for selection by Engineer. Final accepted sample shall remain exposed until completion of all Blast Finish operations.

3. Blast finish operation shall meet all regulatory agency requirements. Blast Finish contractor shall be responsible for obtaining all required permits and/or licenses.

4. Perform abrasive blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface

or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.

5. Use an abrasive grit of proper type and gradation as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:

   a. Medium: Generally expose coarse aggregate - 1/4-in to 3/8-in reveal.

6. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure and blasting techniques required to match Architect's samples.

7. Upon completion of the Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit. Allow to air dry until curing of concrete is complete.

8. After the concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by manufacturer.

3.02 FLOORS AND SLABS

A. Floated Finish

1. Machine Floating

   a. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in the proportion of two sacks of portland cement to 350 lbs of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 lbs /1,000 sq ft of floor. Do not sprinkle neat, dry cement on the surface.

   b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without its digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 lb compaction force distributed over a 24-in diameter disc.

   c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.

   d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

2. Hand Floating

a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-in indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.

3. Finishing Tolerances

a. Level floors and slabs to a tolerance of plus or minus 1/8-in when checked with a 10-ft straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.

B. Broom Finish

1. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage, or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.

C. Steel Trowel Finish

1. Finish concrete as specified in Paragraph 3.04 and 3.05. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.

D. Concrete Sealer

1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:

a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Paragraph 3.05 below.

b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking workmen.

c. Newly-Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.

d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.

e. Methods: Apply sealer so as to form a continuous, uniform film by spray, soft-bristle pushbroom, long-nap roller or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.

f. Applications: For curing only, apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.

g. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full-strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.03 CONCRETE RECEIVING CHEMICAL HARDENER

A. After 28 days, minimum, concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 sq ft per gallon and in accordance with manufacturer's recommendations as reviewed.

3.04 APPROVAL OF FINISHES

A. All concrete surfaces, when finished, will be inspected by the Engineer.

B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.

C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

3.05 SCHEDULE OF FINISHES

A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.

B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:

1. Concrete to Receive Dampproofing: Rough-form finish. See Paragraph 3.01D above.

2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough-form finish. See Paragraph 3.01D above.

3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.

4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.

5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough-form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.

6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.

7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.

8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A above.

9. Concrete for Exterior Walks, Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.

10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C above.

11. Concrete to Receive Hardener: See Paragraph 3.03 above.

12. Concrete to Receive Floor Sealer: See Paragraph 3.02D above.

13. Concrete tank bottoms to be covered with grout: See Section 03600.

END OF SECTION

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SECTION 03410
PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: This Section specifies the materials, labor and equipment required to construct manholes, wetwells, valve vaults, mitered end sections, meter boxes and all other precast concrete structures, as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards.

1. Standard Building Code
2. Local Codes and Regulations
3. ACI Building Code Requirements for Reinforced Concrete
4. American Society for Testing and Materials (ASTM)
5. American Concrete Institute (ACI)

B. The forms, dimensions, concrete, and construction methods shall be acceptable to the County in advance of construction.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

B. The Contractor shall submit Shop Drawings to the County, showing all details of construction, reinforcing and joints.

C. Submit manufacturer's data on certifications and testing for concrete waterproofing additive, joint mastic, gaskets and grout material to be used.

1.04 INSPECTION

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and acceptance by the County. Such inspection may be made at the place of manufacture or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time due to failure to meet any of the specification requirements; even though sample sections may have been acceptable as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All damaged sections will be rejected. If damaged sections have already been installed; they shall be acceptably repaired if authorized by the County, or removed and replaced at the Contractor's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified and the acceptable manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch strength", blisters, cracks, roughness, and soundness. The surface shall be dense and close textured.

C. Imperfections may be repaired subject to the review and acceptance of the County after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final review and acceptance. Cement mortar used for repairs shall have a minimum compressive strength of 4,000-psi at the end of 7-days and 5,000-psi at the end of 28-days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the review and acceptance of the County.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 PRECAST CONCRETE SECTIONS

A. Precast concrete wetwell sections, manhole barrel and eccentric top sections shall conform to specifications for precast reinforced concrete manhole sections, ASTM Designation C478, except as otherwise specified below or as shown on the Drawings. Details of precast sections shown on the Drawings, including thickness and reinforcing, shall supersede ASTM C-478 when such details are more stringent than ASTM C-478. The method of construction shall conform to the detailed Drawings appended to these specifications and the following additional requirements:

1. The minimum wall thickness for the various size barrel sections shall be 5-inches, or as indicated in the Drawings.

2. Barrel sections shall have tongue and groove joints. Joints shall be sealed with cold adhesive preformed plastic gaskets set in double rows on the tongue and in the groove prior to setting the next section. Gaskets shall be K.T. Snyder "Ram-Nek", Conseal "CS-102" or acceptable equal. All extension joints shall be sealed with Portland Type II cement after setting of gasket and placement of manhole section into a watertight joint.

3. Type II cement shall be used except as otherwise accepted.

4. New concrete structures shall contain a crystalline waterproofing concrete admix for all new concrete structures including but not limited to manholes, ARV vaults, wetwells, and wetwell top slabs. Crystalline waterproofing concrete admix shall be added to the concrete during the batching operation. Admixture concentration shall be added based upon manufacturer's design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admixture was added to the concrete. Colorant shall be

added and provided at the admixture manufacturing facility, not at the concrete batch plant. It is recommended that the admixture be added first to the rock and sand and blended thoroughly before adding cement and water or per the manufacturer's recommendations. Concrete structures without crystalline waterproofing admixture or admixture without colorant for field verification shall be rejected. Contractor shall provide certification from the pre-caster that the admixture was added in accordance with the manufacturer's recommendations. Concrete admixture shall be manufactured and supplied by an approved manufacturer as shown in Appendix D "List of Approved Products."

5. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section. Each section must be inspected and stamped by an accredited testing laboratory.

6. Sections shall be cured by an acceptable method for at least 28-days.

7. Manhole top sections shall be eccentric except that precast concrete slabs shall be used where cover over the top of the pipe is less than 4-feet for all manholes. Lift rings or non-penetrating lift holes shall be provided for handling precast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the manhole sections.

8. Precast concrete slabs over top section, where required, shall be capable of supporting the overburden plus a live load equivalent to ASHTO H 20 loading.

9. The tops of bases shall be suitably shaped to mate with the adjoining precast section.

10. Precast leveling rings for setting cast iron frames over manholes shall be 2-inch thick and have 1 (one) Number 2 continuous reinforcing steel bar.

11. Concrete surfaces shall have form oil, curing compounds, dust, dirt, and other interfering materials removed by brush sand blasting and shall be fully cured prior to delivery.

12. Interior surfaces of manholes, wetwells and valve vaults shall be lined in accordance with Appendix D "List of Approved Products."

13. Manholes to be installed around existing gravity sewers shall consist of a cast-in-place concrete base slab and precast concrete barrel and top sections; lined per Section 3410 – 2.01.11. The base slab shall be as shown on the Drawings and include a joint which is compatible with the bottom barrel section and acceptable to the County. The bottom barrel section shall include an inverted "U-shaped" slot to allow installation of the section over existing pipes. Flow channels shall be provided within the manholes as shown on the Drawings. Annular space between the existing pipe and slot shall be made watertight with non-shrink grout. Existing pipes shall be removed within the manhole and outlets plugged watertight with non-shrink grout as shown on the Drawings.

14. The manholes shall have an invert channel shaped to correspond with the lower half of the pipe. The top of the shelf shall be at the elevation indicated and shall be sloped to drain toward the flowing through channel. Every effort shall be made by the Contractor to construct watertight structures.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All manholes and other precast structures shall be set in the dry.

B. Manholes and other precast structures shall be constructed to the dimensions as shown on the Drawings and as specified herein.

C. The base structure may be cast-in-place concrete as specified in Division 3. The concrete structure shall be placed on the required crushed stone base as shown in the Drawings over a dry sub base of structural fill that has been compacted to 95% (percent) of the maximum dry density as determined by the modified proctor test, ASTM D1557. The tops of the cast in place bases shall be shaped to mate with the precast barrel section and shall be adjusted in grade so that the top of the dome section is at the correct elevation.

D. Precast bases conforming to all requirements of ASTM C478 and other requirements for precast sections may be used and shall be set on a sub base as described above.

E. Precast concrete structure sections shall be set vertically with sections in true alignment with a 1/4-inch maximum tolerance per 5-feet of depth. The outside and inside joint shall be filled with a non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24-hours before backfilling. Backfilling shall be accomplished bringing the fill up evenly on all sides. If leaks appear in the structures, the inside joints shall be caulked with non-shrink grout to the satisfaction of the County. The Contractor shall install the precast sections in a manner that will result in a watertight joint.

F. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation.

G. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.

H. Cast iron frames shall be placed over precast concrete leveling rings, shimmed and set in cement mortar to the required grade. No more than 3 courses of leveling rings shall be used.

END OF SECTION

SECTION 03480
PRECAST CONCRETE BUILDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. A factory-build precast concrete building shall be supplied for the Electrical Building and Pump Metering Enclosure in accordance with project plans and specifications.

1.02 SUBMITTALS

A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings and material data showing dimensions, sizes, thickness, materials, finishes and methods of assembly. Submit manufacturer's technical data for all building hardware and equipment. All work shall be fabricated and erected in accordance with the manufacturer's drawings.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C150 – Portland Cement
2. ASTM C33 - Concrete Aggregates
3. ASTM C260 – Air-Entraining Admixtures for Concrete
4. ASTM A185 – Steel Welded Wire Fabric for Concrete Reinforcement
5. ASTM C494 – Chemical Admixtures for Concrete
6. ASTM AC615 – Deformed and Plain Billet Steel Bars for Concrete Reinforcement

B. American Concrete Institute (ACI)

1. ACI-318 Building Code Requirements for Structural Concrete

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. The precast concrete building manufacturer shall have a minimum of five years experience in building fabrication. In addition, the manufacturer shall have made no less than 10 buildings similar to the one on this project. Evidence must be submitted to verify that these requirements are met prior to being deemed an acceptable manufacturer.

B. The ENGINEER shall have the right to inspect or test any material during fabrication in the factory. At the option of the ENGINEER, certified test of materials may be accepted in lieu of field test.

1.05 DESIGN CRITERIA

A. Structural design calculation for the building shall be prepared and sealed by a registered professional engineer, in the State of Florida, and shall be submitted for approval prior to fabrication.

B. The building shall be designed to meet the following minimum loading requirements:

1. Roof Live Load- 60 psf

2. Floor Live Load – 200 psf

3. Wall wind load (120 mph) – 45 psf

C. The building shall be constructed of steel-reinforced precast concrete.

D. The precast concrete building shall be such that the roof and walls are cast at manufacture. The floor shall be permanently attached to the walls by welded connections.

E. The building shall have a minimum roof thickness of 12 inches, minimum floor thickness of 8 inches and minimum wall thickness of 12 inches.

F. The building shall be entirely factor assembled and shipped as 1-piece unit.

G. The building exterior finish shall be exposed aggregate.

H. The exterior surface of the building body shall receive one coat of Thoroseal concrete sealer and one coat of Thorocoat acrylic coating, color to be approved by Owner.

I. The exterior building trim shall be treated in the same manner, except Thorocoat acrylic coating shall be color approved by the Owner.

J. The interior walls and ceiling of the building shall receive one (1) coat of Thoroseal concrete sealer and one coat of Thorocoat acrylic coating color approved by the Owner.

K. The Contractor shall coordinate the location of all penetrations and openings with the manufacturer as shown on design Drawings.

1.06 DELIVERY, STORAGE AND HANDLING

A. The building shall be stored on dunnage placed at the proper locations to prevent cracking, distortion, or any other physical damage.

B. The building shall be shipped by the manufacturer. It shall be provided with lifting fixtures for lifting and setting the building without incurring damage to the walls or roof.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete

1. Concrete used in the manufacture of the various structural components of the precast concrete building shall be factory batched and shall meet the following requirements:

   a. Portland cement shall be Type I, II, or III conforming to ASTM C-150.
   b. Coarse aggregate shall consist of 1/2" maximum well graded crushed stone conforming to ASTM specification C-33.
   c. Fine aggregate shall consist of natural sand conforming to ASTM specification C-33.
   d. Air entrainment admixture shall conform to ASTM C260. The air-entrained content shall be not less than 4% or greater than 7%.
   e. A superplasticizer shall be used and shall conform to ASTM C494 type F or G. Concrete shall be placed at a slump of between 5 and 8 inches.
   f. The concrete used for the structural components shall attain a minimum 28-day compressive strength of 5,000 psi.

B. Steel Reinforcing

1. Welded wire fabric shall conform to ASTM A185. Reinforcing steel shall be new billet steel meeting the requirements of ASTM A615.

2. All reinforcement shall be free from loose rush, oil, and contaminates which reduce bond. Any foreign material shall be removed by suitable means prior to installation.

3. Provide supports for reinforcement including chairs, bolster bars, and other devices for spacing and securing reinforcement in accordance with CRSI requirements. Legs of all supports in contact with exposed-to-view surfaces shall be plastic coated in accordance with CRSI, class I.

PART 3 - EXECUTION

3.01 WARRANTY

A. The manufacture shall warrant the building and its components for one year from the date of installation.

B. The precast concrete structure shall endure and not deteriorate for a period of 10 years.

END OF SECTION

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SECTION 03510
HIGH PERFORMANCE CONCRETE MOISTURE VAPOR REDUCING ADMIXTURE (MVRA)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01Section "Summary."

1.02 SUMMARY

A. Section includes:

1. High Performance Concrete Moisture Vapor Reducing Admixture (MVRA) for all new **concrete slabs**, including slab-on- grade and concrete beams.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for vapor retarder.
2. Division 09 Flooring Sections for flooring materials installed over concrete slabs that contain integral moisture vapor reduction admixture and for preparation requirements.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 REFERENCES

A. American Society for Testing and Materials International (ASTM)

1. ASTM D 5084: Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
2. ASTM E 1643: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
3. ASTM E 1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

4. ASTM F 710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

5. ASTM C 494/C 494M-08a: Standard Specification for Chemical Admixtures for Concrete Type S.

1.05 SUBMITTALS

A. Product Data: Manufacturer's printed data.

B. Product test reports performed by a qualified independent testing agency evidencing compliance of products with specified requirements of moisture vapor transmission based on comprehensive testing of current products.

C. Manufacturer's certificate certifying admixture provided meets or exceeds specified requirements.

D. Sample life of the concrete warranty.

E. Sample adhesion guarantee.

F. Sample moisture letter.

G. MSDS.

H. Sheet Vapor Retarder product data submittal

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than ten (10) years' experience in the manufacture of the specified concrete moisture vapor reduction admixture, capable of providing test reports indicating compliance with specified performance requirements, and able to provide on-site technical representation should the need arise. Selected product must have certification of compliance with ASTM C494 /C494M testing protocols from an independent AASHTO approved laboratory.

B. Pre-installation Conference.

1. Verify all are familiar with MVRA project specific quality control procedures, review concrete mix designs and examine procedures for ensuring quality of concrete materials. Each entity directly concerned with MVRA dosed concrete must attend in person or conference call and provide electronic review of documents, mix designs and procedures. Meeting minutes and a letter stating this requirement has been fulfilled shall be taken by the contractor then directed to the Architect for compliance, prior to any concrete fabrication or installation. Those required to participate or to review include but are not limited to:

2. Contractor.

3. Independent testing agency responsible for concrete design mixtures, sampling and testing.

4. Ready-mix concrete manufacturer.

5. Concrete subcontractor

6. Moisture Vapor Reduction Admixture manufacturer.

C. Ready Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

D. Moisture Vapor Reduction Admixture Collection Agent / Representative Qualifications

1. Personnel conducting field sampling on behalf of the MVRA manufacturer shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Moisture Testing and Evaluation: Personnel performing laboratory tests shall be certified in the conduct of ASTM D5084 under the supervision of a licensed geotechnical engineer. The determination as to whether the concrete slab is prepared to receive flooring, coatings, roofing, etc. rests with the MVRA manufacturer.

F. Source Limitations: Obtain each type of concrete moisture vapor reducing admixture from the same manufacturer.

G. ACI Publications: For slabs to receive moisture sensitive coatings or material, comply with the following unless modified by requirements in the Contract Documents:

1. ACI 302.2R-06, "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring".

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver MVRA in manufacturer’s original, undamaged containers.

B. Store MVRA protected from exposure to harmful weather conditions and in a temperature controlled area above 36 degrees.

C. Do not allow product to freeze. Should product freeze, immediately contact the MVRA manufacturer for further instructions.

1.08 WARRANTY

A. Moisture Vapor Reduction Admixture (MVRA):

1. MVRA must be installed according to, and in compliance with, the manufacturer's published data sheet to include, but not limited to:

   a. Dosing instructions.
   b. Onsite representation and sampling requirements.
   c. Use of an ASTM E 1745 vapor retarder installed following ASTM E 1643 and ASTM F710 guidelines; elevated slabs to receive flooring do not require a vapor retarder
   d. The design and specifications for roof deck assemblies, to include but not limited to, the use of air barriers and/or vapor retarders is the sole responsibility of the design professional and is excluded from this warranty as are any costs incurred due to roofing overburden.

2. Manufacturer's Warranty: To include:

   a. Term: Life of the concrete.
   b. Repair and/or removal of failed flooring or roofing.
   c. Placement of a topical moisture remediation system.
   d. Replacement of flooring/roofing materials like original installed to include material and labor.

3. Adhesion Warranty: MVRA Manufacturer shall provide an adhesion warranty to match the term of the adhesive and/or primer manufacturer's material defect warranty upon MVRA manufacturer's acceptance of field bond test.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design "Barrier One High Performance Moisture Vapor Reduction Admixture" manufactured by Barrier One, Inc..; 522 S. Hunt Club Blvd., #303, Apopka, Florida 32703; Contact Manufacturer's representative: P: 877.224.5850, F: 866.594.3490 or Email at: info@barrierone.com

B. Products of the following manufacturers are acceptable, providing their products equal or exceed the quality specified, **they can provide products of the type, function and testing required and Warranty requirements.**

   1. 1800 Super Admix; Moxie International
   2. Vapor Lock 20/20; Specialty Products Group
   3. Hycrete W1000; Hycrete
   4. Admix C-2000; Xypex

C. Subject to compliance with the requirements of this section, under provisions of Section 01 60 00, substitutions may be considered. Failure to provide a product that meets or exceeds the MVRA warranty requirements of Part I and the MVRA field

quality control requirements of Part 3 will result in all subsequent testing and slab remediation costs being borne by the ready mix supplier.

2.02 MATERIALS

A. Concrete moisture vapor reduction admixture (MVRA) for all interior slab (on ground and elevated) and structural roof deck construction shall be a non-toxic, liquid admixture that is free of all volatile organic compounds (VOC). It shall be specifically designed to have a natural chemical reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through the slab by restricting the integral capillary system. Chemical reaction shall form a permanent barrier (capillary break) that is integral to the concrete, insoluble, and irremovable.

1. Hydraulic conductivity: Project specific maximum of 6.0 E-8 cm/s per ASTM D5084
2. Toxicity: None
3. Odor: None
4. Flammability: None
5. VOC levels: zero
6. Solvent: water
7. Freeze Temp: 32 degrees Fahrenheit (0^0 C)(store above 36^0 F (2.3^0 C))
8. Acid resistance: Excellent
9. Hazardous vapors:None
10. Installation: All concrete
11. Capillary break: Calcium Silicate Hydrate
12. pH: 11.3
13. weight:10.3 lbs/gal (net)
14. Integral biocide to inhibit growth of mold and bacteria

2.03 RELATED MATERIALS

A. Sheet Vapor Retarder: ASTM E 1745 compliant material, with a maximum permeance of 0.1 US Perms and a minimum thickness of 0.01". Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work may be manufactured by, but are not limited to, the following:
   a. Insulation Solutions, Inc.
   b. Meadows, W. R., Inc.
   c. Raven Industries Inc.

d. Reef Industries, Inc.

2. It is the responsibility of the vapor retarder manufacturer to show compliance with the most current version of ASTM E1745.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with the requirements of Division 03 Cast-in-Place Concrete, or other appropriate section, for concrete mixing, placing and curing.

B. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643, ASTM F710, ACI 302.2R-06 and manufacturer's written instructions.

C. Add MVRA in accordance with manufacturer's printed data sheet instructions: For mix designs ranging from 0.42 to 0.52 w/cm, dose at 14 ounces per 100 pounds (414ml/45kg) of total cementitious materials. Remove an equal amount of water from the mix. Add separately from other admixtures at the tail end of the load. Mix designs below 0.42 and above 0.52 may require adjustment and consultation with MVRA manufacturer is required prior to their use.

1. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete with MVRA according to ASTM C 94/C 94M; furnish batch ticket information showing dosage of MVRA.

2. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Add the MVRA to where it makes direct contact with the ready mix and then rotate drum of batch truck on high for at least seven minutes prior to discharge.

D. Freshening onsite with held back mix water is acceptable so long as the practice is in accordance with published ACI guidelines and does not exceed the original water to cementitious material ratio or instructions of the structural engineer.

E. Use of water reducing admixtures is recommended to achieve slumps greater than 4" (102mm).

F. Use of other admixtures in the same batch as MVRA is acceptable so long as each admixture is added separately.

G. The inclusion of a shrink reducing admixture (SRA) is not acceptable

H. Cold-Weather Placement: Comply with ACI 306.1.

I. Hot-Weather Placement: Comply with ACI 301.

3.02 CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Cure concrete slabs to receive moisture sensitive coatings according to ACI 302.2R-06, by one or a combination of the following methods:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure concrete containing MVRA for not less than 24 hours, longer if ambient conditions are hot, windy, and sunny or subject to periods of very low humidity. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3. Removal: After curing period has elapsed, mechanically remove curing compound prior to the installation of final flooring material in accordance with ASTM F-710.

a. Do not chemically remove.

3.03 FIELD QUALITY CONTROL

A. Testing and Inspecting: The manufacturer of the moisture vapor reduction admixture will, at their expense, engage qualified agencies to obtain project specific sample cylinders and independent certified laboratories for subsequent testing per ASTM D5084 and preparation of test reports.

B. Testing of Containing MVRA:

1. The moisture vapor reduction admixture (MVRA) manufacturer will perform all moisture testing in accordance with this specification and will issue project specific warranties and adhesion guarantees prior to installation of any slab finishes; no further field slab moisture nor pH testing shall be required.

2. A representative or agent of the moisture vapor reduction admixture (MVRA) manufacturer must be present at the jobsite during placement of all MVRA treated concrete.

a. Do not proceed without this representative being present.
b. A minimum of one business day notification is required.

3. Field testing technician shall, at the expense of the MVRA Manufacturer, procure at least one 4 inch (102 mm) cylinder from every day of placement of MVRA dosed concrete for the purpose of subsequent hydraulic conductivity/coefficient of permeability testing.

   a. All cylinders shall be independently lab tested in accordance with ASTM D 5084 at the expense of the MVRA manufacturer.
   b. Tilt-up wall panels are not to be erected into place until the cylinder samples have been tested for ASTM D5084 and approved by the MVRA Manufacturer according to specified limits in Section 6.a.
   c. Test results must conform to specified limits.

      i. Should any cylinder from any day of placement deliver results in excess of 6.0 E-08 cm/sec, the concrete moisture vapor reduction admixture manufacturer shall procure, at their expense, a core (or cores) from that day of placement. This core (cores) shall be sent to an independent laboratory for hydraulic conductivity (coefficient or permeability) per ASTM D 5084.
      ii. Should any core deliver results in excess of 6.0 E-08 cm/sec per ASTM D 5084, the concrete moisture vapor reduction admixture manufacturer shall provide, at their expense, a topical moisture mitigation system for all slab areas not meeting the stated limit.
      iii. Should any core deliver results in excess of 6.0 E-08 cm/sec per ASTM D 5084, in tilt-wall or cast-in-place structural system, that component will not be installed and is to be discarded.

4. Proceeding with placement of concrete dosed with the MVRA without the required representation will result in the contractor bearing the cost to core and ship appropriate material for testing per ASTM D 5084.

3.04 MVRA MANUFACTURER WILL NOTIFY THE ARCHITECT, IN WRITING, WHERE DOSED CONCRETE FAILED TO MEET ASTM D5084 TESTING REQUIREMENTS.

A. Make repairs to slab in accordance with Division 03 Section “Cast-in-Place Concrete” and as recommended by concrete moisture vapor reduction admixture manufacturer.

END OF SECTION

SECTION 03600
GROUT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Formwork is included in Section 03100.

B. Concrete Reinforcement is included in Section 03200.

C. Concrete Joints and Joint Accessories are included in Section 03350.

D. Cast-in-Place Concrete is included in Section 03300.

E. Masonry Grout is included in Section 04230.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Commercially manufactured nonshrink cementitous grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.

2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.

3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.

4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03200. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.

B. Laboratory Test Reports

1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.

C. Certifications

1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.

D. Qualifications

1. Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. U.S. Army Corps of Engineers Standard (CRD)

1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

B. Pre-installation Conference

1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing

1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc, for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.

2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.

C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.

D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.

E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 - PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water.

Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.

a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp. or equal.

b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp. or equal.

B. Nonshrink Epoxy Grout

1. Nonshrink epoxy-based grout shall be a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30 x 10^{-6} when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout-Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co. or equal.

C. Cement Grout

1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Concrete Grout

1. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 2900 psi at 28 days, or 2500 psi nominal strength. Coarse aggregate size shall be 1/2-in maximum. Slump should not exceed 5-in and should be as low as practical yet still retain sufficient workability.

2. Synthetic reinforcing fibers as specified in Section 03200 shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 - EXECUTION

3.01 PREPARATION

A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may effect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼" amplitude or provide a raked finish in order to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.

D. Remove all loose rust, oil or other deleterious substances from metal embedments or bottom of baseplates prior to the installation of the grout.

E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24 hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved by the Engineer for each specific location of grout installation.

F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.

G. Construct grout forms or other leakproof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.

1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.

H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.

I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

3.02 INSTALLATION – GENERAL

A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and this Section.

B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.

C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.

E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.

F. Reflect all existing underlying expansion, control and construction joints through the grout.

3.03 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.

B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.

F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION - NONSHRINK EPOXY GROUTS

A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.

B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.

C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.

E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.

F. Epoxy grouts are self curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.05 INSTALLATION - CONCRETE GROUT

A. Screed underlying concrete to the grade shown on the Drawings. Prepare the surface according to 3.01B. Protect and keep the surface clean until placement of concrete grout.

B. Remove the debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing of debris into tank drain lines will not be permitted.

C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Saturation may be maintained by ponding, by the use or soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry

over the surface with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste. (A bonding grout composed of 1 part portland cement, 1.5 parts fine sand, an approved bonding admixture and water, mixed to achieve the consistency of thick paint, may be substituted for the cement slurry.)

D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.

E. Provide grout control joints as indicated on the Drawings.

F. Finish and cure the concrete grout as specified for cast-in-place concrete.

3.06 SCHEDULE

A. The following list indicates where the particular types of grout are to be used:

B. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.

C. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout..

D. Nonshrink epoxy grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.

E. Cement grout: Cement grout may be used for grouting of incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting of primary structural steel members such as columns and girders.

F. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers to allow more control in placing the surface grade.

END OF SECTION

SECTION 03740
MODIFICATIONS AND REPAIR TO CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

1.02 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Concrete Reinforcement is included in Section 03200.

C. Concrete Joints and Accessories are included in Section 03250.

D. Cast-in-Place Concrete is included in Section 03300.

E. Concrete Finishes are included in Section 03350.

F. Grout is included in Section 03600.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, a schedule of Demolition and the detailed methods of demolition to be used at each location.

B. Submit manufacturer's technical literature on all product brands proposed for use, to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.

C. When substitutions for acceptable brands of materials specified herein are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

2. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Sheer.

3. ASTM C883 - Standard Test Method for Effective Shrinkage of Epoxy-Resin Systems Used with Concrete.

4. ASTM D570 - Standard Test Method for Water Absorption of Plastics.

5. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

6. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

7. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool.

8. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.

B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, line drilling will be required in cutting existing concrete.

C. Manufacturer Qualifications: The manufacturer of the specified products shall have a minimum of 10 years experience in the manufacture of such products and shall have an ongoing program of training, certifying and technically supporting the Contractor's personnel.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification and batch numbers.

B. Store and condition the specified product as recommended by the manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General

1. Materials shall comply with this Section and any state or local regulations.

B. Epoxy Bonding Agent

1. General

a. The epoxy bonding agent shall be a two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bond plastic concrete to hardened concrete complying with the requirements of ASTM C881, Type II and the additional requirements specified herein.

2. Material

a. Properties of the cured material:

i. Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
ii. Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
iii. Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
iv. Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
v. Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
vi. Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
vii. Effective Shrinkage (ASTM C883): Passes Test.
viii. Color: Gray.

3. Approved manufacturers include: Sika Corporation, Lyndhurst, NJ - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, OH - Concresive Liquid (LPL) or equal.

C. Epoxy Paste

1. General

a. Epoxy Paste shall be a two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3 and the additional requirements specified herein. It may also be used to patch existing surfaces where the glue line is 1/8-in or less.

2. Material

a. Properties of the cured material:

i. Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
ii. Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
iii. Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days.
iv. Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
v. Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
vi. Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
vii. Color: Concrete grey.

3. Approved manufacturer's include:

a. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concresive 1438 or equal.

b. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concresive 1438 or equal.

D. Repair Mortar

1. General

a. Repair mortal shall be a two-component, polymer modified, cement based, fast-setting, trowel grade, structural repair mortar suitable for use on horizontal, vertical and overhead surfaces prepackaged product specifically formulated for the repair of concrete surface defects.

2. Material

a. Properties of the cured material:

i. Compressive Strength (2 hours 50 percent RH) – 150 psi minimum
ii. Compressive Strength (28 days 50 percent RH) – 150 psi minimum
iii. Bond Strength (pull off method) – 100 percent concrete substrate failure
iv. This system shall conform with ANSI/NSF standards for surface contact with potable water.

3. Approved manufacturer's include:

a. Sika Corporation, Lyndhurst, N.J. – SikaTop 122 PLUS or equal.
b. Overhead applications: Sika Corporation, Lyndhurst, N.J. – SikaTop 123 PLUS or equal.

E. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600 GROUT.

F. Adhesive Capsule type anchor system shall be equal to the HVA adhesive Anchoring System by Hilti Fastening Systems, Tulsa, OK. The capsule shall consist of a sealed glass capsule containing premeasured amounts of polyester or vinylester resin, quartz sand aggregate and a hardener contained in a separate vial within the capsule. Where the adhesive anchor is under sustained tensile loading (i.e. vertically installed anchors) the anchor system shall be Hilti HIT RE-500 SD by Hilti Fastening Systems, Tulsa, OK.

G. Acrylic Latex Bonding Agents shall not be used for this project.

H. Crack Repair Epoxy Adhesive

1. General

a. Crack Repair Epoxy Adhesive shall be a two-component, solvent-free, moisture insensitive epoxy resin material suitable for crack grouting by injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.

b. All concrete surfaces containing potable water or water to be treated for potable use that are repaired by the epoxy adhesive injection system shall be coated with an acceptable epoxy coating system that conforms with ANSI/NSF standards for surface contact with potable water.

2. Material

a. Properties of the cured material

i. Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
ii. Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.
iii. Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
iv. Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
v. Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent maximum at 7 days.
vi. Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
vii. Effective Shrinkage (ASTM 883): Passes Test.

3. Approved manufacturer's include:

a. For standard applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod; Master Builders Inc., Cleveland, OH - Concressive 1380 or equal.
b. For very thin applications; Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod LV; Master Builders Inc., Cleveland, OH - Concressive 1468 or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Cut, repair, reuse, demolish, excavate or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified herein, or necessary to permit completion of the Work. Finishes, joints, reinforcements, sealants, etc, are specified in respective Sections. All work shall comply with other requirements of this of Section and as shown on the Drawings.

B. All commercial products specified in this Section shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations.

C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.

D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be

relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

3.02 CONCRETE REMOVAL

A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer, shall be done by line drilling at limits followed by chipping or jack-hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be removed shall only be done if indicated on the Drawings, or after obtaining written approval from the Engineer.

B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4-in.

C. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1-in deep saw cut on each exposed surface of the existing concrete.

D. Concrete specified to be left in place which is damaged shall be repaired by approved means to the satisfaction of the Engineer.

E. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

3.03 SURFACE PREPARATION

A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs or modifications as shown on the Drawings, specified herein, or as directed by the Engineer.

B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means, i.e. - sandblasting, grinding, etc, as approved by the Engineer. Be sure the areas are not less than 1/2-in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.

C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc, as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2-in. Reinforcing to be saved shall not be damaged during the demolition operation.

D. Reinforcing from existing demolished concrete which is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and

products of corrosion before proceeding with the repair. It shall be cut, bent or lapped to new reinforcing as shown on the Drawings and provided with a minimum cover all around as specified on the contract drawings or 2-in.

E. The following are specific concrete surface preparation "methods" are to be used where called for on the Drawings, specified herein or as directed by the Engineer. All installation of anchors shall be according to the manufacturer's recommendations.

1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16-in layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as detailed on the Drawings.

2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.

3. Method C: Drill a hole 1/4-in larger than the diameter of the dowel. The hole shall be blown clear of loose particles and dust just prior to installing epoxy. The drilled hole shall first be filled with epoxy paste, and then dowels/bolts shall be buttered with paste then inserted by tapping. Unless otherwise shown on the Drawings, deformed bars shall be drilled and set to a depth of ten bar diameters and smooth bars shall be drilled and set to a depth of fifteen bar diameters. If not noted on the Drawings, the Engineer will provide details regarding the size and spacing of dowels.

4. Method D: Combination of Method B and C.

5. Method E: Capsule anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed per the manufacturer's recommendation in holes sized as required. The anchor stud bolt, rebar or other embedment item shall be tipped with a double 45 degree chamfered point, securely fastened into the chuck of all rotary percussion hammer drill and drilled into the capsule filled hole.

3.04 GROUTING

A. Grouting shall be as specified in Section 03600.

3.05 CRACK REPAIR

A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks per manufacturer's recommendations. If cracks are less than 1/16-in in thickness they shall be pressure injected.

B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to surface with crack repair epoxy adhesive per manufacturer's recommendations.

END OF SECTION

SECTION 03900
LEAKAGE TESTING OF WATER RETAINING STRUCTURES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Water tightness testing of reinforced concrete water retaining structures. Furnish all labor, materials and incidentals required and perform watertightness testing of liquid-containing structures as listed herein and all retesting until the structures meet the requirements as specified herein.

1.02 RELATED WORKS

A. Concrete is included in Division 03.

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI 350.1-01 – Tightness Testing of Environmental Engineering Concrete Structures.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide potable water, piping, and equipment required to test concrete structures for leakage.

PART 3 - EXECUTION

3.01 GENERAL

A. Hydrostatically test reinforced concrete structures which will contain water to requirements specified below, and are free of detectable leaks.

B. Do not start leak testing or cleaning of surfaces until concrete is cured and joint sealants have set and cured a minimum of 14 days.

C. Conduct testing before backfill is placed against walls.

D. Prior to testing, clean exposed surfaces by thorough hosing, and remove surface laitance and loose matter from walls and slabs. Remove wash water and debris by means other than washing through plant piping.

3.02 TEST PROCEDURE

A. Fill structure to be tested to the normal operating liquid level. Filling rate shall not exceed 4 feet of water per hour, and shall be at continuous uniform rate with continuous monitoring.

B. The exterior surface of the tank shall be monitored for flowing leaks. Repair any flowing leaks which occur before continuing filling.

C. The water shall be kept at the test level for at least three days prior to the actual test.

D. Measure the vertical distance to the water surface from a fixed point on the tank above the water surface. Record measurements at 24-hour intervals. The test shall be performed for a minimum of 3 days.

E. A drop of the water surface exceeding 1/10 of 1% of the normal volume of contained liquid will be considered failing.

F. The structure will have also been considered to have failed the test if flowing or seeping water is observed, or if moisture can be transferred to a dry hand from the exterior surface.

G. Independently measure change in water volume due to evaporation and precipitation using a 24 inch deep white, watertight container not less than 10 square feet of surface area. Position the container to experience environmental conditions similar to the structure being tested. The volume change of the structure shall be corrected based on the water volume change in the sample container.

H. Failing tanks which exhibit no visible signs of leaking or seepage may be permitted to be immediately retested.

I. Failing tanks will be drained, repaired, and retested until the tank has met the test requirements.

J. Methods for repairing concrete are described in section 03740.

K. Repairs and retesting of tanks shall be accomplished at no additional cost to the Owner.

END OF SECTION

SECTION 04220
CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 03300 "Cast-in-Place Concrete" for dovetail slots for masonry anchors.
2. Section 07620 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.03 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.05 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.

2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength**,** ASTM C 1506 for water retention, and ASTM C 91 for air content.

3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.

4. Delete first subparagraph below if grout is specified by proportions stated in ASTM C 476 rather than by compressive strength.

5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: For the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection:

1. Colored mortar.

2. Weep holes/vents.

E. Samples for Verification: For each type and color of the following:

1. Exposed CMUs.

2. Accessories embedded in masonry.

1.07 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

4. Grout mixes. Include description of type and proportions of ingredients.

5. Reinforcing bars.

6. Joint reinforcement.

7. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 60 inches (1500 mm) long by 48 inches (1200 mm) high by full thickness.

2. Protect approved sample panels from the elements with weather-resistant membrane.

F. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

1. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of otherwythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

2. Provide square-edged units for outside corners unless otherwise indicated.

2.03 CMUS: ASTM C 90.

A. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).

B. Density Classification: Normal weight unless otherwise indicated.

C. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

D. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

E. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.04 CONCRETE BUILDING BRICK: ASTM C 55.

A. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.31 MPa).

B. Density Classification: Normal weight.

C. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 3-5/8 inches (92 mm) high by 7-5/8 inches (194 mm) long.

2.05 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.06 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout[**,** cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Capital Materials Corporation; Flamingo Color Masonry Cement.
b. Cemex S.A.B. de C.V.; Citadel Type S.
c. Essroc, Italcementi Group; Brixment or Velvet.
d. Holcim (US) Inc.; Mortamix Masonry Cement.
e. Lafarge North America Inc.; Lafarge Masonry Cement.
f. Lehigh Cement Company; Lehigh Masonry Cement.
g. National Cement Company, Inc.; Coosa Masonry Cement.

2. Mortar Cement: ASTM C 1329.

F. Products: Subject to compliance with requirements, provide one of the following:

1. Lafarge North America Inc.; Lafarge Mortar Cement or [Magnolia Superbond Mortar Cement.

G. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

3. White-Mortar Aggregates: Natural white sand or crushed white stone.

4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C 404.

I. Water: Potable.

2.07 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.

2. Exterior Walls: Hot-dip galvanized, carbon steel.

3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.

4. Wire Size for Cross Rods: 0.187-inch (4.76-mm) diameter.

5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.

6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.08 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.

3. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.

4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

5. Stainless-Steel Sheet: ASTM A 666, Type 316.

6. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- (1.52-mm-) thick, steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel

2.09 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch (0.86-mm), galvanized steel sheet.

C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

D. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

B. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.

C. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.

D. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.

E. Fabricate through-wall flashing with snap lock receiver on exterior face where indicated to receive counter flashing.

F. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

G. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.

H. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.

2.11 APPLICATION: UNLESS OTHERWISE INDICATED, USE THE FOLLOWING:

A. Where flashing is indicated to receive counter flashing, use metal flashing.

B. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.

C. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a sealant stop].

D. Where flashing is fully concealed, use metal flashing.

E. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Mortar Net USA, Ltd.; Blok-Flash.

F. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

G. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.12 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.

b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement or mortar cement mortar unless otherwise indicated.
3. For exterior masonry, use masonry cement or mortar cement mortar.
4. For reinforced masonry, use masonry cement or mortar cement mortar.

B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type N.
3. For mortar parge coats, use Type S or Type N.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).

2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).

3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Pattern is usually running bond. If other bond patterns are required, specify in first paragraph below or indicate on Drawings.

C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

F. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

G. Revise first paragraph below if flexible perimeter joint or thermal break is required.

H. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

I. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

J. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

K. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. Spacing in first subparagraph below is an example only.

3. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.

4. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

5. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.06 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.

2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.

3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.07 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.09 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

5. Retain one of three subparagraphs below if flexible flashing materials are used. See Evaluations.

6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep

spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space, maximum pour height and not above any horizontal rebar, lintels or bond beams.

2. Limit height of vertical grout pours to not more than 48 inches (1520 mm) .

3. The Contractor shall provide a minimum of 48 Hour Notice for all grout pours.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level 2 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.13 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

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SECTION 05120
STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and install structural steel including bearing plates, columns, beams and miscellaneous shapes and plates required to erect the structural framing as shown on the Drawings and as specified herein.

B. Furnish only anchor bolts with templates to be installed under Division 3. Furnish and install nuts and washers for anchor bolts.

1.02 RELATED WORK

A. Grouting of baseplates is included in Section 03600.

B. Miscellaneous metal is included in Section 05500.

C. Field painting, except as specified herein, is included in Division 9.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, erection drawings, detailed shop drawings, schedules and data for all structural steel. Approval will be for strength only and shall not relieve the Contractor of responsibility for proper fit of members, of connections not detailed on the Drawings, or for supplying all material required by the Contract Documents. Mark numbers painted on the shop assembled pieces of steel shall be the same mark numbers used on the detailed shop and erection drawings.

B. Product data and installation instructions for Contractor proposed load indicator bolts or direct tension indicators.

C. Certified mill test reports for the structural steel and the bolting materials.

D. Certifications that welders are qualified, in accordance with AWS D1.1, on the shop and field welding procedures to be used.

1.04 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC)

1. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges

2. AISC 316 – Manual of Steel Construction – 13th Edition.

3. AISC S335 - Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary.

4. AISC M016 - Manual of Steel Construction Allowable Stress Design.

B. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A123 - Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
7. ASTM A490 - Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
10. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

C. American Welding Society (AWS)

1. AWS A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
2. AWS D1.1 - Structural Welding Code Steel.

D. Research Council on Structural Connections of the Engineering Foundation (RCSCEF)

1. Specification for Structural Joints using ASTM A325 or ASTM A490 Bolts.

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Structural steel shall be in accordance with the AISC Standard for Structural Steel Buildings - Allowable Stress Design and Plastic Design and the Code of Standard Practice for Steel Buildings and Bridges, unless otherwise specified herein.

B. Welding shall be in accordance with AWS D1.1 unless otherwise specified herein or in the AISC Standard.

C. High strength bolt materials, accessories and installation shall be in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

1.06 SYSTEM DESCRIPTION

A. Design connections not detailed on the Drawings to support loads shown on the Drawings. Calculations for these connections shall be sealed by a registered professional engineer in the State of Florida.

B. Beam connections not detailed on the Drawings shall be bolted framed beam connections as shown in Table II of the AISC Manual of Steel Construction - Allowable Stress Design, Part 4.

C. Bolted shear connections shall be bearing-type connections unless otherwise shown.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials promptly so as to cause no delay with other parts of the work.

B. Store materials on skids and not on the ground. Pile and block materials so that they will not become bent or otherwise damaged.

C. Handle materials with cranes or derricks as far as practicable. Do not dump steel off cars or trucks nor handle in any other manner likely to cause damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Rolled steel wide flange: ASTM A992.

B. Plates, rods, bars, and other structural steel shapes other than wide flange shapes, unless otherwise noted: ASTM A36.

C. Structural tube: ASTM A500, Grade B or ASTM A501.

D. Structural pipe: ASTM A53, Type S, Grade B.

E. Welding electrodes: AWS A5.1, E70XX.

F. High strength steel bolts, nuts and washers: ASTM A325. Where galvanized material is to be connect; use ASTM A325, Type 1, mechanically galvanized to ASTM B695, Class 50, Type II.

G. Anchor bolts: ASTM F1154, Grade 36. Provided standard headed bolts with heavy hex nuts and Grade A washers. Where galvanized anchor bolts are shown or specified, provide all components galvanized in accordance with ASTM F2329.

H. Shop primer: As specified in Section 09900.

I. Galvanizing: Zinc with 0.5 percent (minimum) nickel added.

J. Galvanized surface primer: 95 percent zinc duck, organic vehicle primer.

2.02 FABRICATION

A. Match-mark materials for field assembly. Ream unmatched holes in shop assembly of field connections. Reject and replace with new pieces any piece weakened by reaming to a point where the strength of the joint is impaired.

B. Welding of parts shall be done only where shown on the Drawings or specified herein and by welders and welding operators qualified for the procedures used.

2.03 SURFACE PREPARATION AND SHOP COATINGS

A. Prepare and shop prime paint non-galvanized members as specified in Section 09900. Omit paint within 3 inches of field welds. Do not prime paint faying surfaces of slip critical connections.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Furnish and install temporary bracing to provide stability during erection and to prevent distortion or damage to the framing due to wind, seismic, or erection forces. Remove temporary bracing when erection is complete.

B. Use drift pins only to bring members into position and not to enlarge or distort holes.

C. Make all steel to steel connections by high strength bolting except where field welding is shown or specified. Provide not less than two 3/4-in bolts per connection and use not less than 1/4-in thick clip angles.

D. Tighten bolted connections designated as bearing-type connections to the snug tight condition. Tighten all other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening.

E. Field welding shall be done only where shown or specified and only by welders qualified for the procedures used. No welding shall be done when surfaces are wet, exposed to rain or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.

F. Each bolting crew [and welder] shall be assigned an identification mark. This mark shall be made at each completed connection with a paint stick.

G. After erection, prime paint abrasions, field welds and unprimed surfaces, using shop primer except surfaces designated to be unpainted or surfaces in contact with concrete.

H. After erection, prime paint abrasions, field welds, on galvanized surfaces with galvanized surface primer.

3.02 FIELD TESTING

A. Allow the Engineer free access to the work. Notify the Engineer in writing 4 working days in advance of high strength bolting or field welding operations.

B. High strength bolting will be inspected visually. All high strength bolts shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. Retighten rejected bolts or remove and provide new bolts. In cases of disputed bolt installations, the bolts in question shall

be checked using a calibrated wrench certified by an independent testing laboratory approved by the Engineer. The certification shall be at the Contractor's expense.

C. Field welding will be inspected visually by AWS certified welding inspectors provided by the Owner.

D. The fact that steel work has been accepted at the shop and mill will not prevent its final rejection at the site, before or after erection, if it is found to be defective.

E. Remove rejected steel work from the site within 10 working days after notification of rejection.

END OF SECTION

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SECTION 05500
MISCELLANEOUS METAL

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION:

A. This section includes metal fabrications not specifically included in other Sections and required for completion of work as shown on Contract Drawings and as specified herein.

B. Furnish labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B18.5: Round Head Bolts.

B. American Society for Testing and Materials (ASTM):

1. A6: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.
2. A36: Standard Specification for Carbon Structural Steel.
3. A48: Standard Specification for Gray Iron Castings.
4. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
5. A108: Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
6. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
7. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
8. A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
9. A240: Standard Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels.
10. A276: Standard Specification for Stainless Steel Bars and Shapes.
11. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

12. A325: Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
13. A366: Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
14. A489: Standard Specification for Carbon Steel Lifting Eyes.
15. A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
16. A501: Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
17. A502: Steel Structural Rivets.
18. A536: Standard Specification for Ductile Iron Castings.
19. A569: Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.
20. A570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
21. A572: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
22. A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.
23. A675: Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
24. A786: Rolled Steel Floor Plates.
25. A992: Standard Specification for Structural Shapes.
26. B26: Specification for Aluminum-Alloy Sand Castings.
27. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.
28. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
29. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
30. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
31. B308: Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
32. B 429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
33. D1056: Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
34. F436: Standard Specification for Hardened Steel Washers.
35. F541: Standard Specification for Alloy Steel Eyebolts.

36. F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

37. F594: Standard Specification for Stainless Steel Nuts.

38. F844: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

39. F1554: Standard Specification of Anchor Bolts, steel, 36, 55 and 105-ksi Yield Strength.

40. F2329: Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

C. American Institute of Steel Construction (AISC).

1. ANSI/AISC 360-5: Specification for Structural Steel Buildings.

2. AISC Manual of Steel Construction, Thirteenth Edition.

D. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. D1.1: Structural Welding Code.

3. D1.2: Structural Welding Code - Aluminum.

E. National Association of Architectural Metal Manufacturers (NAAMM):

1. MBG 531: Metal Bar Grating Manual.

2. MBG 532: Heavy Duty Metal Bar Grating Manual.

3. MBG 533: Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.

F. Aluminum Association:

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

2. AA M31C22A41.

3. M31: Mechanical Finish, Fine Satin.

4. C22: Finish, Medium Matte.

5. A41: Clear Anodic Coating, Class I.

G. International Code Council – Evaluation Services (ICC-ES):

1. ICC-ES Acceptance Criteria 01: Mechanical Anchors in Masonry Elements.

2. ICC-ES Acceptance Criteria 58: Adhesive Anchors in Masonry Elements.

3. ICC-ES Acceptance Criteria 193: Mechanical Anchors in Concrete Elements.

4. ICC-ES Acceptance Criteria 308: Post-installed Adhesive Anchors in Concrete Elements.

1.03 SUBMIT THE FOLLOWING SHOP DRAWINGS IN ACCORDANCE WITH SECTION 01300.

A. Submit shop drawings and product data showing materials of construction and details of installation for all items furnished under this Section. Shop drawings shall show sizes of members, method of assembly, anchorage and connection to other members.

B. Submit welder certification. Maintain duplicate certification records at jobsite readily available for examination.

C. Test Reports:

1. Submit certified copies of mill test reports on each steel, stainless steel, or aluminum proposed for use showing the physical properties and chemical analysis.

D. Product Data:

1. Manufacturer's catalog sheets on pre-manufactured items.

E. Miscellaneous Submittals:

1. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for concrete anchors.

F. Stamped by Professional Engineer registered in the State of Florida.

1.04 DESIGN CRITERIA:

A. Structural Connections: AISC Specification for Structural Steel Buildings. Design connections not fully detailed on the Drawings to resist the loads shown on the Contract Drawings or specified.

B. Where beam end reactions are not shown, design the connection for one-half the total allowable uniform load in kips for beams laterally supported at the given span, as determined by the tables for allowable loads on beams in the AISC Manual of Steel Construction, in addition to any axial loads identified on the Contract Drawings.

C. Design connections not detailed on Drawings under supervision of a Professional Engineer licensed in the State of Florida.

1.05 QUALITY CONTROL:

A. Comply with the requirements specified in Section 01400.

B. Design connections not detailed on the Drawings under direct supervision of a Professional Engineer licensed in the State of Florida.

C. Prior to any anchor bolt installation, Contractor shall submit for engineer's acceptance a table for all proposed anchor bolts for installation showing type of bolt, size of bolt, size of hole, embedment depth and epoxy type.

D. Steel:

1. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale that will withstand vigorous wire brushing may remain. Perform no welding when base metal is lower than 0 degrees F.

2. Qualify welding operators in accordance with AWS D1.1. Qualification tests shall be run by a recognized testing laboratory acceptable to the Engineer at Contractor's expense.

E. Aluminum:

1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with AWS.

F. Adhesive Anchors:

1. Adhesive Anchor Installers shall be trained and certified by manufacturer.

G. Galvanized Coating:

1. Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements in sections 01600.

B. Insofar as practical, factory assemble items specified herein. Package, ship and tag unassembled materials in a manner that will protect materials from damage and will facilitate identification and field assembly.

C. Package stainless steel items in a manner to provide protection from carbon impregnation.

D. Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling. Use padded slings and straps.

E. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

F. Store fabricated items in a dry area, not in direct contact with ground.

1.07 FIELD MEASUREMENTS:

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 - PRODUCTS

2.01 MISCELLANEOUS METAL SHAPES, CASTINGS, BOLTS AND ACCESSORIES:

A. Structural Steel Shapes:

W Shapes:	ASTM A992, 50 ksi
S, C, M and MC Shapes:	ASTM A572, Grade 50
Angles, plates and bars:	ASTM A36
HSS Square and Rectangular Shapes:	ASTM A500, Grade B, 46 ksi
HSS Round Shapes:	ASTM A500, Grade B, 42 ksi
Pipe Shapes:	ASTM A53, Grade B, 35 ksi
Steel Sheets:	ASTM A366

B. Stainless Steel Shapes:

Exterior and Submerged Uses:	AISI, Type 316
Industrial Uses:	AISI, Type 316
Interior and Architectural Uses:	AISI, Type 304
For Welding:	AISI, Type 304L, Type 316L
Shapes and Bars	ASTM A276
Plate, Sheet and Strip	ASTM A240

C. Aluminum Shapes:

Structural Shapes:	ASTM B308, Alloy 6061-T6

Extruded Pipe: ASTM B429, Alloy 6063-T6

Aluminum Sheet and Plate: ASTM B209, Alloy 6061-T6

D. High Strength Bolts for Steel Members: ASTM A325

Steel Washers: ASTM F436

Plain Unhardened Steel Washers: ASTM F844

E. Anchor Rods:

ASTM F1554, Grade 36 standard headed bolts with heavy hex nuts, Grade A washers, hot-dip galvanized, unless otherwise specified.

F. Stainless Steel Bolts and Nuts:

F593 and F594, AISI Type 316

G. Iron Castings:

ASTM A48, Class 35

2.02 GALVANIZING:

A. Galvanizing: ASTM A123, Zn with 0.5 percent minimum Ni.

B. Galvanizing, hardware: ASTM A153, Zn with 0.5 percent minimum Ni.

C. Zinc rich paint for repair of galvanized steel surfaces:

1. Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90%.
2. Clean damaged surfaces per SSPC SP-1 and SP-11.
3. Products:
   a. ZRC Worlwide, ZRC Cold Galvanizing.
   b. NuWave Solutions, Galv-Match-Plus.
   c. CRC Industries, Inc., Zinc-It.

2.03 POST INSTALLED ANCHORS:

A. Mechanical Expansion Type Anchors: Anchors shall be qualified per ICC-ES AC193.

1. Products:
   a. Hilti Corporation, Kwik-Bolt TZ.
   b. Powers Fasteners, Power Stud SD1+ Stud Anchor.

c. Simpson Strong Tie, Strong Bolt.

2. General:

a. Use Zinc or chromate-plated carbon steel where totally embedded, in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.
b. Use stainless steel in other locations or when attaching aluminum and stainless steel.
c. Do not use expansion anchors in submerged and dynamic load applications.

B. Drop-In Anchors: Anchors shall be qualified per ICC-ES AC01.

1. Products:

a. Hilti Corporation, HDI Drop-In Anchor.
b. Powers Fasteners, Steel Drop-In.
c. Simpson Strong-Tie, Drop-In.

C. General:

1. Use Zinc or chromate-plated carbon steel in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.
2. Use stainless steel in other locations or when attaching aluminum and stainless steel.
3. Do not use drop-in anchors in corrosive or humid areas or when subjected to dynamic loads.

D. Adhesive Anchors: Anchors shall be qualified per ICC-ES AC308.

1. Products:

a. Hilti Corporation, HIT-RE 500-SD.
b. Powers Fasteners, PE1000+ Epoxy Adhesive Anchoring System.
c. Simpson Strong Tie, SET-XP Epoxy-Tie.

2. General:

a. Adhesive anchors shall be Stainless Steel Type 316 unless otherwise noted.

E. Adhesive Anchors for masonry: Anchors shall be qualified per ICC-ES AC58.

1. Products:

a. Hilti Corporation, HIT-HY 20.
b. Powers Fasteners, AC100+ Gold.
c. Simpson Strong Tie, SET High Strength Epoxy Tie.

2. General:

a. Epoxy anchors shall be Stainless Steel Type 316 unless otherwise noted.

2.04 ANCHOR CHANNEL INSERTS:

A. Make anchor channels from channel profiles with "I" anchors shop welded to back of channels. Furnish anchor channels with head bolts, channels, nuts for a complete installation. Material shall be Stainless Steel Type 304.

2.05 STRAP ANCHORS AND STUD ANCHORS:

A. Provide anchors for frames, curbs, sills, and other metal fabrications anchored into concrete or masonry. Fabricate anchors from strap iron, bent to shape, or of weldable studs, welded to backs of members. Where size and spacing not noted, provide 1 inch by 1/4-inch strap anchors or 3/4-inch diameter studs for concrete and 1-1/2 inch by 1/8-inch strap anchors for masonry. Space masonry anchors to fit jointing of adjacent masonry work at 4 feet on center. Space concrete anchors at 3 feet on center.

B. Where anchors and plates or clips are to be built in for attachment of later Work, provide bolts in plates or clips, welded to back, with threaded ends extended.

C. For attaching Work to masonry or concrete where anchors or inserts cannot be built in, provide concrete anchors or machine bolts and screws.

2.06 NEOPRENE GASKET:

A. Provide soft, closed-cell neoprene gasket material suitable for exposure to sewage and sewage gases conforming to ASTM D1056, Type 2, Class C, and Grade 1.

B. Unless otherwise shown on Contract Drawings, provide neoprene gaskets with a minimum thickness of 1/4-inch.

C. Furnish neoprene gaskets without skin coat.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Upon receipt of material at job site, inspect all materials for shipping damage. Replace damaged items at no cost to Owner.

B. Examine supports for size, layout and alignment.

C. Correct defects considered detrimental to proper installation.

3.02 FABRICATION:

A. Connections and Workmanship:

1. Fabricate details and connection assemblies in accordance with Contract Drawings and Specifications, with projecting corners clipped and filler pieces welded flush.
2. Fit work together in fabrication shop and deliver complete or in parts, ready to be set in-place or assembled in field
3. Provide work true to detail; with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture free from defects impairing strength or durability.
4. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
5. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion; smooth and well cleaned by shot blasting.

B. Welding:

1. Provide rigid and continuous welds or spot welded as specified and as shown on Contract Drawing. Dress the face of welds flush and smooth. Close fit exposed joints and locate where least conspicuous.
2. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration.
3. Weld aluminum in compliance with the latest edition of AWS D1.2. Support and clamp component parts of built-up members in proper position for welding.
4. Weld shop connections and bolt or field weld connections, unless otherwise specified.
5. Grind exposed edges of welds to 1/8 inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.
6. Prepare welds and adjacent areas so there is:
    a. No undercutting or reverse ridges on weld bead.
    b. No weld spatter on or adjacent to weld or other area to be painted or coated.
    c. No sharp peaks or ridges along weld bead.

C. Bolting:

1. Use bolts of lengths required so bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

2. Provide holes required for connection of adjacent or adjoining work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of ± 1/16-inch of dimensions indicated.

D. Galvanizing:

1. Galvanize after fabrication by hot-dipped process conforming with ASTM A123.

2. Ship and handle in manner to avoid damage to zinc coating.

E. Shop Painting:

1. Do not paint or coat ferrous metal surfaces embedded in concrete.

3.03 INSTALLATION:

A. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.

B. Erect to lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts using concealed connections when practicable.

C. Plumb and true vertical members to tolerance of ± 1/8 inch in 10 feet. Level horizontal members to tolerance of ± 1/8 inch in 10 feet.

D. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.

E. Anchor Bolts and Concrete Anchors:

1. Preset anchor bolts using templates. Do not use concrete anchors in place of anchor bolts.

2. After anchor bolts are embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of equipment or metalwork.

3. Do not install concrete anchors until concrete has reached specified minimum compressive strength.

4. Install concrete anchors in accordance with anchor manufacturer recommendation.

a. Do not install closer than 6 bolt dia. to edge of concrete or closer than 12 bolt dia. to another anchor unless noted otherwise.
b. Minimum embedment shall be 8 bolt dia. unless noted otherwise.

5. Locate concrete anchors to clear reinforcing bars in concrete.

F. Weld headed anchor studs in accordance with manufacturer's recommendations.

G. Do not place new holes or enlarge unfair holes by use of cutting torch.

3.04 PAINTING, REPAIR, AND PROTECTION:

A. Paint aluminum in contact with concrete in accordance Section 09900. Under no circumstances shall aluminum contact dissimilar metal.

B. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-inch thick neoprene isolator pads, 85 ± 5 Shore A durometer, sized for full width and length of bracket or support.

C. Apply an anti-seize compound on all stainless steel fasteners to prevent galling.

D. Field paint in compliance with Section 09900.

E. Field repair of damaged galvanized coatings:

1. Clean and repair Zinc coating that has been burned by welding, abraded, or otherwise damaged after installation. Clean damage area by wire brushing and removing all traces of welding flux and loose or cracked zinc coating

F. Coat surfaces using zinc-rich paint.

G. Field repair of damaged primer in compliance with Section 09900.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 03300 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 04810 "Unit Masonry Assemblies" for installing loose lintels, anchor bolts, and other items built into unit masonry.

D. COORDINATION

1. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

E. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

F. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

1.04 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
3. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
4. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.03 FASTENERS

A. Usually retain Type 304 in "General" Paragraph below; retain Type 316 if required for corrosive environments.

B. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

C. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

D. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.04 MISCELLANEOUS MATERIALS

A. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.05 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.06 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.

2. Furnish inserts for units installed after concrete is placed.

2.07 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime miscellaneous steel trim.

D. Prime miscellaneous steel trim with zinc-rich primer.

2.08 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.09 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.03 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

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SECTION 05515
ALUMINUM STAIRS AND LADDERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section describes materials, fabrication, and installation of aluminum stairs and ladders as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

A. Aluminum Association (AA):

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

B. American Society for Testing and Materials International (ASTM):

1. A276: Standard Specification for Stainless Steel Bars and Shapes.
2. B26: Specification for Aluminum-Alloy Sand Castings.
3. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.
5. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
6. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.
7. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. D1.1: Structural Welding Code - Steel.

D. Florida Building Code 2010**.**

E. Occupational Safety and Health Administration (OSHA):

1. 29 CFR, Part 1910, Occupational Safety and Health Standards.

1.03 DESIGN CRITERIA:

A. Stairs and ladders shall conform to OSHA, FBC Safety Standards.

B. Stairs, landings, and platforms shall be designed to withstand a minimum uniform live load of 100 psf or a concentrated live load of 300 pounds applied on an area of 4 square inches at any point along the element.

C. Vertical ladders shall be designed to withstand a minimum of two loads of 250 pounds each, concentrated between any two consecutive attachments. The number and spacing of additional loads shall be in accordance with the anticipated usage of the ladder. Individual steps or rungs shall be designed to support a load of 250 pounds applied at any point.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Shop drawings showing clearly the location, size and details of all members
2. Indicate materials, dimensions, connection attachments, anchorage, size and type of fasteners, holes, finishes, and accessories for stairs and ladders.
3. Reference materials of construction by ASTM designation and grade.
4. Indicate welds including length and size of all shop and field welds by symbols conforming to AWS standards.
5. Letter certifying that stairs and ladders are designed and detailed to meet the requirements of standards, building codes, specifications and design criteria herein described.

B. Product Data:

1. Manufacturer’s catalog sheets on pre-manufactured items.
2. Manufacturer’s specifications, load tables, anchor details, and installation details.

C. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
2. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.05 QUALITY CONTROL:

A. Comply with the requirements specified in Section 01400.

B. Obtain field measurements and elevations prior to preparation of shop drawings and fabrication.

C. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Use welders, tackers and welding operators certified by test to perform type of work required in conformance with AWS Structural Welding Code. Maintain current test records certified by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements in sections 01600.

B. Identify and match-mark materials, items and fabrications, for installation and field assembly.

C. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.

D. Carefully handle and store materials, protected from weather, corrosion and other damage.

E. Store off the ground on suitable supports.

F. Accept material on site. Inspect for damage.

G. Do not incorporate damaged material in the work.

PART 2 - PRODUCTS

2.01 ALUMINUM STAIRS:

A. Provide aluminum stairs fabricated from structural members and rectangular bar grating treads.

B. Structural aluminum members and welding electrodes shall be in accordance with Section 05500.

2.02 RECTANGULAR BAR GRATING TREADS:

A. Provide stair treads of alloy 6063-T6 with 3/16 inch thick bearing bars spaced 13/16inch center to center with cross bars pressure locked on 4 inch centers.

B. Provide top surface with mill finish.

C. Provide minimum 3 inch by 3/16 inch carrier end plates welded to stair treads and punched for bolting to stringers.

D. Provide 1-1/4 inch abrasive nosings.

2.03 MANUFACTURERS:

A. IKG Borden Metal Products Co.; Type B.

B. Ohio Gratings, Inc.; Type SG Series.

C. McNichols Co.; Type A.

D. Or acceptable equivalent product.

2.04 VERTICAL LADDERS:

A. Fabricate ladders as shown in the contract drawings.

B. Minimum diameter of rungs shall be 3/4 inch. The distance between rungs, cleats, and steps shall not exceed 12 inches and shall be uniform throughout the length of the ladder.

C. The minimum clear length of rungs or cleats shall be 16 inches.

D. Coat rungs with coarse grain nonskid epoxy coating. Color of coating shall be yellow. Apply nonskid coating per manufacturer's recommendations.

2.05 FALL PREVENTION SYSTEM:

A. Provide ladders with a rigid fall prevention system manufactured of Type 316 stainless steel construction.

2.06 SYSTEM COMPONENTS:

A. Rigid notched carrier rail 1-5/16 inch stainless steel tubing with guide channel, lignment guide and connecting strap.

B. Saf-t-lok sleeve and safety locking mechanism; mounting brackets.

C. Safety belt with two side "D" rings for attaching

D. Body strap (nylon w/elk leather wrap) with buckle of stainless steel.

E. Conform to OSHA Regulation 1910.27 for fall prevention system.

F. Provide safety cages fabricated from aluminum components around ladders where the vertical distance between floors or landings is 20 feet or more.

G. Conform to OSHA Regulation 1910.27 for safety cages.

2.07 SAFETY CLIMB FOR VERTICAL LADDERS:

A. Equip the interior ladders that are higher than 12 feet with a ladder-centered notched safety climbing tube of Type 304 stainless steel. Provide post, storage brackets, and box mounted on the adjacent wall for the removable safety pivot dismount post, that extends above the roof hatch. Provide three sets of safety belts and sleeves. Provide ladder-up safety posts for ladders without safety climbs. Ladder-up posts shall be of the same material as the ladder.

B. Ladder Safety Post

1. Install aluminum ladder safety post on fixed ladders below hatch cover and design with a telescoping tubular section that locks automatically when fully extended. Completely assemble the unit with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

2.08 SECURITY COVERS FOR LADDERS:

A. Provide 6-foot high security covers at bottom of ladders. Equip covers with hinges on one side and locking clasp on the other side. Covers shall be 1/8 inch thick aluminum.

PART 3 - EXECUTION

3.01 GENERAL:

1. Set and secure in place as indicated. Where bolted connections are used, draw together and draw nuts tightly. Use bolts of lengths required so that they do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
2. Locate anchors and anchor bolts and build into connecting work.
3. Install stairs and ladders in accordance with accepted shop drawings.

3.02 FABRICATION:

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified.
2. Straighten work bent by shearing or punching.
3. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded.

4. Provide sufficient quantity and size of anchors for the proper fastening of the work.

B. Fabricate details and connection assemblies in accordance with drawings, with projecting corners clipped and filler pieces welded flush.

C. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

D. Use connections of type and design required by forces to be resisted, and to provide secure fastening.

E. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.

3.03 WELDING:

A. Grind exposed edges of welds to a 1/8 inch minimum radius. Grind burrs, jagged edges and surface defects smooth.

B. Prepare welds and adjacent areas such that there is no undercutting or reverse ridges on the weld bead and no sharp peaks or ridges along the weld bead.

C. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

3.04 BOLTING:

A. Provide stainless steel stud bolts and nuts with heavy aluminum washers for fastening aluminum material.

B. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting to supports to a tolerance of 1/16 inch of exact dimensions indicated.

3.05 CORROSION PROTECTION FOR ALUMINUM SURFACES:

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry in accordance with Section 09900.

B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact in accordance with Section 09900.

END OF SECTION

SECTION 05520
ALUMINUM RAILINGS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Design, furnish and install handrails, guardrails and railing systems, including connectors, fasteners, and system required accessories.

1.02 REFERENCES:

A. Aluminum Association (AA):

1. Aluminum Association Designation System for Aluminum Finishes.
2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.

B. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures.

C. American Society for Testing and Materials (ASTM):

1. B210: Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
2. B221/B221M: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. B241: Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
4. B429: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
5. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
6. E935: Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings
7. E985: Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

D. American Welding Society (AWS):

1. C5.6: Recommended Practices for Gas Metal Arc Welding
2. D1.1-1.17: Structural Welding Code.

E. International Code Council:

1. IBC: International Building Code.

F. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. Guideline 1: Joint Finishes.

2. Metal Rail Manual.

1.03 PERFORMANCE/ DESIGN CRITERIA:

A. Design and provide handrail and guardrail system to meet FBC, OSHA and the criteria specified herein. Railing shall be capable of withstanding the following loads without exceeding design allowable stress of materials for handrails, railing anchors and connections.

1. Top rail:

a. Uniform load of 50 pounds per foot applied in any direction.
b. Concentrated load of 200 pounds applied in any direction at any point.
c. Uniform and concentrated loads above need not be assumed to act concurrently.

2. Intermediate rail:

a. Uniform load of 50 pounds per foot applied in any direction. Uniform load above need not be assumed to act concurrently with loads acting on top rail.

3. Thermal movements: Provide adequate expansion within the system to allow for thermal expansion and contraction caused by a temperature change of 120 degrees F to -20 degrees F without buckling or warping, opening of joints, overstressing of components, failure of connections and other detrimental effects.

B. Control of corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Show fabrication and installation of handrails and railings assembled from standard components. Include plans, elevations, component details, materials, finishes, connection and joining methods, and mounting details to adjoining work.

2. Identify location and type indicated.

B. Product Data:

1. Manufacture’s literature.

2. Assembly and installation instructions.

C. Samples:

1. Two 6 inch long samples of each type of railing showing finish.

D. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. Submit certification that the railing system is in compliance with FBC and OSHA.

E. Operation and Maintenance Data:

1. Manufacturer’s instructions describing procedures for maintaining including cleaning materials, application methods, and precautions as to use of materials which may be detrimental to finish when improperly used.

1.05 QUALITY CONTROL:

A. Comply with the requirements specified in Section 01400.

B. Obtain field measurements prior to preparation of shop drawings and fabrication.

C. Handrails provided shall be end products of one manufacturer to achieve standardization for appearance, maintenance and replacement.

D. Manufacturer shall have minimum five years experience specializing in manufacturing products specified in the section.

E. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Each welder, tacker and welding operator shall be certified by test to perform type of work required in conformance with AWS Structural Welding Code. Testing shall be conducted, and witnessed by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements in sections 01600.

B. Deliver, store and handle materials in manner preventing damage to finished surfaces.

C. Store materials in a dry, well ventilated, weather tight place away from uncured concrete or masonry.

1.07 SITE CONDITIONS.

A. Field verify measurements prior to fabrication and indicate measurements in shop drawings.

PART 2 - PRODUCTS

2.01 ALUMINUM RAILING SYSTEM:

A. Material: ASTM B429, alloy 6063-T6, Schedule 40, 1-1/2 inch diameter minimum extruded structural pipe or tube rails and schedule 80, 1-1/2 inch diameter posts.

B. Railings shall consist of two horizontal members between posts. Locate intermediate rails between top rail and finish floor such that a sphere 21 inches in diameter may not pass between rails.

C. Provide 1/4 inch thick by 4 inch high or "S" type toe plate except on stairs and where a concrete curb is provided. Provide ¼ inch clearance above floor level.

2.02 ANCHORAGE:

A. Provide concrete anchorage for posts by means of base flange welded to post or two 3/8 inch diameter stainless steel set screws and anchored to concrete with minimum of with minimum of 4 stainless steel concrete anchors.

B. For posts set on stair or platform stringers, provide base flange welded to post and bolted to stringer with minimum of two 1/2 inch stainless steel bolts, or weld post to stringer.

2.03 REMOVABLE RAILINGS:

A. Install removable railing units free-standing, unattached to other railing units and adjoining work unless otherwise indicated.

B. Install removable railing in top mounted base flanges where base flange will not hinder equipment removal, use side mounted base flanges otherwise.

2.04 SAFETY CHAINS:

A. 1/4 inch type 316 stainless steel link chain with spring actuated stainless steel clasp capable of withstanding 250 pound horizontal force.

B. Locate safety chains as shown on Drawings.

C. Number of chains shall match number of horizontal rails.

D. Chain drape shall not exceed 3 inch.

PART 3 - EXECUTION

3.01 FABRICATION:

A. Angles, offsets, changes in alignment, and joining of posts and rails shall be made with welded or mechanically fastened connections. Miter and weld joints by fitting top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Run top rails continuously over post.

B. Rail splices shall be butted and reinforced by tight fitting interior sleeve not less than 6 inch long.

C. Provide expansion joint splices at 30 feet maximum spacing, with slip joint internal sleeve extending minimum of 4 inch beyond each side of joint. Weld to one side only. Locate within 12 inch of posts. Splice toe plate with expansion joints in same location as railing expansion joints.

D. Railings shall not bridge expansion joints in structures without providing expansion joint splices.

E. Space posts not more than 5 feet on center. Erect posts plumb in each direction.

F. Fabricate joints which will be exposed to weather so as to exclude water. Provide weep holes at the lowest possible point on all railing system posts.

3.02 FINISHES:

A. Aluminum Association Finish Designation: AA-M12A41 (Mechanical finish, nonspecular, anodic coating, architectural Class I, clear coating 0.7 mil complying with AAMA 607.1 on exposed surfaces.

B. Extruded Components: 0.7 mil anodized.

C. Cast Components: 0.4 mil anodized.

3.03 INSTALLATION:

A. Install as shown on Drawings and accepted Shop Drawings.

B. Provide railing at all slide and sluice gates and at all structures new or modified where fall protection is required by FBC or OSHA.

C. Set posts plumb and aligned in each direction to within 1/4 inch in 12 feet.

D. Set rails horizontal or parallel to rake of steps to within 1/4 inch in 12 feet.

E. Fit exposed connections together to form tight, hairline joints.

F. Provide anchorage devices and fasteners for securing handrails and railings and for transferring loads to the supporting structures.

G. Provide mechanical joints for permanently connecting railing components at nonwelded connections.

3.04 CLEANING:

A. Wash thoroughly using clean water and soap, rinse with clean water.

B. Do not use acid solution, steel wool or other harsh abrasive.

C. When stain remains after washing, remove finish and restore in accordance with manufacturer’s instructions.

3.05 PROTECTION:

A. Protect surfaces of completed installations to prevent damage during construction activities.

3.06 DISSIMILAR METAL:

A. Keep surfaces of dissimilar metal from direct contact by coating the dissimilar metal in accordance with Section 09900.

B. Keep surfaces of aluminum components from direct contact with cement or mortar by coating in accordance with Section 09900.

3.07 REPAIR OF DEFECTIVE WORK:

A. Remove stained or otherwise defective work and replace with no additional cost to Owner.

END OF SECTION

SECTION 05530
METAL GRATING, COVER PLATES, AND ACCESS HATCHES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide metal grating, cover plates and access hatches as indicated and in compliance with Contract Documents.

B. Furnish all labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES:

A. American Society for Testing and Materials International (ASTM):

1. A6: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.
2. A36: Standard Specification for Carbon Structural Steel.
3. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
5. A325: Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
6. A569: Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.
7. A570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
8. A575: Steel Bars, Carbon, Merchant Quality, M-Grades
9. A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.
10. A675: Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
11. A786: Rolled Steel Floor Plates.
12. A1554: Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
13. B26: Specification for Aluminum-Alloy Sand Castings.
14. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

15. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

16. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

B. American Welding Society (AWS):

1. D1.1: Structural Welding Code.

2. D1.2: Structural Welding Code - Aluminum.

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. MBG 531: Metal Bar Grating Manual.

2. MBG 532: Heavy Duty Metal Bar Grating Manual.

3. MBG 533: Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.

D. Aluminum Association:

1. Aluminum Association Designation System for Aluminum Finishes.

2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.

1.03 DESIGN CRITERIA:

A. Grating and Cover Plates

1. Provide grating and cover plates of minimum depth shown on contract drawings, not exceeding manufacturer's maximum recommended span, and meeting the following load and deflection criteria.

2. 100 psf uniform live load or 300 concentrated live load, whichever produces maximum stress.

3. L/360 maximum deflection under uniform live load of 100 psf.

4. 12,000 psi maximum flexural stress.

B. Heavy Duty Grating

1. Provide grating meeting AASHTO H20 loads, unless otherwise stated on drawings.

C. Floor Access Hatches

1. Provide floor access hatches meeting AASHTO H20 loads, unless otherwise stated on drawings

1.04 SUBMITTALS:

Submit the following shop drawings in accordance with Section 01300.

A. Detail shop drawings indicating:

1. Dimensions.
2. Sectional assembly.
3. Location and identification mark.
4. Connections and fastening methods.
5. Size and location of supporting frames required.
6. Materials of construction.
7. Installation instructions.

B. Catalog data and design tables showing limits for span length and deflection under load.

1.05 QUALITY CONTROL:

A. Comply with the requirements specified in Section 01400.

B. Obtain field measurements prior to preparation of shop drawings and fabrication.

1. Aluminum:

Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as accepted and in accordance with recommendations of AWS D1.2.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements in sections 01600.

B. Store to avoid damage.

C. Remove material that has become damaged as to be unfit for use.

D. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

1.07 FIELD MEASUREMENTS:

A. Verify dimensions and make any field measurements necessary and be fully responsible for accuracy and layout of the work.

B. Review the Contract Drawings and report any discrepancies to the Engineer for clarification prior to starting fabrication.

PART 2 - PRODUCTS

2.01 ALUMINUM BAR GRATING:

A. Manufacturers:

1. IKG Borden Metal Products Co.; Type B.
2. Ohio Gratings, Inc.; Type SG Series.
3. McNichols Co.; GAL Series.

B. Provide aluminum alloy 6063-T6 grating material.

C. Provide 3/16-inch thick bearing bars spaced 1-3/16-inch center to center with cross bars pressure locked on 4 inch centers.

D. Fabricate in standard size sections where possible with a maximum panel weight of no more than 80 pounds.

E. Apply bearing bar banding at ends of grating sections and at fixture or pipe openings where two or more bearing bars are cut.

F. Anchor grating to support members using stainless steel grating clamps.

G. Provide top surface with mill finish.

H. Embedded Aluminum Grating Angle Fames:

1. Provide manufacturer's fabricated angle frames of alloy 6063-T6 with a continuous extruded anchor.
    a. Provide supplementary anchor straps welded to angle frames at 18 inches on center for grating spans over 4 feet.
    b. Supplementary anchor straps shall be of same material as angle frames. Minimum diameter shall not be less than ¼ inch. Minimum length shall be 4 inches. Minimum hook length shall be 1 inch.
2. Vertical and horizontal legs of angle frames shall be ¼ inch thick, minimum. Depth of angle frames shall be flush with walking surface of grating.
3. Angle frames shall have mitred corners and welded joints.
4. Coat aluminum surfaces in contact with concrete per Section 09900.
5. See structural drawings for bearing conditions other than embedded angle frames.

2.02 HEAVY DUTY GRATING:

A. Manufacturers:

1. Harsco Industrial IKG; Type WL.
2. Ohio Gratings, Inc.; W Series.
3. McNichols Co.; GHB Series.

B. Provide heavy duty steel grating material conforming to ASTM A36.

C. Provide bearing bars spaced 2-3/8-inches face to face with cross bars welded on 4 inch centers.

D. Fabricate in standard size sections where possible.

E. Apply bearing bar banding at ends of grating sections and at fixture or pipe openings where two or more bearing bars are cut.

F. Anchor grating to support members using stainless steel removable fasteners.

G. Hot dip galvanize steel grating after fabrication in accordance with ASTM A123.

H. Embedded Steel Grating Angle Fames:

1. Provide manufacturer's fabricated angle frames of A36 steel with A36 headed studs.
    a. Provide headed studs welded to angle frames at 24 inches on center.
    b. Headed studs shall have a minimum diameter not less than 3/8 inch. Minimum length shall be 4 inches.
2. Provide vertical flat bars ¼ inch thick welded around angle frame perimeter. Depth of flat bar shall be flush with walking surface of grating.
3. Angle frames shall have mitred corners and welded joints.

I. See structural drawings for bearing conditions other than embedded angle frames.

2.03 STAINLESS STEEL COVER PLATE:

A. Provide floor checked plates and to conform to the following:

1. Checkered Plate: ASTM A793.
2. Frames and Curb Angles: ASTM A276.
3. Stainless Steel Bolts and Nuts: F593 and F594, AISI Type 316.

B. General:

1. Fabricate with a maximum panel weight of no more than 80 pounds.

2. Provide flush type lifting handles for all section of checkered plates.

3. Provide a raised pattern, non-skid surface.

4. See contract drawings for stiffener spacing.

5. Thickness as shown on contract drawings, minimum thickness: 1/4 inch.

C. Furnish fixed cover checkered plates complete with frames, anchors, lifting handles and stainless steel flush head screw fastenings.

D. Furnish hinged cover checkered plates complete with frames, anchors, lifting handles and heavy duty hinges. Hinges shall be Type 316L stainless steel, with stainless steel pins and fastenings. Provide a minimum of 2 hinges for each checkered plate section.

2.04 FLOOR ACCESS HATCHES:

A. Manufacturers of Prefabricated Floor Access Hatches:

1. Bilco Company, Type J series.

2. Halliday, W series.

3. Thompson Fabrication Company, TE series.

B. Component Fabrication:

1. Provide access hatches and frames of, type and size as shown on Drawings.

2. All hatches over water bearing structures or valve vaults or noted in the drawings shall be provided with drainage channel, drainage channel frame shall be a minimum of 1/4-inch thick trough frame with continuous anchor flange around perimeter. Weld 1-1/2 inch diameter drain coupling to frame trough unless indicated otherwise on Drawings.

3. Where hatches are noted without drainage channel provide 1/4-inch thick minimum hatch frame with strap anchors or continuous anchors around frame.

4. Door leaves: 1/4-inch diamond plate with reinforcing on underside for live load. Provide stainless steel safety chain and attachments for end of double-leaf door assembly when open.

C. Door Hardware:

1. Equip doors with heavy stainless steel hinges with stainless steel pins. Hinges shall be through bolted to cover and frame with stainless steel bolts.

2. Equip doors with fully enclosed compression springs and hold - open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.

3. Provide level sensor cable holder.

4. Hardware shall be Type 316 stainless steel.

D. Locking and Latching Devices:

1. Stainless steel snap lock mounted on bottom of door leaf with a removable topside handle and socket recessed in cover.

2. Hinged hasp on exterior door surface.

E. Factory finish on aluminum surfaces shall be mill finish.

F. Manufacturer shall warranty in writing against defects in materials or workmanship for five years.

G. Fall Protection Safety Grate:

Fall protection grate shall be provided for all hatches over pump station wetwells and valve vaults and in other locations as noted on the plans.

1. Color shall be safety orange.

2. Provide torsion rod lift assistance for ease of operation.

3. Provide an aluminum or stainless steel hold open arm to automatically lock the panel in the fully open 90 degree position.

4. Provide a stainless steel release handle for closing the grating panel with a provision for locking the panel to prevent unauthorized access.

5. All other hardware shall be Type 316 stainless steel.

H. Wetwell and valve vault cover shall be permanently embossed "CONFINED SPACE" and painted lettering shall not be acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Upon receipt of material at job site, inspect all materials for shipping damage. Damaged items shall be replaced at no cost to Owner.

B. Examine supports for size, layout and alignment. Surface shall be free of debris.

C. Correct defects considered detrimental to proper installation.

3.02 PROTECTION:

A. Protect aluminum from contact with dissimilar metals, concrete, masonry or mortar. Under no circumstances shall aluminum contact concrete or dissimilar metal.

B. Apply 14 to 20 mil DFT of two part epoxy or Tnemec Series 46-465 with one coat 8 to 12 mil DFT.

C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot water and dry thoroughly.

3.03 INSTALLATION:

A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.

B. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.

C. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

END OF SECTION

SECTION 06105
MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.
4. Plywood backing panels.

B. Related Sections include the following:

C. Division 6 Section "Interior Architectural Woodwork" for interior woodwork not specified in this Section.

1.03 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

1.04 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with

requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.

2. Fire-retardant-treated wood.

3. Power-driven fasteners.

4. Powder-actuated fasteners.

5. Expansion anchors.

6. Metal framing anchors.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

3. Provide dressed lumber, S4S, unless otherwise indicated.

4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Wood Structural Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.

3. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."

4. Factory mark panels according to indicated standard.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:

a. Chromated copper arsenate (CCA).

b. Ammoniacal copper zinc arsenate (ACZA).

c. Ammoniacal, or amine, copper quat (ACQ).

d. Copper bis (dimethyldithiocarbamate) (CDDC).

e. Ammoniacal copper citrate (CC).

f. Copper azole, Type A (CBA-A).

g. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.

B. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

C. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 18 inches above grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Exterior type for exterior locations and where indicated.

2.04 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following:

1. Rooftop equipment bases and support curbs.
2. Blocking.
3. Cants.
4. Nailers.
5. Furring.
6. Grounds.

2.05 PANEL PRODUCTS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 5/8 inch thick.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.

F. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.02 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 PANEL PRODUCT INSTALLATION

A. Wood Structural Panels: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

1. Comply with "Code Plus" provisions in above-referenced guide.

END OF SECTION

SECTION 07552
STYRENE-BUTADIENE-STYRENE (SBS)
MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing.
2. Vapor retarder.
3. Roof insulation.

B. Related Sections:

1. Section 07920 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
2. Section 07710 "Manufactured Roof Specialties" for roof drains.

1.03 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.04 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

1. See Structural drawings for wind loads.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-120.
2. Hail Resistance Rating: SH.

E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainability Submittals:

1. Product Test Reports: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
2. Product Data: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

D. Samples for Verification: For the following products:

1. Sheet roofing materials, including base-ply sheet, roofing membrane sheet and flashing sheet, of color specified.
2. Roof insulation.
3. Six insulation fasteners of each type, length, and finish.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, manufacturer and testing agency.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

D. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

E. Warranties: Sample of special warranties.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. Installer must have installed at least five roofs of the same materials and methods specified for this project that have been warranted for the same number of years as required under this specification by the manufacturer of the product that will be used in the Work.

C. Source Limitations: Obtain components including roof insulation, fasteners, for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Surfaces on which the roofing membrane system is to be applied shall be clean, smooth, dry, and free of fins, sharp edges, loose and foreign materials, oil and grease.

1. Before beginning work, a representative of the manufacturer shall examine the roof surfaces in order to ensure that the substrate is acceptable.

2. Do not begin installation until all defective conditions have been corrected.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of membrane roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SBS-MODIFIED ASPHALT-SHEET MATERIALS

A. SBS-Modified Bituminous Membrane Roofing:

1. Basis-of-Design Product: Subject to compliance with requirements, provide by Soprema Inc., or comparable product by one of the following:

a. CertainTeed Corp.
b. GAF Materials Corporation
c. Johns Manville.
d. MBTechnology.
e. Siplast, Inc.

B. Roofing Membrane Sheet: SOPRASTAR SANDED

1. Description: Soprastar Sanded membrane reinforced with a 180 gram polyester mat and composed of selected SBS modified bitumen with a polypropylene film and a polyester film highly reflective white top surface. The field and flashing base membrane plies are adhered to a property prepared clean, dry and/or primed (where required) substrate by using the specified method. A Soprastar Sanded cold applied cap sheet is installed over a high brush sanded base membrane. Membrane surface is a smooth surface highly reflective top.

a. Color: White
b. SRI: = 96 (Reflectivity .78/Emissivity .89)

2.02 BASE-PLY SHEET MATERIALS

A. Membrane Base Ply: ELASTOPHENE SANDED

1. Description: Waterproofing membrane shall have a glass mat reinforcement and thermofusible elastomeric asphalt. Both sides shall be lightly sanded. This membrane is to be applied by Cold Applied.

2. Components: Reinforcement shall be 1.9 Ibs/sq. fiberglass. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

3. Physical properties:

a. Tensile strength:

Longitudinal - 82 Ibs./in.
Transversal- 67 Ibs./in.

b. Ultimate elongation:

Longitudinal - 4%
Transversal - 4%

c. Static puncture strength - 18 Ibs.
d. Low temperature flexibility, no cracking at -22 degrees F.
e. SBS elongation - 1500%
f. Load strain product:

Longitudinal - 328
Transversal - 268

g. Approximate roll weight - 91 Ibs (41.3 kgs)
h. Approximate thickness - 90 mils (2.2 mm)

2.03 BASE FLASHING SHEET MATERIALS

A. Base Ply Flashing: ELASTOPHENE 180 SANDED

1. Description: Flashing membrane shall have thermofusible elastomeric asphalt membrane is to be applied by non-woven polyester reinforcement and both sides to have a sanded surface by mopping only.

2. Components: Reinforcement shall be 3.68 Ibs/sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

3. Physical Properties:

a. Tensile strength:

Longitudinal - 119 Ibs./in.
Transversal - 88 Ibs./in.

b. Ultimate elongation,

Longitudinal, 58%
Transversal, 64%

c. Static puncture strength - 67 Ibs.
d. Low temperature flexibility, no cracking at -22 degrees F.
e. SBS elongation - 1500%
f. Load strain product:

Longitudinal - 6902
Transversal - 5632

g. Approximate roll weight - 84 Ibs (38.1 kgs)
h. Approximate thickness - 90 mils (2.2 mm)

B. Cap Flashing: ELASTOPHENE 180 PS Flashing membrane: ASTM D 6164, Grade S, Type SBS-modified asphalt sheet (reinforced with polyester fibers); suitable for application method specified. .

2.04 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesive: 80 g/L.
f. Other Adhesives: 250 g/L.
g. Non-membrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.

B. Primer: ELASTOCOL 500.

1. ASTM D 41.

2. Primer shall be applied on all dissimilar materials except insulation.

3. Description: Black bituminous varnish.

4. Composition: Asphalt modified bitumen with thermoplastic polymers and volatile solvents.

C. Cold-Applied Adhesive: FM Adhesive is a ready to use bitumen based cole adhesive that contains a bituminous binder with sticking agents and low solvent percents (complies with California VOC regulations) It is used for membrane adhesion in lieu of hot asphalt to acceptable and properly prepared low slope and horizontal substrates. This adhesive is applied by squeegee or with specific type equipment. FM Adhesive Squeegee Grade meets ASTM D 4479 criteria

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing membrane components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

E. Metal Flashing Sheet: As specified in Section 076200 "Sheet Metal Flashing and Trim."

F. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

1. Water Cut-Off: Sopracolle or Sopramastic.

2. Sopralene Flam 180 for gusset material.

2.05 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick, factory primed.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Georgia-Pacific Corporation; Dens Deck Prime.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.06 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Self-Adhering Sheet Vapor Retarder: ASTM D 1970, minimum of 40-mil- (1.0-mm-) thick, polyethylene film laminated to layer of rubberized asphalt adhesive; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

C. Glass-Fiber Felt: ASTM D 2178, Type IV, asphalt impregnated.

2.07 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Standard board size to be 4 x 8 with an aged R-value

2. The insulation manufacturer shall substantiate in writing its recommendations for the use of their product under the asphalt based waterproofing membrane bonded with hot asphalt.

3. Minimum average aged R - value is to be 25.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.08 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Wood Nailer Strips: Comply with requirements in “Section 061053 "Miscellaneous Rough Carpentry."

D. Tapered Edge Strips: ASTM C 728, perlite insulation board.

E. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05310 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.03 VAPOR-RETARDER INSTALLATION

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

1. Continuously seal side and end laps with tape.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.04 INSULATION INSTALLATION

A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

B. Install one lapped base-sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes more than 45 degrees.

D. Install tapered insulation under area of roofing to conform to slopes indicated.

E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

F. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or more, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

1. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

I. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.

2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.

3. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints a minimum of 6 inches (150 mm) in each direction from joints of insulation below. Loosely butt cover boards together and fasten to roof deck. Tape joints if required by roofing system manufacturer.

1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.

3.05 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:

1. Deck Type: I (insulated).

2. Adhering Method: L (cold-applied adhesive).

3. Squeegee grade adhesives are intended for horizontal applications of the field membrane, except end laps. For the best results, trowel grade FM adhesive should be used in the end laps

4. Temperature range: The membrane, substrate and ambient temperatures must all be 50 degrees F (10C) ambient temperature.

5. Allow a minimum of 3 days after a membrane is installed for the adhesive to sufficiently cure before allowing foot or equipment traffic on the installed membrane and/or before successive plies are installed. When walking on the cold adhered membrane, a sunken footprint should not be visible nor should the adhesive be capable of sustaining a flame.

6. When the adhesive is used to seal side and end laps, a continuous bleed out of one eighth inch to one quarter inch is required; bleed out6 of cap membranes must be dressed with granules to the point of refusal.

7. All membranes must be allowed to relax prior to their installation in FM Adhesive.

8. Apply the adhesive with a three-sixteenth inch or one quarter inch notched squeegee or spray apply, for a uniform application of one and one-half gallons per square. Do not apply more this amount unless it is specified; do not allow the adhesive to puddle. Porous substrates typically require more adhesive than nonporous substrates.

9. Apply the adhesive in an area slightly larger than the width of the sheet; allow 5 to 15 minutes for the solvents to flash off before embedding the membrane. Flash off time will vary depending on available sunlight, relative humidity, wind flow and ambient temperature

10. At the three inch side laps and six inch end laps, bleed out of one-eighth inch to one quarter inch is required; bleed out of cap membranes should be dressed with granules to the point of refusal.

11. Laps may be sealed with FM Adhesive or heat welded. Trowel grade adhesive is recommended on end laps.

12. Adhesive sealed laps are not considered watertight until the adhesive sets, approximately 24 hours.

B. Cooperate with testing agencies engaged or required to perform services for installing roofing system.

C. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. At end of each day's work, provide tie-offs to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.06 BASE-PLY SHEET INSTALLATION

A. Prior to application, the vertical surface receiving the base ply flashing shall receive a coat of primer at the rate of 1SD-200 sq. ft./gallon. This primer coaling must be dry before application of the base sheet flashing.

B. Lay base ply flashing in strips three (3) feet wide to the vertical surfaces, extending onto the flat surface of the roof a minimum of four (4) inches. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches with the laps of the base ply.

C. Cold apply base ply flashing directly on its support from bottom to top followed by the torching of the roof tie-in.

D. After installation of base ply flashing, check all lap seams on the flashing by running a heated trowel along the edge of the seams.

1. Thoroughly seal all voids in the corners and seams.

3.07 TOP PLY INSTALLATION

A. Once the base ply is applied and does not show any defects, install the top ply.

B. Completely unroll membranes and allow the unrolled membrane to completely relax (typically 20 minutes minimum in warm, sunny conditions) Relaxed membranes appear limp wilted or flaccid. When installed, The Soprastar relaxed membranes should be at or very near the same temperature as the base membrane to which it is being applied.

C. Once completely relaxed, Soprastar membranes are ready to install

D. Set membrane in place over the base ply as specified(starting at the lowest point on the roof, so as to offset head lap-s a minimum of two feet and side laps a minimum of twelve inches from those occurring in the base ply membrane. Subsequent rolls should be aligned with six and one half inches end laps and three inch side laps

E. Back roll Soprastar membranes loosely and gently from each end while standing on the rolls, walking backwards, creating two equivalent sub-rolls with 3 feet left flat in the center of the sheet. Care should be taken to keep rolls aligned.

F. Pulling, not pushing, each sub roll with a roll puller, cold apply the membrane

G. Top ply shall have side laps of three (3) inches and end laps of six (6) inches. Prior to installation of following ply surface granules on laps shall be embedded by torch healing the membrane surface and pressing the granules into the melted asphalt with a hot trowel.

H. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.

I. Run membrane tight up against any vertical surfaces such as curbs, parapets, and vents.

J. After installation of the top ply, check all lap seams on the top ply using the edge of a hot trowel. Correct defect.

3.08 TOP PLY FLASHING INSTALLATION

A. Once the base ply is applied and does not show any defects, install the top ply.

B. Completely unroll membranes and allow the unrolled membrane to completely relax (typically 20 minutes minimum in warm, sunny conditions) Relaxed membranes appear limp wilted or flaccid. When installed, The Soprastar relaxed membranes should be at or very near the same temperature as the base membrane to which it is being applied.

C. Once completely relaxed, Soprastar membranes are ready to install.

D. Set membrane in place over the base ply as specified starting at the lowest point on the roof, so as to offset head lap-s a minimum of two feet and side laps a minimum of twelve inches from those occurring in the base ply membrane. Subsequent rolls should be aligned with six and one half inches end laps and three inch side laps.

E. Back roll Soprastar membranes loosely and gently from each end while standing on the rolls, walking backwards, creating two equivalent sub-rolls with 3 feet left flat in the center of the sheet. Care should be taken to keep rolls aligned.

F. Pulling, not pushing, each sub roll with a roll puller, cold apply the membrane.

G. Top ply shall have side laps of three (3) inches and end laps of six (6) inches. Prior to installation of following ply surface granules on laps shall be embedded by torch heating the membrane surface and pressing the granules into the melted asphalt with a hot trowel.

H. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.

I. Run membrane tight up against any vertical surfaces such as curbs, parapets, and vents.

J. After installation of the top ply, check all lap seams on the top ply using the edge of a hot trowel. Correct defect.

3.09 VENT (STACK)

A. Inspect base ply installation and ensure tight seal around pipe.

B. Construct and install sheet metal vent sleeve as per details over base ply.

1. Provide a minimum 5-inch base flange.
2. Prime all metal surfaces.
3. Heat metal flange with torch prior to setting in place and firmly pressing on flange to ensure even contact with roof surface.

C. Mop into place a reinforcing sheet of base ply material three feet square over the vent.

1. Seal all seams and edges with a heated trowel.

D. Install top ply as specified.

1. Cut membrane to fit tight against stack sleeve and seal by running a heated trowel around vent base.

E. Install metal vent cap.

3.10 CORNER FLASHING

A. Inside Comer:

1. Pre-cut all flashing pieces and prime all surfaces prior to installation.
2. Fabricate gusset 4-inch wide by 8-inch long with a 2-inch triangular tip.
   a. Install gusset into comer using a torch and firmly pressing with a hot trowel.
   b. Set gusset with triangular tip on base ply and wrapping the comer a minimum 2-inches on each side.
3. Pre-cut base flashing membranes to provide a 4-inch tie-in to roof surface and 3-inch return at corner.
4. Cold Apply first base flashing sheet into comer over gusset pressing overlap and tie-in firmly into position with a hot trowel.
5. Cold apply second base flashing sheet into position with edge tight into corner.
   a. Cut off base tie-in selvage at 45-degree from vertical.
   b. Seal all edges with a hot trowel.
6. Pre-cut top flashing membranes to provide a 6-inch tie-in to roof surface and 3-inch return at comer.
7. Cold apply first top flashing sheet into corner over second base ply pressing overlap and tie-in firmly into position with a damp sponge.

8. Cold apply second top flashing sheet into position with edge tight into comer.

   a. Cut off base tie-in selvage at 45-degree from vertical.
   b. Press flashing firmly into position with a damp sponge.
   c. Seal all edges with hot trowel and sprinkle granules to cover seeping asphalt.

B. Outside Comers:

1. Pre-cut all flashing pieces and prime all surfaces prior to installation.
2. Fabricate gusset 4-inch wide by 8-inch long with a 2-inch triangular tip.

   a. Install gusset into corner using a torch and firmly pressing with a hot trowel.
   b. Set gusset with triangular tip on base ply and wrapping the corner a minimum of 2-inches on each side.

3. Pre-cut base flashing membranes to provide a 4-inch tie-in to roof surface and 3-inch return at comer.
4. Cold apply first base flashing sheet into comer over gusset pressing overlap and tie-in firmly into position with a hot trowel.
5. Cold second base flashing sheet into position with returns wrapped around corners.

   a. Cut off base tie-in selvage at 45-degree from vertical.
   b. Seal all edges with a hot trowel.

6. Pre-cut top flashing membranes to provide a 6-inch tie-in to roof surface and 3-inch return at corner.
7. Cold apply first top flashing sheet into comer over second base ply pressing overlap and tie-in firmly into position with a damp sponge.
8. Cold apply second top flashing sheet into position with edge tight into comer.

   a. Cut off base tie-in selvage at 45-degree from vertical.
   b. Press flashing firmly into position with a damp sponge.
   c. Seal all edges with hot trowel and sprinkle granules to cover seeping asphalt.

3.11 CURBS

A. Inspect and verify that all curbs are properly secured to deck, are level, a minimum 6-inches above finished roof, primed and ready to receive flashings.

B. Base ply membrane is to run horizontally tight up against the vertical curb or cant as required.

1. When base ply membrane is to act as temporary seal for an extended length of time, carry membrane up vertical surface a minimum of 1-inch.

C. Gusset to be fabricated 4-inch wide by 8-inch long with a 2-inch triangular tip.

1. Install gusset onto comer using a torch and firmly pressing with a hot trowel.
2. Set gusset with triangular tip on base ply and wrapping the corner a minimum 2-inches on each side.

D. Install base ply flashing as specified.

1. Pre-cut flashing to the total sum of curb height, thickness plus 1-inch for inside curb securement and 4-inch tie-in along base with width to match that of curb plus 3-inch overlap on each end.
2. Secure along inside of curb with roofing nails.
3. Cut back comer base selvage at 45-degree angle from vertical.

E. Install top ply as specified.

1. Pre-cut flashing to the total sum of curb height plus 6-inches for base tie-in with width to match that of curb plus 3-inch overlap at each end.
2. Cut flashing flush with the top of curb and seal edges with heated trowel.
3. Cut back comer base selvage at 45-degree angle from vertical.
4. Firmly press flashing into position using a damp sponge.

F. Provide metal counter flashing.

3.12 ROOF EDGE

A. Install base ply membrane as specified. Carry membrane over roof edge a minimum of 3-inches and temporarily fasten using galvanized roofing nails.

B. Install a continuous metal cleat (material) and edge as detailed.

1. Prime all dissimilar surfaces prior to membrane or flashing installation.
2. Flange on edge to be 4-inch minimum.
3. Nail flange to decking or wood blocking at 4-inch center - staggered.

C. Cover edge with a reinforcing strip of base membrane mopped into place. Membrane is to carry beyond the metal flange onto base ply a minimum of 4-inches.

1. Hold the reinforcing strip back from outside edge of metal by 3/4-inch.
2. Seal all edges with a hot trowel.

D. Install top ply of membrane according to 3.11 of this section with the edge tight against the metal and sealed with a hot trowel.

3.13 COPING / PARAPETS

A. Verify all surfaces are properly secured and fully primed, ready to receive flashings.

B. Base ply membrane is to run horizontally tight up to the vertical or cant as required.

C. Install base ply flashing as specified. Carry flashing up the vertical surface, over the top and down the outside face of the parapet a minimum of 3-inches. Fasten along outside edge at 4 inch centers using roofing nails.

1. Install a continuous metal cleat (material) and edge as detailed.
    a. Prime all dissimilar surfaces prior to membrane or flashing installation.
    b. Flange on edge to be 4-inch minimum.
    c. Nail flange to wood blocking at 4-inch center - staggered.

2. Cold apply top ply membrane and flashing as detailed and specified.

D. Install metal coping in lieu of edge as per manufacturer's or SMACNA specifications when applicable.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports.

B. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.

2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

D. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.15 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 07710
MANUFACTURED ROOF SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge flashings.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Sections:

1. Section 06100 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07920 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.03 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Wind Design Standard: Manufacture and install copings and roof-edge flashings tested according to FBC and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:

1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.
3. Details of termination points and assemblies, including fixed points.
4. Details of special conditions.

C. Samples for Verification: For copings, roof-edge flashings and roof-edge drainage systems made from 12-inch (300-mm) lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for roof-edge flashings.

B. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

PART 2 - PRODUCTS

2.01 EXPOSED METALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.02 CONCEALED METALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

1. Finish: No. 4 (fine reflective, polished directional satin)

2.03 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
3. Products: Subject to compliance with requirements, provide one of the following:
    a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
    b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
    c. Henry Company; Blueskin PE200 HT.
    d. Metal-Fab Manufacturing, LLC; MetShield.
    e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

C. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

C. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.05 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Perma-Tite coping, Flat version by Metal Era; or comparable product by one of the following:

a. Architectural Products Company.
b. ATAS International, Inc.
c. Castle Metal Products.
d. Cheney Flashing Company.
e. Hickman Company, W. P.
f. Johns Manville.
g. Merchant & Evans, Inc.
h. Metal-Fab Manufacturing, LLC.
i. National Sheet Metal Systems, Inc.
j. Petersen Aluminum Corporation.

2. Coping Cap Material: Stainless steel, minimum 24 gage, formed as indicated on the Drawings and as required for the installation. Support shall be coping chairs with perforated cleats. Concealed splice plate shall match color and finish of coping caps.

3. Corners: Factory mitered and continuously welded.

4. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.

5. Snap-on-Coping Anchor Plates: Concealed, stainless steel sheet, 12 inches (300 mm) wide, with integral cleats.

6. Cleats: Concealed, continuous stainless steel.

2.06 ROOF-EDGE DRAINAGE SYSTEMS

A. Downspouts: Plain rectangular complete with mitered and fully welded elbows, manufactured from the same metal as conductor head. Furnish with metal hangers, from same material as downspouts, and anchors.

B. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.

1. Fabricate from the following exposed metal:

a. Stainless Steel: 0.019 inch (0.48 mm) thick.

C. Conductor Heads: Manufactured conductor(1) heads, each with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout, exterior flange trim, and built-in overflow.

1. Fabricate from the following exposed metal:

a. Stainless Steel: 0.016 inch (0.40 mm) thick.

D. Stainless-Steel Finish: No. 4 (bright, polished directional satin).

2.07 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Castle Metal Products.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Heckmann Building Products Inc.
5. Hickman Company, W. P.
6. Keystone Flashing Company, Inc.
7. Metal-Era, Inc.
8. Metal-Fab Manufacturing, LLC.
9. MM Systems Corporation.
10. National Sheet Metal Systems, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

2. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

3. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Stainless-Steel Finish: No. 4 (bright, polished directional satin).

2.08 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Self-Adhering Sheet Underlayment: Install wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water. Overlap edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

C. Polyethylene Sheet: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches (50 mm).

D. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.03 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact

surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise shown on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.04 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.05 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Downspouts: Join sections with continuous welds. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspout to direct water away from building.

C. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below discharge.

3.06 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See Section 03300 "Cast-in-Place Concrete" and Section 04810 "Unit Masonry Assemblies" for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counter-flashings overlap 4 inches (100 mm) over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

3.07 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.

B. Related Sections:

1. Section 02764 "Pavement Joint Sealants" for sealing joints in pavements, walkways, and curbing.
2. Section 04810 "Unit Masonry Assemblies" for masonry control and expansion joint fillers and gaskets.
3. Section 08800 "Glazing" for glazing sealants.
4. Section 09250 "Gypsum Board" for sealing perimeter joints.

1.03 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.

4. Joint-sealant color.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

D. Field-Adhesion Test Reports: For each sealant application tested.

E. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

D. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   c. May National Associates, Inc.; Bondaflex Sil 290.
   d. Pecora Corporation; 301 NS.
   e. Sika Corporation, Construction Products Division; SikaSil-C990.
   f. Tremco Incorporated; Spectrem 1.

2. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.

   a. Products: Subject to compliance with requirements, provide one of the following:
   b. Dow Corning Corporation; 790.
   c. May National Associates, Inc.; Bondaflex Sil 728 NS.
   d. Pecora Corporation; 301 NS.
   e. Tremco Incorporated; Spectrem 800.

2.03 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. BASF Building Systems; Sonolac.
   b. Bostik, Inc.; Chem-Calk 600.
   c. May National Associates, Inc.; Bondaflex 600.

d. Pecora Corporation; AC-20+.
e. Schnee-Morehead, Inc.; SM 8200.
f. Tremco Incorporated; Tremflex 834.

2.04 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.05 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

   a. Concrete.
   b. Masonry.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

   a. Metal.
   b. Glass.

5. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

6. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

D. Do not leave gaps between ends of sealant backings.

E. Do not stretch, twist, puncture, or tear sealant backings.

F. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

G. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

H. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

I. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
    a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.

2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Control and expansion joints in unit masonry.
c. Perimeter joints between materials listed above and frames of doors windows and louvers.

2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.

2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings.
c. Vertical joints on exposed surfaces of walls and partitions.
d. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

2. Joint Sealant: Latex.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 08110
STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 08710 "Door Hardware" for door hardware for hollow-metal doors.

1.03 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.04 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Amweld International, LLC.
2. Ceco Door Products; an Assa Abloy Group company.
3. Commercial Door & Hardware Inc.
4. Custom Metal Products.
5. Daybar.
6. Hollow Metal Inc.
7. MPI Group, LLC (The).
8. North American Door Corp.
9. Republic Doors and Frames.
10. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.02 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level C according to SDI A250.4.
2. Doors:
    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm) .
    c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).
    d. Edge Construction: Model 1, Full Flush.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
3. Frames:
    a. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    b. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.03 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm.)
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.

d. Edge Construction: Model 1, Full Flush.

e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

i. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) 10 R-value when tested according to ASTM C 1363.

3. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.

b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.04 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.05 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

5. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

      i. Two anchors per jamb up to 60 inches (1524 mm) high.
      ii. Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      iii. Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
      iv. Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

   b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

      i. Three anchors per jamb up to 60 inches (1524 mm) high.
      ii. Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      iii. Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
      iv. Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

   c. Compression Type: Not less than two anchors in each frame.
   d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.06 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.07 ACCESSORIES

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Install door silencers in frames before grouting.
    b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    d. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.

8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

9. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

10. Non-Fire-Rated Steel Doors:

    a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

b. At Bottom of Door: 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).
c. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

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SECTION 08220
FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FIBERGLASS RESIN TRANSFER MOLDED DOOR FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Fiberglass Reinforced Plastic (FRP) Doors.
2. Fiberglass Resin Transfer Molded Door Frames.

B. Related Sections

1. Division 8 Section "Door Hardware" for door hardware for hollow metal doors.
2. Division 9 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. Door Properties;
    a. Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.
    b. Successfully completed 1,000,000 cycles test in accordance with AAMA 920-03 – Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems, ANSI A250.4-2001 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcements and NWWDA TN-7 Test Method to Determine the Physical Endurance of Wood Doors and Associated Hardware Under Accelerated Operating Conditions.
    c. Additional Testing:

i. SFBC PA 201 Impact procedures for large missile impact.
ii. SFBC PA 202 Uniform static load on building components.
iii. SFBC PA 203Products subject to cyclic wind pressure.
iv. SFBC 3603.2 Force Entry Test.
v. ASTM E 1886 Performance of Exterior Protective Systems.
vi. ASTM E 1996 Impact Performance of Exterior Protective Systems.
vii. ASTM C 518 Heat Transfer Properties of Materials.
viii. ASTM D 1791 Mechanical Properties of Fasteners.

2. Laminate Properties

a. Door face plate is a minimum of 0.125 inch thick fiberglass reinforced plastic molded into one continuous sheet starting with a 25 mil resin-rich gelcoat layer resin integrally molded with multiple layers of 1.5 oz, sq ft fiberglass mat and one layer of 18 oz per square yard fiberglass woven roving saturated with special resin. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass resin.

b. Laminated plate by itself evaluated in accordance with Florida Building Code TAS201 large Missile Impact Test per ASTM-1996-05b, Standard Specification for Performance of Exterior Windows, Curtain Wall, Doors and Storm Shutters Impacted by Windborne debris in hurricanes.

i. ASTM D 638 tensile Strength Properties of Plastics.
ii. ASTM D 790 Flexural Strength Properties of Plastics.
iii. ASTM D 2583 Indention Hardness of Plastics.
iv. ASTM D 256 Izod Pendulum Impact Resistance.
v. ASTM D 792 Density/Specific Gravity of Plastics.
vi. ASTM D 1761 Mechanical Properties of Fasteners.
vii. ASTM E 84 Surface Burning Characteristics of Materials.
viii. ASTM G 155 Xenon Light Exposure of Non Metallic Materials.
ix. ASTM D 635 Method for Rate of Burning.
x. ASTM D 2843 Smoke Density.
xi. ASTM D 1929 Self Ignition Temperature Properties.
xii. SFBC PA 201 Im[pact Procedures for Large Missile Impact.

3. Core Properties

a. ASTM C 177 Thermal Properties of Materials.
b. ASTM D 1622 density and Specific Gravity.
c. ASTM E 84 Surface Burning Characteristics of Materials.
d. ASTM E90-04 Sound Transmission Loss.
e. ASTM E413-04 Classification for Rating Sound Insulation.

f. ASTM E1332-90 Standard Classification for Determination of Outdoor-Indoor Transmission Class.

g. ASTM E2235-04 Standard Test for Determination of Decay rates for Use in Sound Insulation Methods.

B. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure as close to neutral pressure as possible according to NFPA 252.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

E. QUALIFICATIONS

1. Manufacturer Qualifications: A company specializing in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 20 years' experience and with a record of successful in-service performance for the applications as required for this project.

2. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.

3. Source Limitations: Obtain fiberglass reinforced plastic doors and resin transfer molded fiberglass frames through one source fabricated from a single manufacturer, including fire rated fiberglass frames.

1.04 SUBMITTALS

A. Product Technical Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.

1. Acknowledgment that products submitted meet requirements of standards referenced.

2. Manufacturer shall provide a certificate of compliance with current local and federal regulations as it applies to the manufacturing process.

3. Manufacturer's installation instructions.

4. Schedule of doors and frames indicating the specific reference numbers used on the construction documents noting door type, frame type, size, handing and applicable hardware.

5. Details of core and edge construction, including factory construction specificartions.

6. Certification of manufacturer's qualifications.

B. Shop Drawings: Include the following:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.

6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.

8. Details of moldings, removable stops, and glazing.

9. Details of conduit and preparations for power, signal, and control systems.

10. A 5+ year Sample warranty to be issued at substantial completion.

C. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).

2. For the following items, prepared on Samples about 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:

a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.

b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

D. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly. Must meet Florida Product Approval.

F. Operation and Maintenance Manual

1. Include recommended methods and frequency for maintaining optimum condition of fiberglass doors and frames under anticipated traffic and use conditions.

2. Include certificate of warranty for door and frame listing specific door registration numbers.

3. Include hardware data sheets and hardware manufacturer's warranties.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver each door and frame individually palletized, wrapped, or crated to provide protection during transit and Project-site storage clearly marked with project information, door location, specific reference number as shown on the drawings. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

2. Doors shall be stored in the original container on edge, out of inclement weather for protection against the elements.

3. Handle door pursuant to manufacturer's recommendations as posted on outside of crate.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.08 WARRANTY

A. All fiberglass doors and frames are to have a lifetime guarantee against failure due to corrosion. Additionally, fiberglass doors and fiberglass frames are guaranteed for ten

(10) years against failure due to material and workmanship, including warp, separation or delamination, and expansion of the core.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Double Hurricane FBC Door Model CP9 Fiberglass door and frames as manufactured by Chem-Pruf Door Co., Ltd., P.O. Box 4560 Brownsville, Texas 78523, Website: www.chem-pruf.com or a comparable product by one of the following:

1. Builders Hardware, Inc.
2. Crest Metal Doors, Inc.
3. Fib-R-Dor, A Division of Chase Industries, Inc.
4. Jeld-Wen
5. Therma-Tru Doors Corporation.

2.02 FRP DOORS

A. Doors shall be made of fiberglass reinforced plastic (FRP) using Class 1 premium resin. Doors shall be 1 ¾ inch thick and of flush construction, having no seams or cracks. All doors up to 35-3/4" x 93-1/8" shall have equal diagonal measurements.

B. Door plates shall be 0.125 inch thick minimum, molded in one continuous piece, starting with 25 mil gelcoat of the color specified, integrally molded with multiple layers of 1.5 ounces per square foot fiberglass mat and one layer of 18 ounce per square yard fiberglass woven roving. Each layer shall be individually laminated with resin as specified above. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin. Plate alone to withstand Large Missile Impact per FBC TAS 201. Face plates manufactured using the pultrusion process will not be acceptable

C. Stiles and Rails shall be constructed starting from the outside toward the inside, with matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a u-shaped configuration and to the exact dimensions of the door.

D. Core material to be Polypropylene plastic honeycomb core with a non woven polyester veil for plate bonding, 180 psi typical compression range.

E. Internal reinforcement shall be dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1000 lbs per screw.

F. Finish of door frame shall be identical with 25 mil resin-rich gelcoat of specified color integrally molded in at time of manufacture resulting in a smooth gloss surface that is dense and non-porous. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

2.03 FRP FRAMES

A. Exterior Frames: Fabricated and manufactured using the resin transfer method creating one solid piece with complete uniformity in color, size and having a minimum 25 mil gelcoat layer molded in and a minimum of two layers of continuous strand fiberglass mat saturated with resin. The frame will be of one-piece construction with molded stop. All frame profiles shall have a core material of 2 psf polyurethane foam.

B. Finish of frames shall be identical to the door with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

C. Jamb/Header connection shall be mitered for tight fit. Optional seamless one piece frame construction as indicated on the project schedules and related details.

D. Internal Reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1000 lbs per screw. All reinforcing materials shall be completely encapsulated.

E. Mortises for hardware shall be accurately machined to hold dimensions to +/- 0.010 inchin all three axis.

F. Hinge pockets shall be accurately machined to facilitate heavy duty hinges at all hinge locations, using shims when standard weight hinges are used.

G. Frame shall meet all FBC requirements pursuant to SFBC PA 201 / SFBC PA 202 / SFBC PA 203 / SFBC 3603.2.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install FRP doors and frames work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Doors and frames shall be delivered to the job site individually crated. Each rate clearly marked with specific opening information for proper installation. Field modifications to doors and frames is not acceptable and prohibited.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

4. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.

5. Installation Tolerances: Adjust FRP door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. FRP Doors: Fit FRP doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated FRP Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.03 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including FRP work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from FRP work immediately after installation.

END OF SECTION

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SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

B. Related Sections:

1. Section 08220 "FRP Doors and Frames" for door silencers provided as part of FRP frames.

2. Section 08411 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.

C. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

1. Permanent lock cores to be installed by Owner.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.

1. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheet and 4-inch (102-mm) long Samples for other products.

a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

2. Other Action Submittals:

a. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

i. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

ii. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

iii. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

iv. Content: Include the following information:

I. Identification number, location, hand, fire rating, size, and material of each door and frame.

II. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

III. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.

v. Fastenings and other pertinent information.

I. Explanation of abbreviations, symbols, and codes contained in schedule.

II. Mounting locations for door hardware.

III. List of related door devices specified in other Sections for each door and frame.

3. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer].

B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

C. Warranty: Special warranty specified in this Section.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

B. Source Limitations: Obtain each type of door hardware from a single manufacturer.

C. Means of Egress Doors: Latches do not require more than 5 lbf (22.2 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with 2010 Florida Building Code Accessibility requirements.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:
    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.08 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

a. Manual Closers: 10 years from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.02 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on FRP doors and FRP frames.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

a. Baldwin Hardware Corporation.
b. Bommer Industries, Inc.
c. Cal-Royal Products, Inc.
d. Hager Companies.
e. IVES Hardware; an Ingersoll-Rand company.
f. Lawrence Hardware Inc.
g. McKinney Products Company; an ASSA ABLOY Group company.
h. PBB, Inc.
i. Stanley Commercial Hardware; Div. of The Stanley Works.

2.03 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

D. Lock Trim:

1. Description: Per manufacturer's specifications.
2. Levers: Cast.
3. Knobs: Wrought.
4. Escutcheons (Roses): Wrought.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
   a. Arrow USA; an ASSA ABLOY Group company.
   b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
   c. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
   d. Falcon Lock; An Ingersoll-Rand Company.
   e. Marks USA.
   f. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   g. Schlage Commercial Lock Division; an Ingersoll-Rand company.
   h. Yale Security Inc.; an ASSA ABLOY Group company.

2.04 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from stainless steel.

1. Manufacturer: Same manufacturer as for locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are removable; face finished to match lockset.

C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 3 construction master keys.

2.05 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. Master Key System: Change keys and a master key operate cylinders.

2.06 KEYS: BRASS.

A. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

1. Notation: "DO NOT DUPLICATE."

B. Quantity: In addition to one extra key blank for each lock, provide the following:

1. Cylinder Change Keys: Three.
2. Master Keys: Five.

2.07 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.
c. National Guard Products.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.
f. Sealeze; a unit of Jason Incorporated.
g. Zero International.

2.08 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.

c. National Guard Products.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.
f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
g. Sealeze; a unit of Jason Incorporated.
h. Zero International.

2.09 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2.10 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.03 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Furnish permanent cores to Owner for installation.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07920 "Joint Sealants."

F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

G. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.05 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 1

Provide each SGL door(s) with the following:

Quantity	Item	Manufacturer	Product	Finish
3 each	Butts	STH	CB179 4 ½ x 4 ½	630
1 each	Lock Set	CR	CK4210 - GRC	630
1 each	Deadlock	CR	DL3013	630
1 each	Threshold	PEM	2001AT	Alum
1 set	Seals	PEM	P243	-
1 each	Rain Drip	PEM	346C	Alum
1 each	Surface Closer	LC	4041XP	AL

END OF SECTION

SECTION 08800
GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors.

1.03 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.04 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.05 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.

1. Wired glass.

C. Product Certificates: For glass and glazing products, from manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

2.02 GLASS PRODUCTS

A. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.

1. Mesh: M2 (square).

2.03 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.04 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.05 MONOLITHIC-GLASS TYPES

A. Glass Type: Polished wired glass.

1. Thickness: 6.0 mm.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Minimum required face and edge clearances.

3. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.03 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.04 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 09111
NON-LOAD-BEARING STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm).
b. Depth: As indicated on Drawings.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
b. Depth: As indicated on Drawings.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm).

E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and 1-1/2 inch (38 mm) depth required to fit insulation thickness indicated.

2.02 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2-1/2 inches (64 mm).

D. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.
   a. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm).
   b. Depth: 1-5/8 inches (41 mm).

2.03 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.03 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

3.04 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.

b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

2. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Furring Members:

1. Erect insulation, specified in Section 07210 "Building Insulation," vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.05 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.

2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.

3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Do not attach hangers to steel roof deck.

5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 09220
PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Nonstructural steel framing and furring.
2. Interior portland cement plasterwork on metal lath and solid-plaster bases.
3. Exterior portland cement plasterwork (stucco) on solid-plaster bases.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealants installed with exterior portland cement plaster (stucco).

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delivery tickets showing exact quantities and full descriptions of cementitious materials, fiber reinforcement and liquid acrylic admixtures delivered to the job.

1.04 QUALITY ASSURANCE

A. Waterproofing of Stucco: It is the intention that exterior cement plaster stucco be mixed and applied to provide an effective rain shield that resists moisture entry into wall construction. It is intended that the paint film and stucco together form an effective barrier to vapor infusion into the wall from the exterior. Fiber reinforcement and acrylic admixtures shall be used to improve stucco strength and bond, reduce cracking and make it more resistant to moisture.

B. PVC accessories shall not be used for exterior plaster work except in areas completely protected from rain.

C. Fire-Test-Response Characteristics: For portland cement plaster assemblies with fire-resistance ratings, provide materials and construction identical to those tested in as-

sembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

D. Mockups: Before plastering, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for each type of finish indicated.
2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Include the following topics as major points of discussion.

1. Preparation of concrete surfaces and the need for bonding agents.
2. Locations of control joints, and how accuracy of placement will be maintained.
3. Proposed method of monitoring the mix of each batch of cement plaster stucco, to ensure that materials are used in the correct proportion, that acrylic admixture is used in every batch, that materials are not over-mixed, and that excessive water is not added to the mix.
4. Methods of properly curing exterior cement plaster to avoid rapid drying from wind and sun, use of damp curing and plastic sheeting to protect exterior plaster work.

F. Develop method to account for correct usage of liquid acrylic latexes as admixture. Provide quantity of liquid latex in proper proportion to bag goods as recommended by manufacturers. Submit delivery tickets as evidence and retain all empty latex containers. Unused acrylic latex admixture shall become property of the Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.06 PROJECT CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Interior Plasterwork: Maintain room temperatures at greater than 50 deg F for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.

2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

C. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

2. Apply plaster when ambient temperature is greater than 50 deg F.

3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. Products: Subject to compliance with requirements, provide one of the products specified.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 NONSTRUCTURAL STEEL FRAMING MEMBERS, GENERAL

A. Available Manufacturers:

1. Clark Steel Framing Systems.

2. Consolidated Systems, Inc.

3. Dale/Incor.

4. Dietrich Industries, Inc.

5. Marino/Ware; Division of Ware Industries, Inc.

6. Phillips Manufacturing Co.

7. SCAFCO Corporation.

8. Unimast, Inc.

B. Components, General: Comply with ASTM C 1063. For steel sheet components not included in ASTM C 1063, comply with ASTM C 645 requirements for metal, unless otherwise indicated.

C. Cold-Rolled Channels: Base metal thickness of 0.0538 inch with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

D. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter, unless otherwise indicated.

2.03 STEEL FRAMING FOR CEILINGS

A. Suspended Furring:

1. Main Runners (Carrying Channels): Cold-rolled channels, in depth indicated or if not indicated 1-1/2 inches deep.

2. Cross Furring: Cold-rolled channels, 3/4 inch deep.

B. Direct Furring: Cold-rolled channels, 3/4 inch deep.

C. Tie Wire:

1. For tying main runners directly to beams or joists (where wire hangers are used between beams or joists), use double loop of 0.1205-inch- diameter wire.

2. For tying furring directly to concrete structure without main runners, use 0.0800-inch- diameter wire.

3. For tying furring directly to steel or wood structure without main runners, use double loop of 0.0625-inch- diameter wire, or quadruple loop of 0.0475-inch-diameter wire.

4. For saddle tying cross furring to main runners use 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.

D. Wire Hangers: 0.162-inch- diameter wire.

E. Rod Hangers: ASTM A 510, mild carbon steel, ASTM A 153/A 153M, hot-dip galvanized.

1. Diameter: As recommended by ACI 524R.

F. Flat Hangers: Commercial-steel sheet, 1 by 3/16 inch, with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

G. Hanger Attachments to Concrete: Power-actuated fasteners that use explosive powder, gas combustion, or compressed air or other gas to embed fasteners in concrete and that are suitable for application indicated. Fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers. Capable of sustaining, without failure, a load equal to **10** times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

2.04 STEEL FRAMING FOR PARTITIONS

A. Steel Studs and Runners: ASTM C 645.

1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
2. Minimum Base Metal Thickness: 0.027 inch.
3. Depth: 3-5/8 inches unless otherwise indicated.

B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
2. Minimum Base Metal Thickness: 0.027 inch.

C. Channel Bridging: Cold-rolled channels, 1-1/2 inches deep.

1. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel.

D. Vertical Furring:

1. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   a. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
   b. Minimum Base Metal Thickness: 0.0179 inch.
   c. Depth: As indicated 7/8 inch or 1-1/2 inches.
2. Furring Channels: Cold-rolled channels, 3/4 inch deep.
   a. Furring Brackets: Adjustable, corrugated-edge type fabricated from steel sheet with minimum bare steel thickness of 0.0312 inch.
3. Runners: L-runners with perforated or plain legs to suit lath attachment requirements, in 0.0329-inch base metal thickness where attached to overhead support and in 0.0428-inch base metal thickness where attached to floor.

2.05 METAL LATH

A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

1. Manufacturers:

   a. Alabama Metal Industries Corporation (AMICO).
   b. Dale/Incor.
   c. Marino/Ware; Division of Ware Industries, Inc.
   d. Phillips Manufacturing Co.
   e. Unimast, Inc.

2. Diamond-Mesh Lath: Flat and Self-furring.

   a. Weight: 3.4 lb/sq. yd.

3. Flat Rib Lath: Rib depth of not more than 1/8 inch.

   a. Weight: 3.4 lb/sq. yd.

2.06 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Zinc Accessories:

1. Manufacturers:

   a. Alabama Metal Industries Corporation (AMICO).
   b. Dale/Incor.
   c. Dietrich Industries, Inc.
   d. Phillips Manufacturing Co.
   e. Unimast, Inc.

2. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

3. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

4. Casing Beads: Fabricated from zinc; square-edged style; with expanded flanges.

5. Two-Piece Expansion Joints: Fabricated from zinc; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4-to-5/8-inch wide; with perforated flanges.

C. Plastic Trim: Fabricated from high-impact PVC.

1. Manufacturers:

   a. Alabama Metal Industries Corporation (AMICO).
   b. Plastic Components, Inc.
   c. Vinyl Corp.

2.07 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or, if approved, polypropylene fibers, 1/2-inch to ¾-inch long, free of contaminants, manufactured for use in portland cement plaster.

1. Subject to compliance with requirements provide Saint-Gobain AR Glass Strand, or if approved, Durafiber or Swicofil PP Fibers.

C. Bonding Compound: ASTM C 932.

D. Acrylic Admixture: Non-reemulsifiable, acrylic latex bonding agent and admixture that when substituted for part of mixing water for cement plaster, improves flexural strength, workability, reduces shrinkage, and increases bond strength.

1. Subject to compliance with requirements provide one of the following:

a. El Rey Stucco Company Inc.; Superior Additive 200
b. Euclid Chemical Co; Flex-Con.
c. Conproco Corp.; K-88 Admix.
d. Nox-Crete Products Group; Acryl-Binder.
e. Sika; Sika Latex R.
f. Silpro Corp.; C-21
g. Thoro Products; Acryl 60.
h. US Mix Products Co.; Acrylcoat

E. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of not fewer than three exposed threads.

F. Acid-Etching Solution: Muriatic acid (10 percent solution of commercial hydrochloric acid) mixed 1 part to not less than 6 nor more than 10 parts water.

G. Line Wire: 0.0475-inch-diameter, zinc-coated (galvanized), soft, annealed steel wire.

H. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

I. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), unperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

2.08 PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

1. Color for Finish Coats: Gray.

B. Masonry Cement: ASTM C 91, Type N.

1. Color for Finish Coats: Gray.

C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

D. Sand Aggregate: ASTM C 897.

2.09 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to all base-coat mixes (not finish coat) after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability. Do not over-mix after fibers are added.

2. Acrylic Admixture: At exterior (only) cement plaster work use as substitute for a portion of the mixing water according to the manufacturer's printed instructions, but not less than one part admixture to three parts water for each batch of cement plaster; for base coat mixes and finish coat.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 parts lime, except up to 1-1/2 parts lime may be used for interior ceilings. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

b. Brown Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 parts lime, except up to 1-1/2 parts lime may be used for interior ceilings. Use 3 to 5 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

2. Masonry Cement Mixes:

a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.

b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate.

C. Base-Coat Mixes for Use over Monolithic Concrete: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

D. Base-Coat Mixes for Use over Concrete Unit Masonry: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.

E. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 for exterior work and 1-1/2 to 2 parts lime for interior work. Use 1-1/2 to 3 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

2. Masonry Cement Mix: 1 part masonry cement and 1-1/2 to 3 parts aggregate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid-plaster bases that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

C. Accurately install line wires as guides for tooled architectural reveals.

3.03 INSTALLING NONSTRUCTURAL STEEL FRAMING, GENERAL

A. General: Comply with requirements in ASTM C 1063 for applications indicated.

1. Comply with ASTM C 754 for installation of items not addressed in ASTM C 1063.

B. Install supplementary framing, blocking, and bracing at terminations in plaster assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.

2. Isolate partition framing and wall furring where it abuts structure, except at floor. At head of assemblies, install slip-type joints that avoid axial loading and that support assembly laterally.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

E. Soffits: Unless otherwise detailed on Drawings, install furred or suspended soffits to comply with requirements for ceiling installation; install framed soffits to comply with requirements for partition installation.

3.04 INSTALLING STEEL FRAMING FOR CEILINGS

A. Suspend ceiling hangers from building structure as follows:

1. Install hangers plumb and free of contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to limit deflection to 1/360 of span while supporting ceiling loads.

3. Wire Hangers: Secure by looping and tying, either directly to structure or directly to fasteners that are secure and appropriate for substrate, in a manner that will not cause them to deteriorate or otherwise fail.

4. Rod and Flat Hangers: Secure to structure, including intermediate framing members, by attaching to fasteners that are secure and appropriate for substrate and hanger, in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not connect steel framing to or suspend it from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for ceilings so members are level to within 1/4 inch in 10 feet measured lengthwise on each member and transversely between parallel members.

C. Install steel framing components for ceilings in sizes and spacings indicated but not less than that required by the referenced steel framing and installation standards.

1. Hanger Spacing: 48 inches o.c.

2. Main Runner (Carrying Channel) Spacing: For suspended ceilings, 36 inches o.c.

3. Cross-Furring Spacing: For suspended ceilings, 16 inches o.c., except where closer spacing required at curves.

3.05 INSTALLING STEEL PARTITION FRAMING

A. Install runners (tracks) at floors, ceilings, and structural walls and columns where plaster assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing member so fastening surfaces vary in plane not more than 1/4 inch in 10 feet.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling.

D. Install steel studs so flanges point in the same direction.

E. Frame door openings with two studs installed at each jamb, unless otherwise indicated.

1. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

F. Support Spacing:

1. Install steel studs at 16 inches o.c., unless otherwise indicated.

2. Install vertical furring at 16 inches o.c., unless otherwise indicated.

3.06 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

1. Partition Framing and Vertical Furring: Install flat diamond-mesh or flat rib lath.

2. Flat-Ceiling and Horizontal Framing: Install flat rib lath.

3. Curved-Ceiling Framing: Install flat diamond-mesh lath and adjust support spacing as required for curves.

4. On Solid Surfaces, Not Otherwise Furred: Install self-furring diamond-mesh lath at all joints between concrete masonry units and concrete to reinforce joint between differing materials.

3.07 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:

1. Install lath-type external-corner reinforcement at exterior locations, do not use corner beads at exterior locations.

2. Install cornerbead only at interior locations.

C. Install zinc casing bead as termination to cement plaster at expansion joints and elsewhere as required for clean termination of plaster coat.

1. Casing beads may be indicated as “J-Bead” or “Stop Bead” on Drawings. Provide solid zinc not galvanized even if galvanized indicated on Drawings.

D. Control Joints: Install control joints at locations indicated on Drawings, and in specific locations approved by Architect for visual effect as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft..
b. Horizontal and other Nonvertical Surfaces: 100 sq. ft..

2. At distances between control joints of not greater than 18 feet o.c.

3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.

4. Where control joints occur in surface of construction directly behind plaster.

5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.08 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.

2. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Fully grout any door frames which were not grouted during installation as part of masonry work.

3. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

4. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply as required on concrete plaster bases.

C. Plaster Finish Coats: Apply to provide smooth float finish to match Architect's sample.

D. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.

2. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.

3. Where plaster application will be used as a base for adhesive application of tile and similar finishes, finish coat may be omitted.

3.09 CUTTING AND PATCHING

A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.10 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 09250
GYPSUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 09111 "Non-Load-Bearing Steel Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.05 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.02 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. Temple-Inland.
8. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.03 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
   a. Cornerbead.

2.04 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.05 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

4. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.

2. Ceiling Type: As indicated on Drawings..

3. Moisture- and Mold-Resistant Type: In Restroom and Mechanical Room.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.04 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.

3.05 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 5: At panel surfaces that will be exposed to view unless otherwise indicated.
    a. Primer and its application to surfaces are specified in other Section 09912 "Interior Painting."

3.06 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09511
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.03 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.

2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

C. Maintenance Data: For finishes to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.

2. Suspension System: Obtain each type through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned

space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.08 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.02 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc., or a comparable product by one of the following:

1. BPB USA.
2. USG Interiors, Inc.

B. Acoustical Panels Type ACT-1

1. Surface Texture: Fine.
2. Composition: Mineral Fiber.
3. Color: White.
4. Size: 24 in. x 24 in. x 7/8 in.
5. Edge Profile: Angled Tegular for interface with Prelude XL 15/16” Exposed Tee.
6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.70.
7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classification with UL lable on product carton, 38.
8. Articulation Class (AC): ASTM E 1111, Classified with UL label on product carton N/A.
9. Flame Spread: ASTM E 1264; Class A (UL).
10. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.86.
11. Dimensional Stability: HumiGard Plus – temperatures up to 120 degrees F and high humidity excluding only exterior use, use over standing water, and direct contract with moisture.
12. Mold/Mildew Inhibitor: The front and back pf the product have been treated with BioBlock, a paint that contains special biocide that inhibits or retards the growth of mold and mildew, ASTM D 3273.
13. Acceptable Product: Cirrus Tile & Lay-in, 534 as manufactured by Armstrong World Industries.

2.03 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Cast-in-place anchors.
b. Type: Postinstalled expansion anchors.
c. Type: Postinstalled adhesive anchors.
d. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

E. Flat Hangers: Mild steel, zinc coated.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

G. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.04 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Manufacturers:

1. Subject to compliance with requirements, provide products by one of the following manufacturers:

a. Armstrong World Industries, Inc.
b. Celotex Corporation; Architectural Ceilings Marketing Dept.
c. Chicago Metallic Corporation.
d. USG Interiors, Inc.

B. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, G60 coating designation, with prefinished, cold-rolled, 15/16-inch- wide, aluminum caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white.

2.05 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers:

1. Armstrong World Industries, Inc.
1. Celotex Corporation; Architectural Ceilings Marketing Dept.
2. Chicago Metallic Corporation.
3. Fry Reglet Corporation.
4. Gordon, Inc.
5. MM Systems, Inc.
6. USG Interiors, Inc.

B. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with the following requirements:

1. Factory-fabricate to curves indicated in ceiling plan by roll-forming without notching, heating or deforming extrusions.
2. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for alloy and temper 6063-T5.

3. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

4. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

   a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

A. General: Install acoustical panel ceilings to comply with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

   4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate

for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

6. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. Install panels with pattern running in one direction parallel to long axis of space.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.04 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09900
COATING AND LINING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to perform preparation and painting. The listed products and coating systems are provided to guide the supplier in the painting systems and quality required. The named suppliers shall provide system equal to the named products and coating systems.

1.02 GENERAL

A. All cleaning, blasting and painting shall be done in accordance with the specifications of the Steel Structures Painting Council (SSPC) and in accordance with National Association of Corrosion Engineers (NACE) standards and the recommendations of the paint manufacturer.

B. The paint manufacturer shall make available a qualified factory representative to instruct the Contractor's paint applicators in the recommended cleaning, blasting and application procedures to insure that the coatings conform to the paint manufacturer's recommendations and the contract specifications.

C. Like items of equipment provided under this contract shall be painted with the products of one paint manufacturer in order to achieve standardization for the maintenance, color match and appearance.

D. All piping shall be painted per Color Schedule, include flow direction indicators and abbreviation provided in a contrasting color.

1.03 REFERENCES

A. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.

B. ASTM D 4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.

C. ASTM F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. AWWA D 102- Painting Steel Water Storage Tanks

E. International Concrete Repair Institute (ICRI) Guideline No. 310.2-1997 (formerly 03732) - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

F. NACE SP0188 - Standard Recommended Practice, Discontinuity (Holiday) Testing of Protective Coatings.

G. NAPF 500-03-04 Abrasive Blast Cleaning.

H. SSPC-SP 1 - Solvent Cleaning.

I. SPPC-SP 5/NACE 1 - White Metal Blast Cleaning. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.

J. SSPC-SP 10/NACE 2 - Near-White Metal Blast Cleaning. SSPC-SP 16 Brush-Off Blast Cleaning of Non-Ferrous Metals SSPC-SP 13/NACE 6 - Surface Preparation of Concrete.

K. SSPC-TU 11 - Inspection of Fluorescent Coating Systems

1.04 DEFINITIONS

A. Definitions of Painting Terms: ASTM D 16, unless otherwise specified.

B. Dry Film Thickness (DFT): Thickness of a coat of cured paint measured in mils (1/1000 inch).

1.05 SUBMITTALS

A. Submittals shall be made in accordance with Comply with Section 01300 Submittal Procedures.

B. Product Data: Submit manufacturer's product data for each coating, including description, complete technical data, surface preparation, and application instructions.

C. Color Samples: Submit manufacturer's color samples showing full range of standard colors.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.

2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

E. Manufacturer's Quality Assurance: Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.

F. Applicator's Quality Assurance: Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:

1. Project name and location.

2. Name of owner.

3. Name of contractor.

4. Name of engineer.

5. Name of coating manufacturer.

6. Approximate area of coatings applied.

7. Date of completion.

G. Warranty: Submit warranty per Section 01740.

H. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

3. VOC content.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Specialize in manufacture of coatings with a proven successful experience.

2. Able to demonstrate successful performance on comparable projects.

3. Approved Orange County Utility supplier are listed in Appendix D.

B. Applicator's Qualifications:

1. Experienced in application of specified coatings on projects of similar size and complexity to this Work.

2. Applicator's Personnel: Employ persons trained for application of specified coatings.

C. Pre-application Meeting: Convene a preapplication meeting two [2] weeks before start of application of coating systems. Require attendance of parties directly affecting work of this section, including Contractor, Engineer, applicator, Owner, and manufacturer's representative. Review the following:

1. Environmental requirements.

2. Protection of surfaces not scheduled to be coated.

3. Surface preparation.

4. Application.

5. Repair.

6. Field quality control.

7. Cleaning.

8. Protection of coating systems.

9. One-year inspection.

10. Coordination with other work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:

1. Coating or material name.
2. Manufacturer.
3. Color name and number.
4. Batch or lot number.
5. Date of manufacture.
6. Mixing and thinning instructions.

B. Storage:

1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
2. Keep containers sealed until ready for use.
3. Do not use materials beyond manufacturer's shelf life limits.

C. Handling:

1. Protect materials during handling and application to prevent damage or contamination.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Weather:

1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions. But at no times when the temperature of surface to be painted and ambient air temperature are below 50 °F (10 °C) or above 95 °F (35 °C).
2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.

B. Ventilation:

1. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D 102.

C. Dust and Contaminants:

1. Schedule coating work to avoid excessive dust and airborne contaminants.
2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

D. MAINTENANCE MATERIAL SUBMITTALS

1. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.01 ACCEPTABLE COATING MANUFACTURERS

A. Industrial coating systems for the Project shall be provided by one of the manufacturers listed below. No other coating manufacturers other than to ones listed will be considered. The listed acceptable industrial coating manufacturers shall be required to meet all specifications herein.

1. Carboline Company (Basis of the System Coatings Described Herein).
2. Tnemec Company, Inc.
3. PPG/Ameron.

B. All industrial coatings specified in this section shall be supplied by a single manufacturer.

2.02 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

D. Colors: As selected by Architect from manufacturer's full range.

2.03 COATING SYSTEMS FOR STEEL - STRUCTURAL, TANKS, PIPE, EQUIPMENT, AND MISCELLANEOUS

A. Exterior Exposed:

1. System Type: Epoxy*/epoxy/urethane.

2. Surface Preparation: SSPC-SP 6 with a surface profile of 2.0 to 3.0 mils.

3. Primer*: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
5. Finish Coat: Carboline Carbothane 134HG. DFT 2.0 to 4.0 mils.
6. Total DFT: 8.0 to 14.0 mils.
7. Finish Color: As chosen by Owner.

* Carbozinc Primer is also acceptable.

B. Interior Exposed:

1. System Type: Epoxy/epoxy/epoxy.
2. Surface Preparation: SSPC-SP 6 with a surface profile of 2.0 to 3.0 mils..
3. Primer*: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
5. Finish Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
6. Total DFT: 9.0 to 15.0 mils.
7. Finish Color: As chosen by Owner.

C. Immersion (Wastewater):

1. System Type: Epoxy Flake Filled/epoxy Flake Filled
2. Surface Preparation: SSPC-SP 5
3. OPTIONAL Shop Primer: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Primer: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils.
5. Finish Coat: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils.
6. Total DFT: 16.0 to 24.0 mils excluding optional shop primer.*
7. Finish Color: As chosen by Owner.

2.04 COATING SYSTEMS FOR GALVANIZED STEEL AND NONFERROUS METAL - PIPE AND MISCELLANEOUS FABRICATIONS

A. Exterior Exposed:

1. System Type: Epoxy/urethane.
2. Surface Preparation: SSPC SP 16.
3. Primer: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Finish Coat: Carboline Carbothane 134HG. DFT 2.0 to 4.0 mils.
5. Total DFT: 5.0 to 9.0 mils.
6. Finish Color: As chosen by Owner.

B. Interior Exposed:

1. System Type: Epoxy/epoxy.
2. Surface Preparation: SSPC SP 16.
3. Primer: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Finish Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
5. Total DFT: 6.0 to 10.0 mils.
6. Finish Color: As chosen by Owner.

C. Immersion (Wastewater)*:

1. System Type: Epoxy flake filled/epoxy flake filled.
2. Surface Preparation: SSPC-SP 16.
3. Primer Coat: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils
4. Finish Coat: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils
5. Total DFT: 16.0 to 24.0 mils.

* Zinc-rich coatings including galvanizing are ready consumed in acidic conditions, so complete coverage is essential.

D. Aluminum in Contact with Concrete*:

1. System Type: E poxy flake filled/epoxy flake filled.
2. Surface Preparation: SSPC-SP 16.
3. Primer Coat: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils
4. Finish Coat: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils
5. Total DFT: 16.0 to 24.0 mils.

* Zinc-rich coatings including galvanizing are ready consumed in acidic conditions, so complete coverage is essential.

2.05 COATING SYSTEMS FOR DUCTILE OR CAST IRON - PIPE, PUMPS, AND VALVES

A. Exterior Exposed:

1. System Type: Epoxy/epoxy/urethane.
2. Surface Preparation: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxide may remain.
3. Primer*: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
5. Finish Coat: Carboline Carbothane 134HG. DFT 2.0 to 4.0 mils.
6. Total DFT: 8.0 to 14.0 mils.
7. Finish Color: As chosen by Owner.

* Carbozinc Primer is also acceptable.

B. Below Ground (Buried):

1. System Type: Coal tar epoxy.
2. Surface Preparation: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxide may remain..
3. Primer: None.
4. Finish Coat: Carboline Bitumastic 300M. DFT 14.0 to 20.0 mils.
5. Total DFT: 14.0 to 20.0 mils.
6. Finish Color: Black.

C. Interior Exposed:

1. System Type: Epoxy/epoxy/epoxy.
2. Surface Preparation: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxide may remain.
3. Primer*: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
5. Finish Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.
6. Total DFT: 9.0 to 15.0 mils.
7. Finish Color: As chosen by Owner.

* Carbozinc Primer is also acceptable.

D. Exterior Immersion (Wastewater):

1. System Type: Epoxy flake filled/epoxy flake filled.
2. Surface Preparation: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxide may remain.
3. Primer: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils.
4. Finish Coat: Carboline Carboguard 890GF: DFT 8.0 to 12.0 mils
5. Total DFT: 16.0 to 24.0 mils.

2.06 COATING SYSTEMS FOR PVC

A. Interior or Exterior Exposed:

1. System Type: Acrylic.
2. Surface Preparation: Scarify.
3. Primer: Carboline Sanitile 120. DFT 2.0 to 4.0 mils.
4. Finish Coat: Carboline Carbocrylic 3359. DFT 2.5 to 4.0 mils.

5. Total DFT: 4.5 to 8.0 mils.

6. Finish Color: As chosen by Owner.

B. OPTIONAL Industrial Interior Exposed:

1. System Type: Epoxy/epoxy.

2. Surface Preparation: Scarify.

3. Primer: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.

4. Finish Coat: Carboline Carboguard 893SG. DFT 3.0 to 5.0 mils.

5. Total DFT: 6.0 to 10.0 mils.

6. Finish Color: As chosen by Owner.

2.07 COATING SYSTEMS FOR INSULATED PIPE

A. Interior or Exterior Exposed:

1. System Type: Acrylic.

2. Surface Preparation: Clean and dry.

3. Primer: Carboline Sanitile 120. DFT 2.0 to 4.0 mils.

4. Finish Coat: Carboline Carbocrylic 3359. DFT 2.5 to 4.0 mils.

5. Total DFT: 4.5 to 8.0 mils.

6. Finish Color: As chosen by Owner.

2.08 COATING SYSTEMS FOR PRECAST CONCRETE, CAST-IN-PLACE CONCRETE, AND DENSE CONCRETE MASONRY UNITS

A. Exterior Exposed:

1. System Type: Elastomeric Acrylic

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 2 or ICRI CSP 3. Clean and dry.

3. Primer: Carboline Flexxide Elastomer. Spreading Rate 90 to 115 sf/gal.

4. Finish Coat: Carboline Flexxide Elastomer. Spreading Rate 90 to 115 sf/gal.

5. Finish Color: As chosen by Owner.

B. Interior Exposed:

1. System Type: Epoxy.

2. Surface Preparation: SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP2 or 3.

3. Primer: Carboline Sanitile 555. DFT 2.0 to 4.0 mils. Roll or backroll.

4. Finish Coat: Carboline Sanitile 555. DFT 3.0 to 4.0 mils.

5. Total DFT: 5.0 to 8.0 mils.

6. Finish Color: As chosen by Owner.

C. Below Grade (Soil Side):

1. System Type: Coal tar epoxy.

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 2 or ICRI CSP 3. Clean and dry.

3. Primer: None.

4. Finish Coat: Carboline Bitumastic 300M. DFT 14.0 to 20.0 mils.

5. Total DFT: 14.0 to 20.0 mils.

6. Finish Color: Black.

D. Immersion (Wastewater):

1. System Type: Epoxy.

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 2 or

3. Filler: Fill bug holes, air pockets and other voids with Carboline Carboguard 501.

4. Primer: Carboline Plasite 4500S. DFT 20.0 to 30.0 mils.

5. Finish: Carboline Plasite 4500S. DFT 20.0 to 30.0 mils.

6. Total DFT: 40.0 to 60.0 mils.

7. Finish Color: As chosen by Owner.

2.09 COATING SYSTEMS FOR CONCRETE FLOORS

A. Heavy Traffic and Chemical Exposure:

1. System Type: Aggregate-filled epoxy/epoxy.

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 5 or 6.

3. Primer for concrete: Carboline Carboguard 1340. DFT 6.0 to 8.0 mils.

4. First Coats: Carboline Sanitile 944SL, double broadcast. DFT 1/8 inch.

5. Finish Coat: Carboline Sanitile 944SL. DFT 6.0 to 8.0 mils.

6. Total DFT: Greater than 1/8 inch.

7. Finish Color: As chosen by Owner. [Limited Color Selection]

8. Finish Texture: As required by the Engineer.

B. Decorative:

1. System Type: Ceramic-filled epoxy. Ceramic Carpet.

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 5 or 6.

3. Primer for concrete: Flowcrete Flowprime. DFT 6.0 to 8.0 mils.

4. First Coats: Flowcrete Peran STC, double broadcast with decorative quartz. DFT 1/8 inch.

5. Grout Coat: Flowcrete Peran STC. DFT 8.0 to 10.0 mils.

6. Finish Coat: Flowcrete Flowseal UV. DFT 2.0 to 3.0 Mils

7. Total DFT: Greater than 1/8 inch.

8. Finish Color: As chosen by Owner.

9. Finish Texture: As required by the Engineer.

C. High-Build Epoxy/Urethane Floor Coating. Mosaic Decorative Flake:

1. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 4 or 5.

2. Primer for concrete: Flowcrete Flowprime. DFT 6.0 to 8.0 mils.

3. Base Coat: Flowcrete Flowseal EPW (broadcast flake to refusal or as directed by Engineer). Liquid DFT 8.0 to 10.0 Mils.

4. Grout Coat: Flowcrete Peran STC. DFT 8.0 to 10.0 Mils.

5. Finish Coat: Flowcrete Flowseal. DFT 2.0 to 3.0 Mils

6. Total DFT: 24.0 to 31.0 Mils.

7. Finish Color & Pattern: As selected by Owner from manufacturer's standard colors.

2.10 COATING SYSTEMS FOR SECONDARY CONTAINMENT

A. Chemical Storage Containment Area:*

1. System Type: High-solids novolac epoxy lining system.

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 4 or 5.

3. Primer: Carboline Semstone 110. DFT 4.0 to 6.0 mils.

4. Intermediate Coat: Carboline Semstone 145. DFT 15.0 to 20.0 mils.

5. Finish Coat: Carboline Semstone 145. DFT 15.0 to 20.0 mils.

6. Total DFT: 34.0 to 46 mils.

7. Finish Color: As indicated on the drawings. [Limited Color Selection]

* Verify resistance to stored commodities PRIOR to installation.

B. Floors, Severe Chemical, Abrasion, and Traffic Exposure:*

1. System Type: Aggregate-filled, high-solids novolac epoxy lining system.

2. Surface Preparation: SSPC-SP 13/NACE 6 with a surface profile of ICRI CSP 5 or 6.

3. Primer: Carboline Semstone 110. DFT 4.0 to 6.0 mils.

4. First Coats: Carboline Semstone 145, double broadcast. DFT 1/8 inch.

5. Finish Coat: Carboline Semstone 145. DFT 15.0 to 20.0 mils.

6. Total DFT: Greater than 1/8 inch (125 mils).

7. Finish Color: As chosen by Owner. [Limited Color Selection]

* Verify resistance to stored commodities and anticipated traffic load PRIOR to installation.

2.11 COATING SYSTEMS FOR POROUS CONCRETE MASONRY UNITS

A. Exterior Exposed:

1. System Type: Elastomeric Acrylic.

2. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.

3. Primer: Carboline Flexxide Elastomer. Spreading Rate 90 to 115 sf/gal.

4. Finish Coat: Carboline Flexxide Elastomer. Spreading Rate 90 to 115 sf/gal.

5. Finish Color: As selected by Owner from manufacturer's standard colors.

B. Interior Exposed:

1. System Type: Cementious Acrylic/epoxy

2. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.

3. Primer: Carboline Sanitile 500. Spreading rate 80 to 100 sq. ft/gal.

4. Intermediate Coat: Carboline Sanitile 555. DFT 2.0 to 4.0 mils.

5. Finish Coat: Carboline Sanitile 555. DFT 3.0 to 4.0 mils.

6. Total DFT: 5.0 to 8.0 mils plus filler.

7. Finish Color: As selected by Owner from manufacturer's standard colors.

2.12 COATING SYSTEMS FOR PLASTER, GYPSUM BOARD, AND WOOD

A. Interior or Exterior Exposed:

1. System Type: Acrylic.

2. Surface Preparation: Clean and dry.

3. Primer: Carboline Sanitile 120. DFT 1.0 to 1.5 mils.

4. Intermediate Coat: Carboline Carbocrylic 3359. DFT 2.5 to 4.0 mils.

5. Finish Coat: Carboline Carbocrylic 3359. DFT 2.5 to 4.0 mils.

6. Total DFT: 6.0 to 9.5 mils.

7. Finish Color: As selected by Architect from manufacturer's standard colors.

2.13 OPTIONAL: COATING SYSTEMS FOR ARCHITECTURAL GYPSUM BOARD

A. Interior Exposed:

1. System Type: High Build Acrylic.
2. Surface Preparation: Clean and dry.
3. Primer: Carboline Sanitile 120. DFT 1.0 to 1.5 mils.
4. Intermediate Coat: Carboline Carbocrylic 3357 HB. DFT 3.0 to 6.0 mils.
5. Finish Coat: Carboline Carbocrylic 3357 HB. DFT 3.0 to 6.0 mils.
6. Total DFT: 7.0 to 13.5 mils.
7. Finish Color: As selected by Owner from manufacturer's standard colors.

2.14 ACCESSORIES

A. Coating Application Accessories:

1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.
2. Products of coating manufacturer.

2.15 PAINT MATERIALS

A. Products shall meet federal, state, and local requirements limiting the emission of volatile organic compounds (VOC's).

B. All permanent prime, intermediate and finish coats applied to the interior of filter and piping valves, tanks and submerged items for potable water use shall be National Sanitation Foundation (NSF) certified to standard 61 for potable water.

C. Materials including primer and finish coats to be produced by same paint manufacturer.

D. Thinners, cleaners, driers and other additives only as recommended by paint manufacturer of the particular coating and shown on the product data sheet supplied by the paint manufacturer.

E. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which coating systems are to be applied. Notify Engineer of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.02 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.

B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 SURFACES NOT TO BE COATED

A. Unless otherwise specified, the following surfaces shall be left uncoated:

1. Exposed aluminum, except ductwork.
2. Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.
3. Nickel or chromium.
4. Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.
5. Rubber and plastics, except as specified.
6. Exterior concrete, except below grade.
7. FRP wastewater troughs.
8. Surfaces specified to be factory finished.

3.04 SHOP FINISHING.

A. Items to be shop finished include the following. Shop finishing shall be in accordance with the coating manufacturer's recommendations.

1. All slide gates.
2. Other surfaces where blast cleaning cannot be or is not recommended to be performed in the field.
3. Other items as otherwise specified.

3.05 FIELD COATING.

A. Items to be field coated include the following. Field coating shall be in accordance with the field priming requirements, the coating requirements, and the manufacturer's recommendations.

1. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.

2. All interior and exterior ferrous metal surfaces. Coat all metals as described herein, including all pipes, electrical conduits, and ductworks.

3. Coat all interior and exterior concrete surfaces, including but not limited to the floors, walls, and ceilings of influent pump station, outlet box, isolation box, electrical building, as specified herein. All primed surfaces delivered shall be compatible with the specified and approved coating and painting systems.

3.06 SURFACE PREPARATION OF STEEL

A. Prepare steel surfaces in accordance with manufacturer's instructions.

B. Fabrication Defects:

1. Correct steel and fabrication defects revealed by surface preparation.

2. Remove weld spatter and slag.

3. Round sharp edges and comers of welds to a smooth contour.

4. Smooth weld undercuts and recesses.

5. Grind down porous welds to pinhole-free metal.

6. Remove weld flux from surface.

C. Ensure surfaces are dry.

D. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 1O/NACE 2. Create a surface profile as specified in Part 2 or as required by the coating manufacturer.

E. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3. Create a surface profile as specified in Part 2 or as required by the coating manufacturer.

F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.

G. Shop Primer: Shop primed steel shall receive cleaning according to manufacturer prior to the application of subsequent coats. Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

3.07 SURFACE PERPARATION OF GALVANIZED STEEL AND NONFERROUS METAL

A. Prepare galvanized steel and nonferrous metal surfaces in accordance with SSPC-SPI 6 and the coating manufacturer’s instructions.

B. Test galvanized surfaces for chromate treatments and remove as required by SSPC-SP 16, or other Engineer approved method.

C. Ensure surfaces are dry.

3.08 SURFACE PREPARATION OF DUCTILE OR CAST IRON

A. Prepare ductile or cast iron surfaces in accordance with NAPF 500-03-04 Abrasive Blast Cleaning with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxide may remain.

B. Bituminous coated pipe shall NOT be allowed if field painting is required.

C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.09 SURFACE PREPARATION OF PVC

A. Prepare PVC surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Scarify PVC surfaces.

3.10 SURFACE PREPARATION OF INSULATED PIPE

A. Prepare insulated pipe surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.11 SURFACE PREPARATION OF CONCRETE

A. Interior, Wet Substrate:

1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.

2. Allow concrete to cure for a minimum of 28 days.

3. 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F1869.

4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.

5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

6. Fill holes, pits, voids, and cracks with manufacturer approved surface.

7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

B. Exterior and Interior Dry:

1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
2. Allow concrete to cure for a minimum of 28 days.
3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F1869.
4. Level concrete protrusions and mortar spatter.
5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
6. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with manufacturer's instructions.
7. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with manufacturer's instructions.
8. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

3.12 SURFACE PREPARATION OF CONCRETE FLOORS

A. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Allow concrete to cure for a minimum of 28 days before coating.

D. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.

E. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.13 SURFACE PREPARATION OF SECONDARY CONTAINMENT

A. Prepare secondary containment surfaces in accordance with manufacturer's instructions.

B. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.

C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

D. Allow concrete to cure for a minimum of 28 days before coating.

E. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.

F. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.14 SURFACE PREPARATION OF POROUS CONCRETE MASONRY UNITS

A. Prepare porous concrete masonry unit surfaces in accordance with manufacturer's instructions and SSPC-SP 13/NACE 6.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Allow mortar to cure for a minimum of 28 days before coating.

D. Level protrusions and mortar spatter.

3.15 SURFACE PREPARATION OF PLASTER

A. Prepare plaster surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Allow plaster to cure and dry out for a minimum of 28 days before coating.

D. Do not coat over plaster containing free water, lime, or other soluble alkaline salts.

E. Remove plaster nibs and other protrusions.

F. Patch voids and cracks with approved materials and after dry, sand flush with surface.

3.16 SURFACE PREPARATION OF GYPSUM BOARD

A. Prepare gypsum board surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Sand joint compound smooth and feather edge.

D. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.

E. Do not apply putty, patching pencils, caulking, or masking tape to drywall surfaces to be painted.

F. Lightly scuff-sand tape joints after priming to remove raised paper nap. Do not sand through primer.

3.17 SURFACE PREPARATION OF WOOD

A. Prepare wood surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, surface deposits of sap or pitch, and other contaminants.

C. Seal knots and pitch pockets.

D. Sand rough spots with the grain.

E. Fill cracks and holes with approved materials after primer is dry. Sand flush with surface when filler is hard.

F. Lightly sand between coats.

3.18 APPLICATION

A. Apply coatings in accordance with manufacturer's instructions.

B. Mix and thin coatings, including multi-component materials, m accordance with manufacturer's instructions.

C. Keep containers closed when not in use to avoid contamination.

D. Do not use mixed coatings beyond pot life limits.

E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.

F. Uniformly apply coatings at spreading rate required to achieve specified DFT.

G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

H. Stripe paint with brush critical locations on steel such as welds, comers, and edges using specified primer. Apply and additional strip coat of the intermediate coating material in 1mmers1on areas.

I. Roll or backroll the first coat of epoxy or block filler applied to concrete or interior block substrates to work the material into the substrate.

3.19 REPAIR

A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.

C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.20 FIELD QUALITY CONTROL

A. Required Inspections and Documentation:

1. Verify coatings and other materials are as specified.

2. Verify environmental conditions are as specified.

3. Verify surface preparation and application are as specified.

4. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC- PA2.

5. Coating Defects:

   a. Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
   b. Check for holidays on interior steel immersion surfaces using holiday detector in accordance with NACE SP0188 or SSPC TU-11 using a safe blue light inspection lamps if OAP technology is used.

6. Report:

   a. Prepare inspection reports daily.
   b. Submit written reports describing inspections made and actions taken to correct nonconforming work.
   c. Report nonconforming work not corrected.
   d. Submit copies of report to Engineer, Contractor, and Owner.

B. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

C. The Contractor shall perform daily test in the presence of resident project representative to verify conditions are acceptable.

3.21 CLEANING

A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.22 PROTECTION OF COATING SYSTEMS

A. Protect surfaces of coating systems from damage during construction.

3.23 ONE-YEAR INSPECTION

A. Owner will set date for one-year inspection of coating systems.

B. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.

C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturer's instructions.

3.24 COLOR COATING AND LETTERING

A. Lettering. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915", Seton "Setmark", or equal. Letter size shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 inch [15 mm] and smaller	Metal tags -1/4 inch [6 mm]
3/4 to 4 inches [20 to 100 mm]	3/4 inch [20 mm]
5 inches [125 mm] and larger	2 inches [50 mm]

B. Color Coding and Lettering. Contractor to verify that all colors listed below are per approved Orange County listings at the time of construction. All piping for the following services shall be color coded unless otherwise directed by the Engineer. Bands shall be 6 inches [150 mm] wide spaced along the pipe at 5 foot [1.5 m] intervals. For services not listed, the color coding and lettering shall be as directed by the Engineer.

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Activated Silica (solution)	Light brown with blue bands	White
Alum (solution)	Orange	Black
Ammonia	White	Black
Ash	Dark gray with green bands	White
Backwash waste	Light brown	White
Carbon	Black	White
Carbon Dioxide (liquid or gas)	Yellow with gray bands	Black
Carbon Dioxide (solution)	Yellow with black bands	Black
Chilled Water (supply or return)	Dark blue with red bands	White
Chlorine (gas, liquid, or vent)	Yellow	Black
Chlorine (solution)	Yellow	Black
Chlorine Dioxide	Yellow with violet bands	Black
Combustion Air	Dark green yellow bands	White
Compressed Air	Dark green	Black
Condensate	Light gray with brown bands	Black
Condenser Water (supply or return)	Dark blue with white bands	White
Digester Gas	Red with black bands	Black
Distilled Water	Light Blue with white bands	Red

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Drain	Dark gray	White
Electrolyte	Aluminum with red bands	Black
Emergency Gas Treatment System – Indoors	Yellow with black bands	Black
Emergency Gas Treatment System – Outdoors	White	Black
Ferric Chloride	Orange	Black
Filtrate	Dark gray with red bands	White
Fire Protection Water	Red	White
Fluoride	Light blue with red bands	Black
Fuel Oil	Black	White
Gasoline	Black with red bands	White
Grease	Black with yellow bands	White
Grey Water	Purple	Black[1]
Grit	Light grey with black bands	White
Heated Sludge	Light brown with yellow bands	White
Heating Water (supply or return)	Light gray with black bands	Black
Hydrofluosilicic Acid	Yellow with blue bands	Black
Instrument Air	Light green with dark green bands	Black
Laboratory Special Gases	Match adjacent surface	Black
Laboratory Vacuum	Dark green with light green bands	Red
Lime Sludge	Light brown with white bands	White
Lime Slurry	Light green	Black
Liquid Alum	Yellow with orange bands	Black
Low Pressure Air (aeration supply)	Light green with orange bands	Black
Natural Gas Or Propane Gas	Yellow with red bands	Black

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Nonpotable Water (downstream of backflow preventer)	Purple	Black
Odor Control – Indoors	Dark green with light brown bands	White
Odor Control – Outdoors	White	Black
Oil – Hydraulic	Black with white bands	White
Other Hydrocarbons (identify)	Black	White
Ozone	Yellow with orange bands	Black
Plant Effuent Water	Purple	Black
Plumbing Vents	Dark gray	White
Polymer	Orange with green bands	Black
Polyphosphate	Light green with red bands	Black
Potable Water (hot or cold)	Dark blue	White
Potassium Permanganate	Violet	Black
Raw Water	Olive green	White
Refrigerant	Yellow with white bands	Black
Sample	Light gray with green bands	Black
Scum	Dark brown	White
Service Water	Dark blue with red bands	White
Settled Sewage	Light gray with brown bands	Black
Settled Sewage Service Water	Dark blue with orange bands	White
Settled Water	Aqua	Black
Sewage	Dark gray	Black
Sludge	Dark brown	White
Soda Ash (solution)	Light green with orange bands	Black
Sodium Chlorite	Orange with red bands	Black
Sodium Hydroxide (caustic)	Yellow with green bands	Black

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Sodium Silica (solution)	Light brown with orange bands	White
Steam	Light gray with orange bands	Black
Steam Vent	Light gray with red bands	Black
Sulfur Dioxide	Light green with yellow bands	Black
Sulfur Dioxide (solution)	Orange with blue bands	Black
Sulfuric Acid	Yellow with red bands	Black
Vacuum Pump Discharge	Aluminum	Black

Notes:

1. Lettering shall read, "CAUTION: NONPOTABLE WATER, DO NOT DRINK." At each hose station.
2. Lettering shall be on a yellow background and shall read, "CAUTION: NONPOTABLE WATER, DO NOT DRINK.". Each outlet on the nonpotable water line shall be similarly labeled.
3. Lettering shall read, "CAUTION: RECLAIMED WATER, DO NOT DRINK".
4. Lettering shall be on a light green background.

Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by Engineer. Vent lines shall be coated to match surfaces they adjoin.

In addition, special coating of the following items will be required:

Item	**Color**
Valve handwheels and levers	Red
Hoist hooks and blocks	Yellow and black stripes

Numerals at least 2 inches [50 mm] high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the Drawings or in the Specifications by number.

END OF SECTION

SECTION 09961
FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100% solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves, slide gates, and structural steel. Fusion-Bonded Epoxy shall be compliant with the Orange County Utilities Standards and Construction Specifications Manual.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following;
2. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.
3. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 - MATERIALS

2.01 PIPING AND EQUIPMENT SURFACES

A. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.

B. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

2.02 SHOP-APPLIED EPOXY LINING AND COATING

A. Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red, or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

B. Field-Applied Epoxy Coating for Patching

1. Use a two-component, 80% solids liquid resin, such as Scotchkote 306.

C. Painting and Coating of Grooved-End and Flexible Pipe Couplings

1. Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 - EXECUTION

3.01 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING--GENERAL

A. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.

B. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

C. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.

D. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

E. After cleaning and surface preparation, test the surface for residual chloride concentration. If the residual chloride concentration exceeds 5 $\mu g/cm^2$, then apply a phosphoric acid wash to the surface after sandblasting. Apply a phosphoric acid wash to the pipe, item, or piece of equipment after sandblasting. The average temperature, measured in three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be a 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the surface shall be determined by using the average temperature as tabulated below:

Surface Temperature (°F)	**Contact Time (seconds)**
80	52
85	45
90	36
95	33
100	28
105	24
110	21
130	10

F. After the acid wash has been completed, remove the acid with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

G. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

3.02 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO PIPE--ADDITIONAL REQUIREMENTS

A. Apply lining and coating per AWWA C213 except as modified herein.

B. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

3.03 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO JOINT AREAS OF DUCTILE-IRON AND CAST-IRON FITTINGS--ADDITIONAL REQUIREMENTS

A. Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

B. Quality of Lining and Coating Applications

1. The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.04 FACTORY TESTING OF COATING--GENERAL

A. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is less than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.

B. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

3.05 FACTORY TESTING OF LINING AND COATING OF PIPE--ADDITIONAL REQUIREMENTS

A. Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

B. Field Repairs

1. Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80% solids (minimum), and liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged

area before applying the liquid epoxy coating. Apply a two-part epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END OF SECTION

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SECTION 09970
SPECIALTY COATINGS FOR CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of specialty coatings for concrete.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the Section 01300.

B. Submit manufacturer's data sheets showing the following information:

1. Percent solids by volume of coating compound.
2. Number of coats required to give the specified dry thickness.
3. Minimum recommended dry thickness per coat for prime, intermediate, and finish coats.
4. Recommended surface preparation.
5. Recommended surface tensile strength of the concrete surface.
6. Application instructions including recommended equipment and temperature limitation.
7. Curing requirements and instructions.

C. Submit color swatches.

D. Submit certificate and supplier’s data sheets identifying the type and gradation of abrasives used for surface preparation.

E. Submit gradation of aggregate used in traffic bearing coating systems.

F. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

2.01 TYPE "A" COATING: 100% SOLIDS TROWELEABLE EPOXY

A. The coating shall be a 100% solids epoxy system consisting of a cement-based surfacer, two-component primer, a three-component liner, and a two-component gel (top) coat. The coating shall be a monolithic epoxy lining.

B. Characteristics shall be as follows:

1. Compressive Strength: Min 10,000 psi per ASTM D695.
2. Modulus of Elasticity: 1,300,000 (minimum) per ASTM C580.
3. Tensile Strength: 1,500 to 2,500 psi per ASTM C307.
4. Flexural Strength: 5,000 to 6,000 psi per ASTM C580.

C. Products: Saureisen or accepted equal:

1. Resurfacer – Restokrete Substrate Resurfacer No. F-121
2. Primer – ConoWeld No. 501
3. Epoxy Coating – SewerGard Trowelable No. 210
4. Top Coat – SewerGard Glaze No. 210

D. Apply primer to a thickness of 20 mils, liner to a minimum thickness of 125 mils, and gel coat to a minimum thickness of 20 mils.

2.02 TYPE "B" COATING: POLYURETHANE DECK COATING

A. The coating shall be a polyurethane system. Coating system shall be as follows:

1. Epoxy primer minimum 2 mils
2. Polyurethane Base Coat 25 mils
3. Polyurethane Top Base Coat 20 mils
4. Silica Sand Aggregate 8-10lbs/100sq-ft applied using back roll method for surfaces exposed to pedestrian traffic

B. Products:

1. Neogard: 7760/7761 Primer, 70420 Base Coat, 70420 Top Coat.
2. Sonoguard: Epoxy Primer, Sonoguard Base Coat, Sonoguard Top Coat.

PART 3 - EXECUTION

3.01 COATING SYSTEM

A. Materials including primer, intermediate, and finish coats shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the coating manufacturer.

B. Deliver coatings to the jobsite in the original, unopened containers.

3.02 PROTECTION OF SURFACES NOT TO BE COATED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be coated. Provide drop cloths to prevent coating materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and coating process. Mask openings in motors to prevent coating and other materials from entering the motors.

3.03 WEATHER CONDITIONS

A. Do not coat in the rain, wind, snow, mist, and fog or when surface temperatures are less than 5°F above the dew point.

B. Do not apply coatings when the relative humidity is above 85% or the temperature is above 90°F.

C. Do not coat when temperature of concrete to be painted is above 120°F.

D. Do not apply coatings if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

E. Follow manufacturer's directions if stringent.

3.04 SURFACE PREPARATION

A. Surface preparation of concrete shall be in accordance with coating manufacturer.

B. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable, not rising.

C. Coating manufacturer representative shall field verify surfaces to be coated and other field conditions prior to coating application. Written acceptance of these conditions shall be provided to the Owner prior to application.

3.05 ABRASIVE BLAST CLEANING

A. Use dry abrasive blast cleaning material. When field blast cleaning with hand-held nozzles, do not recycle or reuse blast particles.

B. After blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast-cleaned surface not coated within said eight-hour period.

C. Keep the area of the work in a clean condition, and do not permit blasting particles to accumulate and constitute a nuisance or hazard.

D. During sandblast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.06 COATING APPLICATION

A. The entire coating shall be pinhole free.

B. Apply coating to the following surfaces:

Structure	Area	Surface	System Designation
Influent Pump Station and Isolation Box	Interior	All interior vertical surfaces and underside of top slab and floor	Type A
Outlet Box	Interior	All interior vertical surfaces and underside of top slab and floor	Type A
Influent Pump Station and Isolation Box	Top Slab	Top of Elevated Slab	Type B
Outlet Box	Top Slab	Top of Elevated Slab	Type B

3.07 DRY-FILM THICKNESS TESTING

A. Measure coating thickness specified for concrete or masonry surfaces in accordance with ASTM D4138. Test the finish coat of concrete and masonry surfaces in accordance with NACE SP0188-2006 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.

B. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

3.08 HOLIDAY (CONTINUITY) TESTING OF APPLIED COATING

A. The Contractor shall inspect each coat of primer and finish coating in accordance with ASTM D4787 to determine integrity. Each coating application will be checked and deficiencies marked. After observing specified recoat time, apply additional coating materials over areas having any holidays or pinholes. After correction of

deficiencies, the Contractor shall re-inspect those areas to determine the acceptability of the additional coating. Each coating application must be 100% to the satisfaction of the Owner's Representative prior to succeeding coating applications.

END OF SECTION

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SECTION 10200
LOUVERS AND VENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Fixed, extruded-aluminum louvers, impact-resistant.

a. Impact-resistance not required for louvers in ceilings/soffits.

B. Related Sections include the following:

1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

2. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

3. Delete subparagraph above and revise or delete first subparagraph below if metal door louvers are included in this Section.

4. Division 9 Section “Painting (Professional Line Products)" for field painting louvers.

5. Division 15 Sections for louvers that are a part of mechanical equipment.

1.03 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Delete below if drainable-blade louvers are not required.

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.04 PERFORMANCE REQUIREMENTS

A. Florida Product Approvals. As required by Florida law, building envelope components and systems shall have either a state or local product approval for demonstrating resistance to the structural wind loads required in the current Building Code edition as a condition for site specific permit verification. The Contractor shall be responsible for obtaining and providing approvals demonstrating compliance with this requirement as it relates to products covered under this section.

B. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

2. Louver manufacturer shall provide integral mullions as required to withstand applied wind loads.

C. Select subparagraph above and indicate pressures on appropriate elevation Drawings or select one of two subparagraphs and associated subparagraphs below with appropriate design data. Requirements below are examples only. Revise to suit Project. Consult structural engineer to quantify design loads applicable to Project. Verify compliance with codes. See Evaluations.

D. Revise paragraph and subparagraph below to indicate specific loads determined by Project's structural engineer or refer to loads indicated on Drawings. Model building codes and ASCE 7 establish criteria for buildings subject to earthquake motions. Verify requirements of authorities having jurisdiction.

E. Impact Rating: Provide impact louvers where indicated on Architectural Elevation Drawings capable of withstanding large missile impact and having Miami-Dade County Product Approval.

F. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

G. Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.

1. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of metal finish required.

E. Qualification Data: For professional engineer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."

2. AWS D1.3, "Structural Welding Code--Sheet Steel."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - MATERIALS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide RS-4605 by Construction Specialties or Approved equal.

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

D. Use types and sizes to suit unit installation conditions.

E. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.

F. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Delete first paragraph and subparagraphs below if not applicable.

C. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

D. Usually select subparagraph above or below. If both conditions are required, select one subparagraph as default requirement and indicate exceptions on Drawings.

E. Retain paragraph above only if appearance is critical; otherwise, delete and retain first paragraph below. Above is not possible with some designs. Below is manufacturers' standard practice.

F. Maintain equal louver blade spacing to produce uniform appearance.

G. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

H. Frame Type: Channel, unless otherwise indicated.

I. Include supports, anchorages, and accessories required for complete assembly.

J. Coordinate paragraph and subparagraphs below with Drawings and product descriptions.

K. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

L. Retain subparagraph above or first subparagraph below if any louvers require a continuous appearance. Note that fully recessed mullions are not available for drainable-blade mullions and that only a few manufacturers offer drainable-blade louvers with semirecessed mullions.

M. Delete subparagraph below if no exterior mitered corners. If retaining, verify available corner construction with manufacturers selected.

N. Delete first paragraph below if not applicable. If retaining, detail on Drawings.

O. Where indicated, provide subsills made of same material as louvers or extended sills for recessed louvers.

P. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

Q. Delete paragraph above or below. Verify availability of joinery methods with manufacturers listed.

R. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.04 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Impact-Resistant Louver:

1. Retain one of first two subparagraphs and associated subparagraph below. Retain "Basis-of-Design Product" Subparagraph below with "Basis-of-Design Product" Subparagraph in Part 2 "Manufacturers" Article.

2. Basis-of-Design Product: American Warming and Ventilating Model LE-32 (Special Miami-Dade County Hurricane Louver).

3. Coordinate first subparagraph and associated subparagraph below with Part 2 "Manufacturers" Article if multiple products are specified. Retain "Available" for nonproprietary and delete for semiproprietary specifications.

4. Louver Depth: 6 inches.

5. Usually retain second option in first subparagraph below; blades of storm-resistant louvers gain stiffness from their complex shapes and therefore do not need to be as thick as blades of some other louver types. If retaining first option, verify availability of louvers with performance requirements selected.

6. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than .125 inch.

7. Performance Requirements:

a. See Editing Instruction No. 4 in the Evaluations.
b. Free Area: Not less than 6.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
c. Air Performance: Not more than 0.21-inch wg static pressure drop at 1250 fpm free-area velocity.
d. Water Penetration Performance: Not more than .01 oz per sq. ft. of free area at an airflow of 1250 fpm free area velocity when tested for 15 minutes.

8. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.05 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face..

2. Screening Type: Insect screening.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Mill finish, unless otherwise indicated.

3. Select one of two options in subparagraph below. First allows screen mesh to be replaced without replacing frame, which is desirable for insect screen. Second requires frame to be replaced when replacing screen mesh, which is typical for bird screen.

4. Type: Rewirable frames with a driven spline or insert for securing screen mesh.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Stainless steel, 18-by-18 mesh, 0.009-inch wire.

2.06 BLANK-OFF PANELS

A. Insulated, Blank-off Panels: Laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets.

B. Thickness: 1 inch.

C. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.

D. Insulating Core: Unfaced mineral-fiber rigid insulation board.

E. Subparagraph below is an example only; revise to suit Project.

F. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.

G. Delete first subparagraph below if not required.

H. Seal perimeter joints between panel faces and louver frames with 1/8-by-l-inch PVC compression gaskets.

I. Panel Finish: Same finish applied to louvers.

J. Select one of two options below or revise to suit Project. Other methods include slide bolts and cam latches with or without hinges.

K. Attach blank-off panels to back of louver frames with stainless-steel, sheet metal screws.

2.07 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

2.08 ALUMINUM FINISHES

A. Delete this Article if no aluminum louvers and vents. Retain or revise finishes below to suit Project. If retaining more than one, indicate location of each on Drawings or by inserts.

B. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic-Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Three-Coat Coating System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.04 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 10520
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

2. Hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.03 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project Site.

1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

2. Review methods and procedures related to fire extinguishers including but not limited to, the following:

a. Schedules and coordination requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

C. Retain subparagraph below for cabinet-mounted hose valves.

D. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

E. Retain "Samples" Paragraph below for single-stage Samples, with a subordinate list if applicable. Retain "Samples for Initial Selection" and "Samples for Verification" paragraphs for two-stage Samples.

F. Samples: For each type of exposed finish required.

G. Samples for Initial Selection: For each type of exposed finish required.

H. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.

I. Product Schedule: For fire-protection cabinets and extinguishers. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.05 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Hydrostatic test in first subparagraph below is required every five years for water, AFFF, FFFP, dry-chemical-in-stainless-steel-shell, carbon dioxide, and wet-chemical fire extinguishers; test is required every 12 years for other dry-chemical, dry-powder, and halogenated-agent fire extinguishers.

b. Failure of hydrostatic test according to NFPA 10.

c. Faulty operation of valves or release levers.

2. Warranty Period: Six (6) years from date of Substantial Completion

1.08 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Requirement in paragraph below applies only to recessed and semirecessed cabinets.

C. Coordinate sizes and locations of fire-protection cabinets with wall depths.

D. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.09 SEQUENCING

A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Retain "Electrical Components, Devices, and Accessories" Paragraph below if wired alarms are specified for fire-protection cabinets.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

E. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

F. Retain subparagraph below if required for insurance purposes; verify availability with manufacturers because not all products comply.

G. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.02 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fire-End & Croker Corporation.
    b. GMR International Equipment Corporation.
    c. Guardian Fire Equipment, Inc.
    d. JL Industries, Inc.; a division of the Activar Construction Products Group.
    e. Larsens Manufacturing Company.
    f. Modern Metal Products, Division of Technico Inc.
    g. Nystrom, Inc.
    h. Potter Roemer LLC.
    i. Strike First Corporation of America.

B. Cabinet Construction: As designated by location.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined

with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Stainless-steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop or drywall bead.

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Coordinate cabinet trim material in "Cabinet Trim Material" Paragraph below with door construction. These materials are available for both nonrated and fire-rated cabinets. Delete below if no trim.

H. Cabinet Trim Material: Same material and finish as door.

I. Door Material: Stainless-steel sheet.

J. Door Style: Vertical duo panel with frame.

K. Delete "Door Glazing" Paragraph below if retaining only solid opaque panel in "Door Style" Paragraph above.

L. Door Glazing: Tempered float glass (clear).

M. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.

2. Continuous hinges in subparagraph below are most common. Concealed hinges are used for flush panel doors. Pivots are sometimes used for fully glazed, frameless acrylic doors; verify availability with manufacturers.

3. Provide continuous hinge, of same material and finish as trim, concealed hinge permitting door to open 180 degrees.

N. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

2. Retain "Break-Glass Strike" Subparagraph below if retaining break glass, tempered break glass, or break bubble.

3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

i. Location: Applied to cabinet door.
ii. Application Process: Pressure-sensitive vinyl letters.
iii. Lettering Color: Red.
iv. Orientation: Vertical.

O. Materials:

1. Stainless Steel: ASTM A 666, Type 304.

a. Finish: No. 4 directional satin finish.

2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.03 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.
b. Amerex Corporation.
c. Ansul Incorporated.
d. Badger Fire Protection.
e. Buckeye Fire Equipment Company.
f. Fire End & Croker Corporation.
g. Guardian Fire Equipment, Inc.
h. JL Industries, Inc.; a division of the Activar Construction Products Group.
i. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
j. Larsens Manufacturing Company.
k. Moon American.
l. Nystrom Building Products.
m. Pem All Fire Extinguisher Corp.
n. Potter Roemer LLC.
o. Pyro-Chem; Tyco Safety Products.

p. Strike First Corporation of America.

2. Handles and Levers: Stainless steel.

3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B**,** and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. In retained paragraphs below, insert drawing designation. Use these designations on Drawings to identify each product.

C. Retain one or more of first three paragraphs below for stored-pressure water-type extinguishers. Potential for freezing exists with all types. Retain second paragraph if freeze potential is high.

D. Retain one or more of first four paragraphs below for regular dry-chemical-type extinguishers.

E. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

2.04 MOUNTING BRACKETS

A. Insert drawing designation. Use these designations on Drawings to identify each product.

B. Mounting Brackets: Manufacturer's standard[**galvanized**] steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Ansul Incorporated.
c. Badger Fire Protection.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. Guardian Fire Equipment, Inc.
g. JL Industries, Inc.; a division of the Activar Construction Products Group.
h. Larsens Manufacturing Company.
i. Nystrom Building Products.
j. Potter Roemer LLC.
k. Strike First Corporation of America.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

2.05 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.

2. Provide factory-drilled mounting holes.

3. Prepare doors and frames to receive locks.

4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.

2. Fabricate door frames of one-piece construction with edges flanged.

3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.06 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

A. General: Install fire-protection cabinets, fire extinguishers and mounting brackets in locations and at mounting heights indicated and in compliance with requirements of authorities having jurisdiction.

1. According to NFPA 10, maximum mounting height for fire extinguishers weighing 40 lb (18 kg) or less is 60 inches (1524 mm); for those weighing more, it is 42 inches (1067 mm).
2. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
3. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Retain subparagraph below if Project includes fire-rated hose and valve cabinets or hose-valve cabinets.
5. Fire-Rated Cabinets:
    a. Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Center pipe within knockout.
    b. Seal through penetrations with firestopping sealant as specified in Section 07841 "Through-Penetration Firestop Systems."

C. Identification: Apply vinyl lettering at locations indicated.

D. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.04 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 11201
STAINLESS STEEL SLIDE GATES AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE

A. The work covered by this section includes furnishing all labor, materials, equipment and incidentals as shown on the Drawings, specified herein and required to supply and install fabricated heavy duty stainless steel slide gates, complete with slides or gate discs, frames,, seals, operating stems, manual operators and all appropriate appurtenances in full conformance with the Contract Drawings and as specified herein. Refer to Table 11201-1 for a Stainless Steel Slide Gate Schedule for this Project.

B. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the Drawings, specified herein or otherwise required for a complete, properly operating installation.

1.02 DESIGN REQUIREMENTS

A. Gate Manufacturer Qualifications

1. Manufacturer of fabricated heavy duty stainless steel slide gates shall have a minimum of 15 years of experience in the production of substantially similar size and type equipment in the United States, and shall show evidence of satisfactory operation in at least 100 project installations. Fabricated stainless steel gates and operators shall be the products of a manufacturer regularly engaged in the production of fabricated gates. The gate manufacturer's plant fabricating the gates shall be ISO 9001 certified.

2. The gate manufacturer shall assume unit responsibility for all items specified in this section. Unit responsibility shall require that all items be products of, or warranted by, the manufacturer. The gate manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance and certifications on the equipment as a unit.

3. Slide gates shall be the product of one manufacturer.

4. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

B. General Design Criteria

5. The safety factors that shall be used in the design of all heavy duty slide gates shall be as follows: Working stresses shall not exceed the lower value of the one-third of the yield strength or one-fifth of the ultimate strength of the material. The gates and appurtenances shall be designed for installation in the structures as shown on the Drawings.

6. All work shall be performed in accordance with the best modern practice for the manufacture of high-grade machinery. All parts shall conform accurately to the design dimensions and shall be free of all defects in workmanship or material that will impair their service. The gates shall be completely shop assembled to ensure the proper fit and adjustment of all parts.

7. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which they are to be subjected.

8. All materials shall be of a quality to withstand the corrosion, abrasion and stresses to which this equipment will be subjected during fabrication, erection and continuous operation.

9. The gate sealing system shall have been factory tested on similar type gates to confirm negligible wear (less than 0.01") and proper sealing. The factory testing shall have consisted of an accelerated wear test of a similar gate design comprised of a minimum of 10,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

10. Gate Leakage Requirements:

    a. Gates used for flow control conditions, leakage shall not exceed 0.05 gallons per minute (gpm) per foot of seating perimeter for slide gates in a seating head condition or 0.10 gpm per foot of seating perimeter for slide gates in an unseating head condition.
    b. Gates used for isolation conditions, leakage shall not exceed 0.05 gallons per minute (gpm) per foot of seating perimeter for slide gates in a seating or unseating head condition.

11. The slide gates shall not deflect more than 1/720 of the span of the gate under design head measured from water surface to mid-height of gate.

12. Manual operators shall turn right (clockwise) to close, unless otherwise specified. Operators shall indicate the direction of operation.

13. Bolts, studs, cap screws, and adjusting screws shall be of ample section to withstand the force created by operation of the gate under a full head of water.

14. Downward opening gates shall be capable of being lowered to an elevation below the invert of the channel or opening.

15. Slide gates shall open to not less than 6-inches above the maximum water level in the channel in which they are installed.

16. Slide gates shall be supplied in accordance with the Slide Gate Schedule, Table 11201-1, as specified in these Specifications. The schedule shall be verified by the Contractor against the Drawings.

B. Design Standards: Fabricated Stainless Steel Slide Gates shall be designed and manufactured in accordance with the requirements of AWWA C561, latest revision, except as modified or supplemented herein.

C. Shop Tests

1. Shop test each slide gate, fully assembled for proper seating.

2. Prior to shipment, all wall mounted or thimble mounted gates shall be hydrostatically tested for leakage at the factory or the manufacturer's testing facility, under unseating head conditions to verify that the gates are in compliance with the maximum leakage specified above in Article 1.02.B.6. Embedded frame gates shall be hydrostatically tested for leakage in the field following installation as specified below in Article 3.02.B.4.

3. Fully open and close slide gate in its guide system to ensure that it operates freely.

4. Operate and test floor stands and bench stands to ensure proper assembly and operation.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following in accordance with Section 01300 - Submittals. Shop drawings for fabricated slide gates shall be prepared and assembled by the approved manufacturer. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted. Submittals for fabricated slide gates shall include the following:

1. Certified fabrication, assembly and installation drawings and diagrams. Shop drawings shall include a complete description of all materials including the material thickness of all structural components of the frame and slide. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations.

2. Provide the maximum bending stress and deflection of the slide under the maximum design head for each slide gate.

3. Manufacturer's literature, illustrations, specifications and engineering data.

4. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

5. Copies of AWS welding certificates for welders performing welds for fabrication of gates and frames.

6. Wiring diagrams for electric motor actuators.

7. Submittals shall clearly identify the location, method of installation and type of operator for each slide gate to be provided.

B. Field Test Results: Submit a written report giving the results of the field tests required.

C. Operation and Maintenance Manuals

1. Submit complete manuals including copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare

parts information and a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operating and Maintenance Data.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Fabricated slide gates shall be stored and protected in accordance with the requirements of Section 01600 of these Specifications, in addition to the following.

B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

C. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted thereto.

D. Each box, crate or package shall be properly marked to show its net weight in addition to its contents.

E. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete in ample time to not delay the Work.

F. Handle and protect all slide gates and appurtenances properly during delivery, storage and installation in a manner to prevent damage of any nature, in strict accordance with manufacturer's recommendations. Slide gates that are distorted or otherwise damaged will not be acceptable. Protect all bolt threads and ends from damage.

G. Store materials to permit easy access for inspection and identification. Keep stainless steel members off the ground using pallets, platforms or other supports. Protect stainless steel members and packaged materials from corrosion and deterioration.

H. Store all mechanical equipment in covered storage off the ground and prevent condensation.

1.05 QUALITY ASSURANCE

A. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

B. The gate manufacturer shall provide unit responsibility for all items specified in this section. Unit responsibility shall require that all items be products of, or warranted by, the gate manufacturer. The gate manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance, and certification on the equipment as a unit.

1.06 WARRANTY AND GUARANTEES

A. The Contractor shall provide a warranty against defective materials and workmanship in accordance with the requirements of Section 01730 of these Specifications. The Contractor shall warrant trouble-free operation for a period of not less than one year, which shall commence from the date of final written acceptance by the Owner. The

equipment shall be warranted during the one year period to be free from defects in workmanship, design and materials, specifically including leakage and sticking due to corrosion. If any part of the equipment should fail during the warranty period, it shall be replaced at no expense to the Owner.

B. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period regardless of when the equipment was shipped. No exception to this provision shall be allowed.

C. In addition to the one year Contractor's warranty period, the fabricated gate manufacturer shall warrant each fabricated gate being supplied to the Owner against defects in workmanship and materials for a minimum period of 24 months from the date of Final Acceptance by the Owner, under normal use, operation, and service, up to a maximum of 36 months from the date of delivery to the job site. This warranty shall be held in effect regardless of pre-commissioning conditions in a typical indoor or outdoor environment as long as the fabricated gates have not been abused or disassembled.

D. The fabricated gate manufacturer shall also provide factory-authorized service and parts stock either within the state of Florida or at other locations within the United States available to ship to the job site within 24 hours of notification by the Owner. The factory-authorized service center's location and the telephone number shall be indicated in the shop drawing submittal and the O&M manuals for the gates

PART 2 - **PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

A. Fabricated stainless steel slide gates shall be provided by one of the following:

1. Fontaine - Aquanox.
2. Hydro Gate.
3. Rodney Hunt.
4. Waterman Industries, Inc.
5. Whipps.

2.02 FABRICATED STAINLESS STEEL SLIDE AND WEIR GATES

A. Gates shall be constructed of the following materials unless noted otherwise:

Component:	Material:	Specification:
Slide, Reinforcing Stiffeners, Frame Assembly, Rails, Stem Guides / Brackets, Yoke, Stem Extension, Retainers, Wall Thimbles	Type 316L Stainless Steel	ASTM A 240, Type 316L
Side Seals, Top Seals, Weir Gate Bottom Seals, Stem Guide Bushings, Stem Guide Liner	Ultra High Molecular Weight Polyethylene, (UHMWPE)	UHMWPE - ASTM D 4020

Compression Cord	EPDM	ASTM D 2000, M6BG 708, A14, B14, E014, E034
Sluice and Channel Gate Bottom Seal	EPDM	ASTM D 2000 Grade 2, BC-510
Threaded Stems, Pinion Shafts	Type 316 Stainless Steel	ASTM A 276, Type 316
All bolts, studs, cap screws, adjusting screws, anchors and other fasteners	Type 316 Stainless Steel	ASTM F 593 and 594, Type 316-GR2
Pedestal, Wall Brackets	Type 316L Stainless Steel	ASTM A 276, Type 316L
Crank and Handwheels	Cast Aluminum, Cast Type 316 Stainless Steel or Fabricated Type 316 Stainless Steel	
Handwheel Operator or Crank Operator Gear Housing	Cast Aluminum	
Frame-to-Wall Gasket	EPDM, Nylon Reinforced	ASTM D 1418 or 1056
Stem Cover	Polycarbonate or Clear PVC	ASTM D 3935
Lift Nut, Couplings	Manganese Bronze	ASTM B 584

B. All welds for gate and frame fabrication shall be performed by welders with AWS certification. All welds shall be continuous. No stitch welding shall be allowed.

C. Mill finish shall be provided on stainless steel. Welds shall be sandblasted or cleaned to remove weld burn and scale in accordance with ASTM A380 and SSPC SP10.

D. Stainless Steel. All stainless steel shall be pickled in accordance with ASTM A380 at the mill before being shipped. Pickling shall produce a modest etch and shall remove all embedded iron and heat tint. After fabrication, pickled surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron. All pickled surfaces damaged during fabrication including welded areas shall be re-pickled or passivated in accordance with ASTM A380 to remove all traces of iron contamination. All stainless steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination from iron or carbon steel objects or surfaces.

E. Frame shall consist of the structural frame, guide/seal retainer angles and yoke. Frame shall be fabricated from structural members or plate, welded into a one-piece structure for rigidity, with a flange back configuration. Frame flange shall be suitable for mounting directly to a flat concrete face, or embedded thimble, as shown on the Drawings. Gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned to ensure that the load is transferred to the anchor bolts or the wall thimble studs. The frame shall extend to accommodate a minimum of two thirds of the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening weir gates. Frame shall include a rigid stainless steel invert member across the bottom of the opening which shall be the flush-bottom type configuration for upward opening gates, with provision for replacement of top, side and invert seals, in-place. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings. A rigid stainless steel member shall be provided across the invert of the opening on downward opening weir gates. All

structural components of the frame and slide shall have adequate strength to prevent distortion during normal handling, during installation and while in service. All metal components for gate parts shall have a minimum thickness of 1/4-inch.

F. The slide shall be a reinforced plate, designed to withstand the seating and unseating heads as shown in Table 11201-1 at the end of this Section. Design shall limit slide deflection to 1/720 of the gates span under design head. Slide shall have plate or channel stiffeners welded to the slide to provide the required deflection strength. A bolted bracket shall be attached to the upper slide frame member to attach the operating stem end. Attachment of the stem shall be by a heavy pin, locked into the bracket. Alternatively, a thrust nut pocket and thrust nut may be used.

G. Guides and seals shall be designed to limit perimeter leakage rate to the AWWA C561 standard and as specified above in Article 1.02.B.6. Perimeter seal shall be a formed UHMWPE sealing against the slide faces that allows no metal to metal contact between frame and slide, and has a friction coefficient of 0.2. Guide configuration shall assure smooth, low resistance movement between slide and frame, and prevent racking of the slide during operation. Seals shall be mounted so as not to obstruct the waterway opening. Guides shall extend beneath the opening a sufficient amount to support the disc in the fully down or open position for downward opening gates and shall extend above the channel to support the full height of the disc when the gate is fully up or open position for upward opening gates. The seals shall be self-adjusting using a continuous compression cord or pad, or a stainless steel seal retaining bar which shall compress the seal against the slide surface, ensuring a tight seal between the frame and the slide in both seating and unseating conditions. Gates using "J" or "P" type seals shall not be acceptable. Guide design shall support at least two-thirds of the slide vertical height in the fully-open position. Top and side guides/seals for channel slide gates and, side and bottom guides/seals for downward opening weir gates, shall be mechanically retained with stainless steel retainers/retaining bars between the frame and retainer angles to lock the seals in place. The flush bottom seals for channel slide gates shall be made of resilient neoprene held in place with adhesives or stainless steel attachment hardware. For bolted on gates, the gasket between the frame and the concrete wall shall be made of reinforced EPDM.

H. A stainless steel angle shall be welded to the guides across the invert of the opening on face mounted gates and up both sides of all gates.

I. The invert of embedded unit frames shall have an angle welded to the lower ends of the guides to incorporate a flush bottom seal that is attached to the bottom of the frame invert. Seals attached to the slide or disc shall not be acceptable.

J. For self-contained slide gates, a yoke shall be provided across the top of the frame for mounting of the lifting device. The yoke shall be formed by two structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed with sufficient strength to take the full thrust created by operating the gate under the maximum specified head with a maximum deflection of 1/720 of the full span of the yoke. The yoke shall be designed to be bolted or welded

to the frame members to allow removal of the gate slide and stem without disconnecting the yoke.

K. The frame, guides, yoke and slide shall be designed for a minimum safety factor of 5 with regard to tensile, compressive and shear strength.

L. Fasteners: All anchor bolts, assembly bolts and nuts shall be of ample section to safely withstand forces created by operation of the gate. All bolts and nuts for slide gates shall have hexagonal heads. Quantity and size shall be recommended by the manufacturer. Anchor bolts shall be furnished with two nuts each to attach gates to concrete.

2.03 STEMS AND STEM RELATED COMPONENTS

A. An operating stem shall be utilized to connect the operating mechanism to the slide. The threaded portion of the stem shall engage the operating nut in the manual operator or motor actuator. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a minimum tensile strength of not less than 80,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a minimum tensile strength of 75,000 psi.

B. Operating stems shall be of a size to safely withstand, without buckling or distortion, the stresses induced by normal operating forces in accordance with AWWA C561. The stems shall be designed based on the Euler Formula to transmit, in compression, at least twice the rated output of the floor stand or bench stand with a 40 lb. effort on the crank or handwheel. Operating stems shall be designed to withstand the tension load caused by the application of a 40 lb. effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material. Where an electric motor actuator is used, the stem design force shall not be less than 1.50 times the output thrust of the electric motor actuator in the stalled condition.

C. The stem shall be threaded to allow full travel of the slide. The stem shall be constructed of solid stainless steel bar for the entire length. Stem extension pipes or tubes shall not be acceptable. All stems shall have a slenderness ratio (L/R) of less than 200. The threads engaging the operator stem nut shall be full or stub Acme-type, machine-rolled or machine-cut with a minimum 16 micro-inch finish or better.

D. Multi-section stems shall be coupled with solid stainless steel couplings. Couplings shall be grooved, keyed and bolted, as required, to the stem to provide a solid mechanical connection, which shall be of greater strength than the stem.

E. Provide adjustable stop collars on the stem to prevent over-travel in both the open and closed position.

F. Stem guides shall consist of a wall-mounting bracket, adjustable in two directions, and stem bushing bracket, joined by slotted holes. Wall brackets shall be designed to bolt to the structure wall, providing adjustable spacing between the wall face and stem bushing. Stem bushings shall be replaceable bronze or UHMW polyethylene and contained in a stainless steel cartridge bolted into the guide bracket. Stem guides shall be provided to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less. Guide spacing shall be in accordance with the manufacturer's

recommendations, but no more than 8-feet on-center, unless required for full gate travel.

G. Provide a clear Lexan or butyrate plastic pipe stem cover with Mylar position indicator strip for each stem. Covers shall be furnished with a cast or fabricated stainless steel adapter for mounting covers to floor stands. Stem covers shall be designed and furnished with gasketed, vented breathers and a watertight cap to eliminate water intrusion into operators and condensation within covers. Position indicating tape shall be applied to the stem cover after the gate is installed to provide accurate position indication. At a minimum the gate positions for full closed, 1/4 open, 1/2 open, 3/4 open and full open shall be indicated on the stem cover.

H. Gates with a width greater than 60 inches or greater than two times the height shall have two interconnected lifting mechanisms.

2.04 WALL THIMBLES

A. Wall thimbles shall be welded stainless steel construction, fabricated and drilled to mate with the gate flanges. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be cast. Thimbles shall be required where shown in Table 11201-1. Thimbles shall be provided with a seal welded waterstop collar located at the midpoint of the embedded portion of the thimble around the entire periphery of the thimble to seal against leakage between the thimble and surrounding concrete. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation. Grout holes shall be provided as necessary to prevent air entrapment on any horizontal surfaces greater than 18-inches. Thimble material thickness shall be sufficient to support the gates without deflection and to resist all operating forces.

B. Wall thimbles shall be constructed of 1/4-inch minimum thickness stainless steel and the front face shall have a minimum thickness of 1/4–inch after machining. The fabrication process shall ensure that the wall thimble is square and plumb and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.

C. A suitable neoprene gasket, minimum 1/8-inch thick, shall be provided to seal between the gate frame and the wall thimble. Fasteners used to mount gate to thimble shall be as described above in Article 2.02.

2.05 MANUAL OPERATORS AND FLOOR STANDS

A. Manual operation shall be by handwheel, minimally 24-inches in diameter or crank-operated floor stands or bench stands as shown on the Drawings and as indicted in Table 11201-1. Handwheel operated type shall be without gear reduction; crank-operated type shall have either a single or double gear reduction, depending upon the lifting capacity required. Handwheel operators or crank operated gear box housings shall be fully enclosed and shall have a cast aluminum housing. Each type shall be provided with a threaded, cast bronze lift nut to engage the operating stem.

B. Dual Actuators. Dual actuators shall be provided where indicated in the gate schedule. Dual actuators shall be interconnected by a cross shaft complete with required couplings so both stems move at the same rate. Each cross shaft shall be

protected by a full length removable stainless steel cover attached to the yoke beam or actuator.

C. Gears shall be steel with machined cut teeth designed for smooth operation. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings. Tapered roller bearings or ball thrust bearings with lubrication fittings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts. Positive mechanical seals, to retain lubricant and exclude moisture and dirt, shall be provided on the operating nut and the pinion shafts where they extend from the stainless steel case or gear box. Lubricating fittings shall be provided for the lubrication of all operator gears and bearings.

D. The gate manufacturer shall select the proper gear ratio for the gate operator to ensure that the maximum operating effort shall not exceed 40 pounds pull on the crank or handwheel when the gate is in the closed position and experiencing the maximum operating head. The gate operator shall be designed to withstand, without damage, a force of 80 pounds pull on the handwheel or crank. Operator shall be located approximately 36-inches above the operating floor, mounted with sidewall brackets of ASTM A276 Type 316L stainless steel, as required or with a floor stand mounted directly to the floor slab. A cast iron gear housing shall be provided with either a removable crank or a handwheel as indicated in Table 11201-1. The removable crank shall be either cast aluminum or fabricated or cast Type 316 stainless steel with a revolving stainless steel grip on the crank. The handwheel shall be removable and either cast aluminum or fabricated or cast of Type 316 stainless steel. An arrow with the word "OPEN" shall be permanently attached or cast on the floor stand or operator indicating the direction of rotation to open the gate.

E. Floor operator pedestal floor stands shall be fabricated from ASTM A276 Type 316L stainless steel. The pedestal floor stand height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36-inches above the operating floor.

F. Wall brackets shall be used to support pedestal floor stands where shown on the Drawings and shall be constructed of ASTM A276 Type 316L stainless steel. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 40 lb. effort on the crank or handwheel. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the Engineer. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.

G. For self-contained type gates, the distance between handwheel or crank operator and the operating floor shall be 36-inches minimum to 42-inches maximum.

H. Where indicated on the Drawings and in Table 11201-1, the operator shall be floor mounted with a skirted 2-inch square nut operator and with a non-rising gate stem.

2.06 ELECTRIC MOTOR ACTUATORS

A. Electric motor actuators shall comply with the requirements of Section 11205 of these Specifications. Electric motor actuators shall be provided by the slide gate manufacturer with the gate as a complete assembly.

B. A front mounted gate operator gear drive system utilizing right angle bevel gear boxes, 316 stainless steel interconnecting shafting, and flexible couplings shall be furnished by the gate manufacturer when the stem drive is located over 42-inches above the operating floor. The transmission system design shall provide for the electric motor actuator for the gate to be operated from a position of 36- to 42-inches above the operating floor.

C. Bevel gear reducer boxes for the gate operator transmission system shall be provided with Type 316 stainless steel pinion shafts supported on roller bearings. A mechanical seal shall be provided around the pinion where it extends from the bevel box enclosure.

D. The gear reducer boxes shall be supported from and attached to the gate frame by 316 stainless steel reinforced support brackets. Anchoring hardware shall be Type 316 stainless steel.

E. The electric motor actuator for the gate shall be attached to a reinforced support bracket fabricated of Type 316 stainless steel, which is attached to the front of the gate frame. Bolting hardware for the bracket and the electric actuator shall be Type 316 stainless steel.

2.07 ANCHORS AND BOLTING HARDWARE

A. Anchors and bolting hardware shall be provided by the gate manufacturer for mounting the gates and appurtenances to concrete walls or bolting hardware to mount the gates to wall mounted brackets.

1. Quantity, size and location of anchors and bolting hardware shall be determined by the gate manufacturer.

2. Epoxy-type anchors shall be provided.

3. Anchors shall be of ample length and diameter to safely withstand all forces expected to be created by operation of the gate, with a minimum safety factor of 1.5. The minimum diameter for anchors shall be 1/2-inch.

4. All bolts and nuts for slide gates shall have hexagonal heads. Anchors shall be furnished with two nuts each to attach gates to concrete.

PART 3 - **EXECUTION**

3.01 INSTALLATION

A. Slide gates and appurtenances shall be installed as shown on the Drawings and/or specified herein, and in strict accordance with the manufacturer's written installation instructions and Drawings.

B. Gates and appurtenances shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the gate for maintenance.

C. Gates shall be installed so that frame members and anchor bolts do not rest upon or contact steel reinforcing bars. Anchor bolts shall be set using a template.

D. All anchors shall be set in accordance with approved manufacturer's drawings. All bolts shall be tightened and all items requiring lubrication, including pivot pins, shall be lubricated. Anti-seize thread lubricant shall be liberally applied to the threaded portion of stainless steel anchor bolts during the installation and tightening of nuts. Excess lubricant shall be thoroughly removed following final tightening.

E. Slide gate frames and plates shall be checked, prior to installation, for projections or warpage that would promote excessive leakage. Defective gates and plates shall be removed and replaced.

F. Each fabricated stainless steel slide gate shall be carefully installed and adjusted for proper operation. Each gate shall be adjusted so that it does not bind or leak in excess of specified requirements. Slide gate frames shall be installed in a true vertical plane, square and plumb, with 90 degree corners to the lines and elevations shown and accurately aligned and adjusted for correct operation. Frames shall be internally braced and adequately supported during concrete placement and/or installation. Care shall be taken to avoid warping the gate frames and to maintain tolerances between seating faces.

G. Wall thimbles, if required, shall be accurately positioned and supported to prevent shifting during placement of surrounding concrete. Square or rectangular thimbles shall be carefully braced both horizontally and vertically to prevent distortion. Install the neoprene gasket, provided by the gate manufacturer, between the gate frame and wall thimbles in accordance with the manufacturer's instructions.

H. Any voids between the gate frame and existing concrete walls shall be filled with non-shrink grout as shown on the installation drawings and in accordance with the manufacturer's recommendations. Grout fill shall be placed in the pit in front of each flush bottom closure gate after the gate has been adjusted. For bolted on gates, install the reinforced EPDM gasket, provided by the gate manufacturer, between the gate frame and the concrete wall.

I. Each actuator shall be accurately set and plumbed and shall be in proper alignment with the gate and stem before the actuator is grouted in place. Operating stems shall be installed in proper alignment and shall not bind in the lift nut or stem guides.

J. Provide minimum of 1-inch of non-shrink grout under all floor stands.

K. Limit switches for electric actuators shall be adjusted following a complete installation of the slide gate in strict accordance with the actuator manufacturer's written installation instructions.

3.02 INSPECTION AND FIELD TESTING

A. Following installation, operating tests will be performed to demonstrate to the Owner and the Engineer that all slide gates will perform in a satisfactory manner and that all items of equipment are in full compliance with this Section. The Contractor shall make, at Contractor's expense, all necessary modifications, changes and/or adjustments required to ensure satisfactory operation.

B. After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service

representative of the manufacturer shall conduct a functional field test and a leakage test of each slide gate in the presence of Engineer.

1. Functional Tests: Each slide gate with appurtenances shall be field tested. Tests shall demonstrate to Engineer that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by Contractor at his expense.

2. Each gate shall be operated through at least two complete open/close cycles to confirm that it operates without sticking, binding, scraping, or distorting. The effort to open and close manual operators shall be measured using a torque wrench or other similar measuring device, and shall not exceed the maximum operating effort specified above.

3. Electric motor actuators shall function smoothly and without interruption.

4. Leakage Tests: Each gate shall be water tested by the Contractor to confirm that leakage does not exceed the specified allowable leakage. Maximum permissible leakage shall be in accordance with the Design Requirements as stated in Article 1.02. Excessive leakage shall be reduced to meet specified requirements by adjusting or modifying the gate and seals per the manufacturer's instructions and re-testing the gates for leakage as often as necessary to meet the specified requirements, at no additional cost to the Owner.

C. Deficient equipment will be rejected. If gates, operators and appurtenances do not meet the specified requirements after corrective measures have be attempted by the Contractor, the equipment shall be removed and replaced with equipment that satisfies the conditions specified and tested to verify compliance. Replacement and retesting of defective equipment shall be made at no additional cost to the Owner.

3.03 MANUFACTURER'S REPRESENTATIVE SERVICES

A. The Contractor shall provide the services of a trained, competent, qualified and experienced factory-employed field representative during inspection, testing and start-up of the equipment and for instruction of the Owner's personnel in the proper operation and maintenance of the equipment. Factory personnel are required for this start-up and training. Manufacturer's sales representatives are not deemed acceptable to provide the start-up service. The factory representative shall have a complete and full knowledge and experience in the installation, start-up procedures, and proper operation and maintenance of the slide gates and weir gates. The services of the factory technician shall be provided as follows:

1. Three (3) separate trips and a total of four (4) 8-hour days of service to inspect and certify the installation prior to startup, conduct check-out and start-up services, and instruct the Owner's operation and maintenance personnel in proper operation and maintenance of the equipment.

    a. One, 8-hour day during the installation phase of the slide gate and electric actuator equipment for consultation to the Contractor,

b. Two, 8-hour days to inspect the final installation and supervise the Contractor's personnel to check-out of the completed installations, perform initial start-up of the slide gate and electric actuator equipment and perform the functional testing of the slide gate systems.

c. One, 8-hour day to instruct the Owner's personnel in the proper operation and maintenance of the slide gate and electric motor actuator equipment in accordance with a training schedule approved by the Owner.

2. Upon completion of his work, the manufacturer's field service technician shall submit to the Engineer, six (6) copies of a written report for the fabricated slide gates installed, as a result of his inspection, adjustments, corrections, repairs, start-up and testing. The report shall include descriptions of the inspection, adjustments, corrections and repairs made, testing and start-up, and training of the Owner's personnel. The report shall also include a notarized certification signed by the manufacturer's field service technician that each installed fabricated slide gate:

   a. Has been installed and lubricated per manufacturer's requirements.
   b. Has been accurately aligned, set and leveled and proper clearances set.
   c. Is free from undue stress imposed by mounting bolts or setting.
   d. Each fabricated slide gate has been tested and is in conformance with nominal operating parameters and leakage requirements. Test procedures and results shall be included in the report.
   e. Each fabricated slide gate is ready for permanent operation on a continuous basis, is free from any known defects and that nothing in the installation will render the manufacturer's warranty null and void.

3. The Contractor's attention is directed to the fact that the services specified for the manufacturer's field service technician represent an absolute minimum acceptable level of service, and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. The Contractor shall procure, at no additional cost to the Owner, all services required, including additional or extended visits to the jobsite by manufacturer's representatives, to comply with said requirements.

3.04 CLEANING

A. Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with the requirements of Section 01710 of these Specifications.

TABLE 11201-1

STAINLESS STEEL SLIDE GATE SCHEDULE

Gate Tag No.	Location	Opening Direction	Size W x H, inches*	Operator Type	Elevation C.L. Gate	Elevation Operating Floor	Maximum Head, feet			Flow Control or Isolation	Top Seal Required Yes / No	Frame Type	Thimble Type
							Seat	Unseat	Operating				
SG-16	Screen Channel No. 1	Up	48-in by 96-in	G, NRS SQ NUT	75.71	93.48	4.00	3.50	7.80	Isolation	No	SC, FB, EMF	N/A
SG-17	Screen Channel No. 2	Up	72-in by 96-in	G, NRS SQ NUT	75.71	93.48	4.00	3.50	7.80	Isolation	No	SC, FB, EMF	N/A
SG-18	Screen Channel Outlet Box Discharge Pipe No. 1	Up	63-in by 63-in	G, RS, P, SM-HW	74.34	93.50	4.80	3.41	7.50	Isolation	Yes	FB, WMF	N/A
SG-19	Screen Channel Outlet Box Discharge Pipe No. 2	Up	63-in by 63-in	G, RS, P, SM-HW	74.34	93.50	4.80	3.41	7.50	Isolation	Yes	FB, WMF	N/A
SG-20	Screen Channel Outlet Box Discharge Pipe No. 3	Up	63-in by 63-in	G, RS, P, SM-HW	74.34	93.50	4.80	3.41	7.50	Isolation	Yes	FB, WMF	N/A
SG-21	Influent PS Isolation Box Influent Pipe No. 1	Up	63-in by 63-in	G, RS, P, SM-HW	74.13	93.50	3.70	5.00	6.25	Isolation	Yes	FB, WMF	N/A
SG-22	Influent PS Isolation Box Influent Pipe No. 2	Up	63-in by 63-in	G, RS, P, SM-HW	74.13	93.50	3.70	5.00	6.25	Isolation	Yes	FB WMF	N/A
SG-23	Influent PS Isolation Box Influent Pipe No. 3	Up	63-in by 63-in	G, RS, P, SM-HW	74.13	93.50	3.70	5.00	6.25	Isolation	Yes	FB WMF	N/A
SG-24	Influent PS Wetwell Channel No. 1	Up	96-in by 96-in	G, DOS, RS, MO	75.50	93.50	2.25	2.00	6.25	Isolation and flow control	No	FB, WMF	N/A
SG-25	Influent PS Wetwell Channel No. 2	Up	96-in by 96-in	G, DOS, RS, MO	75.50	93.50	2.25	2.00	6.25	Isolation and flow control	No	FB, WMF	N/A
SG-26	Screen Channel No. 3	Up	48-in by 96-in	G, NRS SQ NUT	75.71	93.48	4.00	3.50	7.80	Isolation	No	SC, FB, EMF	N/A
SG-27	Screen Channel No. 4	Up	72-in by 96-in	G, NRS SQ NUT	75.71	93.48	4.00	3.50	7.80	Isolation	No	SC, FB, EMF	N/A
SG-28	Screen Channel No. 5	Up	48-in by 96-in	G, NRS SQ NUT	75.71	93.48	4.00	3.50	7.80	Isolation	No	SC, FB, EMF	N/A

* Operating or nominal size without allowance for frame
C.L. = Centerline

Frame Types
FL = Flange Back
FT = Flat Back, Surface-Mounted (See Drawings for Bottom)
SC = Self Contained
FB = Flush Bottom
EMF = Embedded Frame, Sides and Bottom
WMF = Wall Mounted Frame

Thimble Type
ETR = Rectangular E-Section Thimble
FTS-PB = F-Section, Square to Pipe Bell Thimble
FTS-R = F- Section, Square to Round Thimble
FTW = Weir F-Section Thimble

Gate Types
SG = Slide Gate
WG = Weir Gate

Operator Types
SM-HW = Side-Mounted Handwheel Operator
CR = Crank Operated, Side-Mounted

G = Geared
P = Pedestal Operator
NG = Non-Geared
HW = Top-Mounted Handwheel Operator
MO = Motor Operated
SQ NUT = 2" Square Nut Operator

Stem Operation
RS = Rising Stem
NRS = Non-Rising Stem
DOS = Dual Operating Stems

NOTES:

1. "Seat" under "Maximum Head (feet)" in the Gate Schedule shall be defined as feet of water as measured from the approximate gate disc centerline to water surface that exerts a seating pressure of gate disc onto seals or seats.

2. "Unseat" under "Maximum Head (feet)" in the Gate Schedule

3. "Operating" under "Maximum Head (feet)" in the Gate Schedule shall be defined as feet of water under which the gate must be opened or closed.

4. The information shown within the Gate Schedule does not substitute or relieve the manufacturer from examining the Drawings for fit and/or interferences with size of the manufacturer's structural gate frames and members that the manufacturer shall use.

END OF SECTION

SECTION 11205
ELECTRIC MOTOR ACTUATORS

PART 1 - **GENERAL**

1.01 SCOPE

A. Provide all labor, materials, tools, equipment, and related items to furnish and install motorized actuators on slide gates and valves as specified in Tables 11205-1 and 11205-2 of this Specification.

B. All motorized actuators shall be by the same manufacturer. The Contractor shall coordinate this requirement with all valve and slide gate manufacturers.

1.02 DESIGN REQUIREMENTS

A. The valve and gate manufacturers shall be responsible for determining maximum torque requirements of the motorized actuators.

B. Electric motor actuators shall be suitable for either indoor or outdoor use. Motorized actuators shall be of the non-intrusive design housed in a double sealed watertight enclosure rated to IEC Publication 529, IP68 (7 meters, 72 hours). Where indicated in the Tables of this Specification, furnish an explosion proof enclosure in lieu of a watertight enclosure.

C. The motorized actuators shall be suitable for use on a nominal 460 Volt, 3 Phase, 4 wire, 60-Hertz power supply. All controls shall operate on 115 volt AC power and a control power transformer shall be provided within the unit as required.

D. No batteries shall be furnished nor required for full functionality and control of the motorized actuators under normal primary power. All programmable and non-programmable functions for the electronic control, protection and monitoring package for the motorized actuators shall be stored in non-volatile memory not requiring auxiliary battery power for memory retention in the event of a primary power failure. The digital display shall be maintained and updated during hand wheel operation when main power to the actuator is isolated. In the event of a (main) power (supply) loss or failure, the position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities. If batteries are required to maintain contact functionality the actuator vendor shall provide a supply sufficient for 45 continuous days of un-powered operation with one complete valve cycle every hour.

E. The motorized actuators shall be a self-contained units consisting of the following:

1. Electric motor
2. Position encoder
3. Electronic torque sensor
4. Integral reversing starter
5. Electronic control, protection, and monitoring package

6. Manual override hand wheel

7. Valve interface bushing

8. LCD display

9. Local control switches all contained in a sealed enclosure suitable for the enclosure rating specified.

F. All calibration shall be possible without removing any covers.

G. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator.

H. The actuator shall be capable of functioning in an ambient temperature ranging from minus 22°F (-30°C) to + 140°F (+60°C) and a humidity up to 100%.

I. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in Table 11205-1 or Table 11205-2.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following in accordance with Section 01300 of these Specifications. Shop drawings for electric motor actuators shall be prepared and assembled by the approved plug valve and slide gate manufacturer. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted. Submittals for fabricated slide gates and plug valves shall include the following:

1. Certified fabrication, assembly and installation drawings and diagrams. Shop drawings shall include a complete description of all materials. Installation drawings showing all details of construction, details required for installation, dimensions and mounting bolt locations.

2. Manufacturer's literature, illustrations, specifications and engineering data.

3. Wiring diagrams for electric motor actuators.

4. Submittals shall clearly identify the location, method of installation and type of operator for each slide gate or valve to be provided.

5. The manufacturer shall furnish test data from an independent testing agency certifying the enclosure rating.

B. Operation and Maintenance Manuals

1. Submit complete manuals including copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information and a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operation and Maintenance Data.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Electric motor actuators shall be stored and protected in accordance with the requirements of Section 01600 of these Specifications, in addition to the following.

B. Handle during delivery, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved instructions.

C. The Contractor shall store and temporarily support electric motor actuators prior to installation in strict accordance with the Manufacturer's recommendations and instructions. Protect all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.

D. Protect the equipment from being contaminated by dust, dirt, vibration and moisture. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed or during a prolonged storage period at the site and the units and equipment are ready for operation. Electric motor actuators shall be stored in a clean, dry building or trailer, which shall have a concrete or wooden floor, a roof and fully closed walls on all sides, prior to installation.

E. Temporarily connect equipment with built in motor space heaters to a power source and keep heaters in operation. Rotate all shafts that have bearings on at least a monthly basis.

F. Each box, crate or package shall be properly marked to show its net weight in addition to its contents.

1.05 QUALITY ASSURANCE

A. The electric motor actuator manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

B. All technologies and devices used in the electric motor actuators shall have a minimum of five years of commercial operating experience for that specific manufacturer, including torque and position sensing, lubrication, and electrical compartment design. Manufacturer shall provide ten municipal site references in the United States of similar applications in service for five years, including telephone numbers and individual contact names.

C. The valve and gate manufacturers shall provide unit responsibility for all items specified in this section. Unit responsibility shall require that all items be products of, or warranted by, the valve [or gate] manufacturer. The valve and gate manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance, and certification on the equipment as a unit.

D. The manufacturer shall review all Contract Drawings to ensure that installation arrangements are suitable for their equipment. Any potential conflicts or

recommended modifications shall be noted on the shop drawings or by a pre-submittal request for information, if appropriate. Any modifications required to satisfy manufacturer's recommendations or requirements shall be at the Contractor's expense.

1.06 WARRANTY AND GUARANTEES

A. Refer to the General Conditions and Section 01740 for general guarantee and warranty requirements.

B. All equipment supplied under this Section shall be warranted for a period of one year by the Contractor. Warranty period shall commence upon Owner final acceptance as outlined in the General Conditions. The equipment shall be warranted during the one year period to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced at no expense to the Owner.

C. In addition to the one year Contractor’s warranty period, the electric motor actuator manufacturer shall warrant each actuator and gearing being supplied to the Owner against defects in workmanship and materials for a minimum period of 60 months from the date of Final Acceptance by the Owner, under normal use, operation, and service, up to a maximum of 72 months from the date of delivery to the job site. This warranty shall be held in effect regardless of pre-commissioning conditions in a typical indoor or outdoor environment as long as the actuator is not abused or disassembled.

D. The electric motor actuator manufacturer shall also provide factory-authorized service and parts stock within the state of Florida. The factory-authorized service center's location and the telephone number shall be indicated in the shop drawing submittal and the O&M manuals for the actuators.

PART 2 - **PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

A. Approved Electric Actuator Manufacturers: Electric motor actuators shall be as manufactured and provided by one of the following approved manufacturers and actuator manufacturer model number. All valve and gate operators for the Project shall be of the same manufacturer and model series.

1. Rotork Controls; Model IQ Series.

2. Flowserve / Limitorque; Model Accutronix MX.

2.02 ELECTRIC MOTOR ACTUATORS

A. Actuator shall be an electric motor driven gear reducer with integral controls for motorized and manual operation of non-rising stem valves and rising stem gates. The actuating unit shall be mounted on and assembled to the valve or gate. The actuator shall provide multi-turn operation for plug valves and slide gates. All externally-exposed nuts, bolts and other fasteners shall be Type 316 stainless steel. Fasteners

shall be installed with appropriate anti-seize compound to allow subsequent disassembly.

1. The operating speed for gates and valves shall be as specified in Tables 11205-1 and 11205-2 of this Specification.

B. The actuators shall be suitable for use on a nominal 460-volt, three-phase, 60-hertz power supply and are to incorporate motor, integral reversing starter, local control facilities, and terminals for remote control and indication connections. It shall be possible to carry out the setting of the torque, turns, and configuration of the indication contacts without the necessity to remove any electrical compartment covers.

C. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

D. No batteries shall be furnished nor required for full functionality and control of the motorized actuators under normal primary power. All programmable and non-programmable functions for the electronic control, protection and monitoring package for the motorized actuators shall be stored in non-volatile memory not requiring auxiliary battery power for memory retention in the event of a primary power failure. The digital display shall be maintained and updated during hand wheel operation when mains power to the actuator is isolated. In the event of a (main) power (supply) loss or failure, the position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities. If batteries are required to maintain contact functionality the actuator vendor shall provide a supply sufficient for 45 continuous days of un-powered operation with one complete valve cycle every hour.

E. Actuator Sizing: The actuator shall be sized to guarantee gate or valve closure at the specified differential pressure and temperature. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating gates or valves, the operating speed shall be such as to give valve closing and opening at approximately 12 inches per minute unless otherwise stated in Table 11205-1 or Table 11205-2. For 90° valve types the operating time shall be specified.

F. Actuator Motor: The motor shall an integral part of the actuator, designed specifically for valve actuator applications. The electric motor shall be a low inertia, high torque design, AIEE Class F insulated with a Class B temperature rise resulting in a time rating of at least 15 minutes at 104 degrees Fahrenheit (40 degrees Celsius) or twice the valve or gate operation time, whichever is the longer, at an average load of at least 33 percent of maximum valve or gate torque. The motor starting torque shall be equal to 2-1/2 times the running torque. Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control. Electrical and mechanical disconnection of the motor shall be possible without draining the lubricant from the actuator gear case.

G. Motor Protection: Protection shall be provided for the motor as follows:

1. Stall - The motor shall be de-energized in the event of stall when attempting to unseat a jammed valve.

2. Over Temperature - A thermostat shall be provided to cause tripping of the motor to protect against overheating shall sense motor temperature. The motor shall auto-reset upon cooling.

3. Single phasing – Protection shall be provided against a lost phase

4. Direction – Phase rotation correction shall be provided.

H. Gearing:

1. The actuator gearing shall be totally enclosed in an oil-filled gear case suitable for operation at any angle. Grease lubrication shall not be permissible. All main drive gearing must be of metal construction. Where the actuator operates slide or weir gates, sluice gates, gate valves or large diameter ball or plug valves, the drive shall incorporate a lost-motion hammer blow feature. For rising spindle gates or valves, the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator, and the design should be such as to permit the gear case to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service. For 90° operating type of valves or gates, the drive gearing shall be self-locking to prevent the valve or gate back-driving the actuator. Standard SAE80EP or synthetic EP gear oil shall be used to lubricate the gear case.

2. All valves and gates shall incorporate the use of a secondary multi-turn or quarter turn gear. Worm gears shall be constructed in accordance AWWA C517 and shall be IP68 rated continuous duty to 50ft. Test certificates, signed by chief engineer of gear operator manufacturer, must be supplied showing full compliance to AWWA C504/C517.

3. Actuator gearing shall be enclosed in a ductile iron housing with outboard seals to protect the bearings and other internal components. The actuator worm gear drive shaft and the quadrant shall be supported on permanently deep groove ball bearings. Input shaft and fasteners shall be made of Type 316 stainless steel. Gears shall be efficiency optimized 3 stage gear reduction type.

4. Externally adjustable open and closed position travel stops shall be provided. The adjustable closed position stop shall be used to set closing torque and provide adjustment to compensate for change in pressure differential or flow direction. A Type 316 stainless steel position indicator shall be provided.

5. Actuator gears shall incorporate the use of a rotor lock device for back-winding protection to prevent undesired reverse rotation of the gear train at the extents (i.e. fully closed position) of travel when holding a residual applied torque.

6. An Arcor coated steel, removable and repositionable drive sleeve shall be provided. The coating shall be included in the bore and keyway to allow for continuous submersion. An Arcor coated steel input shaft machined from one solid piece of steel. Shall be provided. The coating shall be Amercoat 880 glass flake paint, suitable for a corrosive or a heavy wear environment. Gear operator output shaft shall be splined (multiple keyways). Matching 2" nut shall be supplied for buried valves.

7. Valve gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Valve actuators shall be 90% grease filled. Valve actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals.

8. The actuator gear housing shall have a Type 316 stainless steel tag containing the serial number, gear ratio; number of turns and other data, which shall be permanently affixed to the gear housing for future identification with Type 316 stainless steel rivets or screws. Gears shall be Rotork Model IW-RL-MD-RAW.

I. Hand Operation:

1. A hand wheel shall be provided for emergency operation engaged when the motor is declutched by a lever or similar means; the drive being restored to electrical operation automatically by starting the motor. The hand wheel or selection lever shall not move on restoration of electric motor drive. The hand/auto selection lever should be pad lockable in both "hand" and "auto" positions. It shall be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in "Hand" without damage to the drive train.

2. The hand wheel drive must be mechanically independent of the motor drive, and any gearing should be such as to permit emergency manual operation in a reasonable time. The manual force required shall not exceed 90 lbs. through gate or valve stroke or 180 lbs. through gate or valve seating or unseating. Clockwise operation of the hand wheel shall give closing movement of the valve unless otherwise stated in the Project specifications. For safety purposes, it shall be possible to disengage the electric drive with the declutch lever. This disengagement and any subsequent re-engagement shall not cause any damage to the valve or operator, even with the motor running.

J. Drive Interface Bushing: The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bushing shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base, should be of the sealed-for-life type. The base shall be capable of withstanding five times the rated thrust of the actuator.

K. Torque and Turns Limitations: Torque and turns limitation to be adjustable as follows:

1. Position setting range: 2.5 to 100,000 turns, with resolution to 7.5 degrees of actuator output. Torque setting: 40 to 100 percent rated torque. Measurement of torque shall be from direct measurement of force at the actuator output, either electrically or electronically. Extrapolating torque from measured motor speed, current, flux etc. are not acceptable due to response time.

2. Direct drive part turn actuators: 90 deg. +/-10 deg., with resolution to 0.1 deg. of actuator output.

3. The unit shall continuously monitor valve position and torque. The actuator shall include an adjustable electronic torque sensor to interrupt the motor power circuit when an obstruction is encountered in either direction of travel or when torque seating/unseating of valves or gates is required for tight shut-off. Control of valve position in proportion to a 4-20 mA DC signal shall be accomplished by comparing the command signal to an internal position feedback.

4. A means shall be provided for automatic "torque switch bypass" of the torque sensing system to inhibit torque-off during gate or valve unseating and "latching" to prevent torque switch hammer under maintained or repeated control signals or during starting in mid-travel against high inertia loads.

5. The electric circuit diagram of the actuator shall not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

L. In order to maintain the integrity of the actuator enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers and without mains power providing the option of Infrared or *Bluetooth*® wireless interface. An inexpensive commissioning tool may be used by some manufacturers for non-intrusive calibration and interrogation of the actuator. The tool shall not form an integral part of the actuator and must be removable for secure storage / authorized use. Using this commissioning tool all calibrations may be possible without removing any access covers on the actuator. If provided, this tool will be able to provide speedy interrogation capabilities as well as security in a non-intrusive intrinsically safe watertight casing. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infrared command for maximum security. If provided by the actuator manufacturer, one setting tool will be provided for every three actuators, with a minimum of two setting tools provided for the Project.

M. Remote Valve Position and Actuator Status Indication

1. Eight contacts shall be provided which can be selected to indicate any position of the valve with each contact externally selectable as normally open or normally closed or for any purpose for valve status listed below. The contacts shall be rated at 5 mA to5-ampere, 120-VAC, 30-VDC.

2. Any of the eight above contacts shall be selectable to signal one of the following:

   a. Valve Opening or Closing
   b. Valve Moving (Continuous or Pulsing)
   c. Local Stop Selected
   d. Remote Selected
   e. Open or Close Interlock Active
   f. ESD Active
   g. Motor Tripped on Torque in Mid-Travel
   h. Motor Tripped on Torque Going Open
   i. Motor Tripped on Torque Going Closed
   j. Pre-Set Torque Exceeded
   k. Valve Jammed
   l. Actuator Being Operated by Hand Wheel
   m. Lost Main Power Phase
   n. Customer 24V DC or 480V AC Supply Lost
   o. Internal Failure Detected
   p. Thermostat Tripped
   q. Actuator Fault.

3. Provision shall be made in the design for the addition of a contactless transmitter to give a 4 to 20 mA analog signal corresponding to valve travel for remote indication when required. The transmitter will auto range to the set limits.

4. Remote operation when required shall be accomplished by use of 2, 3 or 4 wire control and shall be internally powered or 4-20 mA DC.

N. Local Display and Indication:

1. The actuator must provide a local LCD display and message screen for calibration of the valve or gate and a dedicated numeric/symbol digital position indicator displaying gate or valve position from fully open to fully closed in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With main power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 16ft. The display shall be able to be rotated in 90-degree increments so as to provide easy viewing regardless of mounting position.

2. Red, green, and yellow LED lights corresponding to open, closed, and intermediate positions shall be included on the actuator display when power is switched on. The yellow LED shall also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during hand wheel operation when main power to the actuator is isolated. In the event of a (main) power (supply) loss or failure, the position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities. If batteries are required to maintain contact

functionality the actuator vendor shall provide a supply sufficient for 45 continuous days of un-powered operation with one complete valve cycle every hour.

3. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator.

4. For actuators exposed to sunlight, the actuator local display shall be provided with the addition of environmental cover to protect the display from high levels of UV radiation or abrasive materials.

O. Integral Starter and Transformer: The reversing starter, control transformer, and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup. For "On/Off" service, this starter shall be an electromechanical type suitable for 60 starts per hour and of rating appropriate to motor size. For modulating duty, the starter shall be suitable for up to a maximum of 1,200 starts per hour. The controls supply transformer shall be fed from two of the incoming three phases. It shall have the necessary tapings and be adequately rated to provide power for the following functions:

1. 120-VAC energizing of the contactor coils;

2. 24-VDC output where required for remote controls; and

3. Supply for all the internal electrical circuits.

P. Integral Push Buttons and Selector:

1. Integral to the actuator shall be local controls for open, close, and stop, and a local/stop/remote selector switch, pad lockable in any one of the following three positions:

   a. Local Control Only
   b. Off (No Electrical Operation)
   c. Remote Control plus Local Stop Only

2. It shall be possible to select maintained or non-maintained local control. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

3. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

Q. Control Facilities:

1. The necessary control, wiring and terminals shall be provided integral to the actuator enclosure. Open and close external interlocks shall be made available to inhibit local and remote valve opening / closing control. It shall be possible to configure the interlocks to be active in remote control only. Connections

for external remote controls fed from an internal 24-VDC supply and/or from an external supply, between 10 VDC and 60 VDC or 40 VAC and 120 VAC, to be suitable for any one or more of the following methods of control:

a. Open, Close, and Stop control.
b. Open and Close maintained or "Push to Run" (inching) control.
c. Overriding Emergency, Shutdown to Close (or Open) Valve from a normally closed or open contact.
d. Two-Wire Control, Energize to Close (or Open), De-Energize to Open (or close).

2. Selection of maintained or push-to-run control for modes described above shall be provided and it shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energizing of approximately 300 ms.

3. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The motor starter shall be protected from excessive current surges during rapid travel reversal.

4. Provision shall be made for connectivity with field bus control systems via a plug-in card. The following interfaces shall be available:

a. Profibus DP conversion to Profinet.

5. Analog Control: The analog comparator circuit shall provide a 4-20 mA DC output signal for remote position indication. The system shall allow calibration of Zero, Span, Band and Delay. Both input and output signals shall be optically isolated. The actuator shall be configurable for Remain-In-Last Position or Travel to any preset position on loss of control signal.

6. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2.0-KV

R. Monitoring and Diagnostics Facilities:

1. Facilities shall be provided for monitoring actuator operation and availability as follows:

a. Monitor (availability) relay, having one change-over contact.
b. Relay being energized from the control transformer only when the Local/Off/Remote selector is in the "Remote" position to indicate that the actuator is available for remote (control room) operation.
c. Where required, it shall be possible to provide indication of thermostat trip and "Remote" selected as discreet signals.
d. Datalogger data shall be accessed via non-intrusive *Bluetooth*® communication and data displayed on the local LCD. Sufficient standard intrinsically safe tools shall be provided for downloading datalogger and actuator configuration files from the actuators and

subsequent uploading to a PC. The actuator manufacturer shall supply PC software to enable datalogger files to be viewed and analyzed.

2. The actuator text display shall indicate the following status/alarms:

   a. Closed Limit, open limit, moving open, moving closed, stopped,
   b. Torque trip closing, torque trip opening, stalled,
   c. ESD active, interlock active,
   d. Thermostat trip, phase lost, 24V supply lost, Local control failure,
   e. Configuration error, Position sensor failure, Torque sensor failure,
   f. Battery low, power loss inhibit.

3. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

   a. Torque versus Position,
   b. Number of Starts versus Position,
   c. Number of starts per hour,
   d. Dwell Time,
   e. Average temperature.

4. The integral datalogger shall record and store the following operational data:

   a. Opening last /average torque against position,
   b. Closing last /average torque against position,
   c. Opening motor starts against position,
   d. Closing motor starts against position,
   e. Total open/closed operations,
   f. Maximum recorded opening and closing torque values,
   g. Event recorder logging operational conditions (valve, control and actuator).

   The datalogger shall record relevant time and date information for all stored data.

5. The main display shall be capable of indicating 4 different home-screens of the following configuration:

   a. Position and status
   b. Position and torque (analogue)
   c. Position and torque (digital)
   d. Position and demand (positioning)

S. Wiring and Terminals:

1. Internal wiring for the actuator shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and three-phase power. Each wire shall be clearly identified at each end. The terminals shall be embedded in a terminal block of high tracking resistance compound. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal.

2. The terminal compartment of the actuator shall be provided with a minimum of three threaded conduit/cable entries, with provision for an additional five (5) extra conduit entries. For the three standard threaded conduit entries, two shall be, 0.75-inch NPT connections and one shall be, 1.25-inch NPT connection.

3. All wiring supplied as part of the actuator to be contained within the main termination enclosure for physical and environmental protection. The termination enclosure shall include screw-type terminals, 3 for power, 1 for ground, and 40 for control, for site connections. External conduit connections between components are not acceptable. Control logic circuit boards and relay boards shall be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.

4. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

   a. Serial Number
   b. External Voltage Values
   c. Wiring Diagram Number
   d. Terminal Layout

5. The terminal identification card shall be suitable for the Contractor to inscribe cable identification beside terminal numbers.

T. Enclosure:

1. Actuators shall be O-ring sealed, watertight to IP68, 7 meters for 72 hours, meet the requirements of NEMA 4, 4X and 6, and shall at the same time have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator fully protecting the motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling. Enclosure protection of NEMA 6 and IP68, shall be guaranteed without the need of suitable cable glands.

2. Enclosure shall allow for temporary site storage without the need for electrical supply connection.

3. All external fasteners shall be plated Type 316 stainless steel. The use of un-plated stainless steel fasteners shall not be permitted.

4. Actuators for explosion/hazardous applications shall in addition be certified flameproof for Zones 1 and 2 (Divisions 1 and 2) Group gases.

U. Startup Kit: Each actuator shall be supplied with a startup kit comprising an installation instructions manual, electrical wiring diagram, and sufficient spare cover screws and seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

2.03 REMOTE OPERATION PANELS

A. Where indicated in Tables 11205-1 or 11205-2, the actuator shall be provided with a remote pushbutton control panel.

B. The panel enclosure shall be NEMA 4X, Type 316 stainless steel with a non-metallic panel back plate. The panel shall be designed for a 120 volt, 60Hz, 1 phase power supply.

C. Remote panel shall have the following components:

1. Actuators that are not accessible shall have the capability of a "mirror image" of the face of the actuator using a Remote Hand Station (RHS) The RHS shall be suitable for remote connection to an electric actuator up to 100m distance, include local control facilities, a backlit LCD display and terminals for communication highway connection to the host actuator housed within a self-contained, double-sealed enclosure. In order to maintain the integrity of the enclosure, setting of the actuator torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any covers via a *Bluetooth*® wireless interface.

D. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with the component manufacturer's and industry standard practices.

2.04 SHOP COATING

A. The actuator shall be shop coated with a high-solids epoxy primer, and finish painted with a polymer powder coat suitable for field recoating with a coating as specified in Specification Section 09901 – Coatings and Linings.

PART 3 - **EXECUTION**

3.01 INSTALLATION

A. Electric motor actuators shall be installed as shown on the Drawings, specified herein, and in accordance with the manufacturer's recommendations and written instructions.

3.02 INSPECTION AND TESTING

A. Following installation, operating tests will be performed to demonstrate to the Owner and the Engineer that all equipment and accessories for the electric motor actuators will function and perform in a satisfactory manner and that all items of the equipment are in full compliance with this Section. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

B. After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a functional field test of each electric motor actuator in the presence of Engineer.

1. Functional Tests: Each electric motor actuator shall be field tested. Tests shall demonstrate to Engineer that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by Contractor at his expense. Each electric motor actuator shall be operated through at least two complete open/close cycles for the valve or gate that it operates to confirm that the actuator operates and functions smoothly and without interruption.

2. Each actuator shall be performance tested and individual test certificates for each actuator shall be supplied to the Contractor by the actuator supplier. The test equipment shall simulate a typical valve load, and the following parameters at a minimum shall be recorded.

   a. Current at maximum torque setting,
   b. Torque at maximum torque setting,
   c. Flash test voltage,
   d. Actuator output speed or operating time,
   e. Time to open gate or valve,
   f. Time to close gate or valve.

3. In addition, the test certificate shall record details of actuator values such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number and any other relevant information that may be of value to the Owner's operations staff.

C. Deficient equipment will be rejected. If electric motor actuators and appurtenances do not meet the specified requirements after corrective measures have be attempted by the Contractor, the equipment shall be removed and replaced with equipment that satisfies the conditions specified and tested to verify compliance. Replacement and retesting of defective equipment shall be made at no additional cost to the Owner.

3.03 MANUFACTURER'S REPRESENTATIVE SERVICES

A. The Contractor shall provide the services of a trained, competent, qualified and experienced factory service technician (employee of the actuator manufacturer) or a certified factory trained service technician (employee of a local actuator manufacturer's representative) during inspection, testing and start-up of the equipment and for instruction of the Owner's personnel in the proper operation and maintenance of the equipment. Factory personnel are required for this start-up and training. Manufacturer's sales representatives are not deemed acceptable to provide the start-up service. The factory representative shall have a complete and full knowledge and experience in the installation, start-up procedures, actuator programming and set-up, and proper operation and maintenance of the electric motor actuators.

B. The service technician shall make three separate visits to the site. The first visit shall be for assistance to the Contractor in the installation of the electric actuator equipment for the slide gates and valves. The second visit shall be for checking the completed installations, testing the actuator operation and start-up of the actuator systems. Actual start-up of the actuators shall be performed only by direct factory employees or certified local manufacturer's representatives. The third visit shall be as described under Section 01730, Operating and Maintenance Data, to train the Owner's personnel in the proper operation and maintenance of the electric motor actuator equipment.

C. Prior to start-up, the Contractor shall inform the service technician of all requirements necessary to obtain a certificate of proper installation. All forms and documentation required to complete a certificate of proper installation shall be provided to the service technician prior to start-up.

D. A minimum of one, 8 hour day for every actuator installed and started up shall be provided to perform all of the services described herein by the factory service technician.

E. Upon completion of his work, the manufacturer's field service technician shall submit to the Engineer, six (6) copies of a written report for each electric motor actuator, as a result of his inspection, adjustments, corrections, repairs, start-up and testing. The report shall include descriptions of the inspection, adjustments, corrections and repairs made, testing and start-up, and training of the Owner's personnel. The report shall also include a notarized certification signed by the manufacturer's field service technician that each installed electric motor actuator:

1. Has been installed and lubricated per manufacturer's requirements.
2. Has been accurately aligned, set and leveled and proper running clearances set.
3. Is free from undue stress imposed by mounting bolts or setting.
4. The equipment has been tested and is in conformance with nominal operating parameters. Test procedures and results shall be included in the report.
5. Is ready for permanent operation on a continuous basis, is free from any known defects and that nothing in the installation will render the manufacturer's warranty null and void.

F. The Contractor's attention is directed to the fact that the services specified for the manufacturer's field service technician represent an absolute minimum acceptable level of service, and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. The Contractor shall procure, at no additional cost to the Owner, all services required, including additional or extended visits to the jobsite by manufacturer's representatives, to comply with said requirements.

3.04 CLEANING

A. Prior to acceptance of the work of this Section, thoroughly clean all installed equipment, materials and related areas in accordance with the requirements of Section 01710 of these Specifications.

TABLE 11205-1

ELECTRIC MOTOR ACTUATOR SCHEDULE
FOR 316 SST FABRICATED SLIDE GATES

Slide Gate Designation:	SG-24*	SG-25*						
Slide Gate Actuator Designation:	SGA-24*	SGA-25*						
Location:	Influent PS Wetwell Channel No. 1	Influent PS Wetwell Channel No. 2						
Type of Gate:	Slide	Slide						
Size, W x H or Diameter (inches):	96-in x 96-in	96-in x 96-in						
Type of Actuator:	Electric	Electric						
Electrical Supply Voltage/Phase:	480 volt, 3 phase, 60 Hz	480 volt, 3 phase, 60Hz						
Operation Type, Open/Close or Modulating:	Modulating	Modulating						
Maximum Opening/Closing Time (seconds):	480 seconds	480 seconds						
Input Signal for Controls:	Discrete	Discrete						
NEC Service Classification :	Unclassified	Unclassified						
Remote Pushbutton Panel Required, Yes / No	Yes	Yes						

* Electric Motor Actuator provided for new slide gate by slide gate manufacturer and installed by Contractor

TABLE 11205-2

ELECTRIC MOTOR ACTUATOR SCHEDULE FOR VALVES

Valve No.	Type *	Size (in)	End Conn.	Mod.[2] / O/C[1]	Location	NEC Classification	Voltage and Phase	Maximum Open/Close Time	Input Signal for Controls	Remote Pushbutton Panel Required, Yes / No
C03-PV1	PV	54-inch	RJ	O/C	54" IPS Discharge, Bypass	Class 1/Div1/Group D	480 VAC; 3P; 60 Hz	270 seconds	Discrete	Yes

(1) O/C -- Open – Closed Operation
(2) Mod – Modulating Operation

*** Valve Type**
PV – Plug Valve (Actuator Provided by Valve Manufacturer)

END OF SECTION

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SECTION 11305
SUBMERSIBLE SOLIDS HANDLING PUMPS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: This Section specifies the furnishing, installation, and testing of submersible solids handling wastewater pumps and associated equipment for the South Water Reclamation Facility Influent Pump Station, complete, tested and ready for operation. The pumps shall be supplied with a mating cast discharge connection. Motors shall be suitable for inverter duty. The pumps and associated equipment covered under this Section include the following requirements:

1. Six (6) duty submersible solids handling pumps and motors capable of handling raw unscreened sewage. One (1) uninstalled spare pump, motor and cables.
2. The following accessories and associated equipment are to be provided by the pump supplier:
    a. Electrical power and control cables
    b. Quad boxes for monitoring only, PC441 System or equal.
    c. Type 316 stainless steel lifting bales included with pump
    d. Discharge base elbows
    e. Type 316 stainless steel guide rail assembly and upper guide rail brackets
    f. Drilled suction flange for suction tail pipe
    g. 3/8” Thick Type 316 stainless steel suction tail pipe with 48” bell diameter as indicated in drawing plan sheets M-08 and M-09
    h. Blind flange removable via guide rails for pumps 4 and 8 as indicated on drawing plan sheet M-09

1.02 QUALITY ASSURANCE

A. Contractor shall perform Physical Hydraulic Modeling per Section 13210 and provide results for Owner/Engineer for review.

B. Comply with the requirements specified in Section 01400.

C. Pumps shall be the product of one manufacturer.

D. Pumps shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

E. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

F. Shop tests as specified.

G. Unit Responsibility: All equipment including but not limited to the pumps, variable frequency drives, suction tail pipes, motors, pump discharge base elbows, guide rails, and startup service shall be supplied by the pump supplier as a complete and integrated package to insure proper coordination, compatibility, and operation of the system.

1. Variable frequency motor controllers shall be supplied by the pump manufacturer. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Pump manufacturer shall coordinate the variable frequency motor controllers with the motor manufacturer and contractor and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

b. Provide variable frequency motor controllers in accordance with Section 16260.

2. Guide rails and hatches shall be supplied by the pump manufacturer. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the hatch size with the pump manufacturer and submit as part of the shop drawings a written statement signed by the Contractor and pump manufacturer that the Contractor has received the required information from the pump manufacturer and that all parties have reviewed the hatch size and coordinated the hatch size, bridge crane and equipment removal.

b. The Contractor shall coordinate the cable or rail size with the pump manufacturer and submit as part of the shop drawings a written statement signed by the contractor and pump manufacturer that the Contractor has received the required information from the pump manufacturer and that all parties have reviewed the cable or rail size and coordinated the size and equipment removal.

H. Services of Manufacturer's Representative as stated in Section 01400 and as specified herein.

I. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping and electrical:

   a. 2 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   a. 2 person-days.

4. Performance Testing: Field performance test equipment specified.

   a. 3 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions including several shifts.

   a. 3 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

J. Manufacturer of pumps shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

K. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

L. For variable speed pump systems the pump manufacturer must perform or submit a previous certified analysis of the combined motor and pump assembly for resonant frequency or their harmonics independent of a structure.

1. Submit a copy of these calculations for the record.

2. Should calculations indicate the probability of encountering such frequencies within the speed range required, provide all additional supporting devices necessary to affect the unit mass, and raise or lower resonant point to be within the speed range required.

3. Provide and install such additional devices at no additional cost to the Owner.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the Owner/Engineer for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300: Submittals.

1. Data regarding pump and motor characteristics and performance:

   a. Prior to fabrication and testing, provide manufacturer's guaranteed performance curves based on actual shop tests of mechanically duplicate pumps (the manufacturer has built pumps previously and this is not serial number 1), showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and NPSH3.
   b. For units of same size and type, provide curves for a single unit only.
   c. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).
   d. Results of shop performance tests as specified.
   e. Provide motor performance data to include Power factor, motor efficiency at 50 % to 100% load.
   f. Submit curves for manufacturer's guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.

2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide NPSH3 curve for each speed.

3. Layout drawings showing installation details with dimensions specific for this application.

4. Shop Drawings for all associated equipment and accessories specified under this Section in accordance with Division 1 in sufficient detail to enable the Owner to determine compliance with all stated specification requirements.

5. Certified setting plans, with tolerances, for anchor bolts.

6. Manufacturer's literature as needed to supplement certified data.

7. Operating Instructions: Operating and maintenance data shall be furnished to the Owner as provided in the General Conditions and Division 1. The

instructions shall be prepared specifically for this installation and shall include all required cut sheets and operating and maintenance instructions for personnel unfamiliar with such equipment.

8. Listing of reference installations as specified with contact names and telephone numbers.
9. Certified results of hydrostatic testing.
10. Certified results of dynamic balancing.
11. List of recommended spare parts other than those specified.
12. Shop and field inspection reports.
13. Bearing Life: Certified by the pump manufacturer. Include design data.
14. Pump shop test results.
15. Motor shop test results.
16. Qualifications of field service engineer.
17. Recommendations for short and long-term storage.
18. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.
19. Special tools.
20. Number of service person-days provided and per diem field service rate.
21. Results of shop vibration test data for each pump and drive assembly.
22. Recommended location of discharge pressure gauges.
23. Manufacturer's product data, specifications and color charts for shop painting.
24. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
25. The latest ISO 9001 series certification.
26. Provide a scaled drawing for each pump service showing the pumps, motors, and tailpiece including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance and removal of the assembly and clearance within the trench.
27. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of

five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.04 PRODUCT DELIVERY STORAGE AND HANDLING

A. All equipment shall be delivered in packages, cases or crates, and stored or placed as directed by the manufacturer. Each package shall have an identifying mark and a complete list showing contents. Equipment shall not be stored directly upon the ground.

B. All equipment shall be lifted and handled in a manner so as not to damage or deform the equipment in any way and in any special way as instructed by the manufacturer.

C. All parts and equipment shall be protected so that no damage or deterioration will occur during a long term storage delay from the time of shipment until installation is completed and the units and equipment are ready for operation. Finished surfaces of all exposed pump openings shall be protected by securely bolted wood planks. Finished iron or steel surfaces not painted shall be protected to prevent rust and corrosion during periods of storage and installation until the time of the final acceptance test.

1.05 WARRANTY

A. Warranty: The pump manufacturer shall warrant the all equipment provided by the pump manufacturer to the Owner against defects in workmanship and materials for a period of 5-years 100%. The warranty shall be in published form and apply to all similar units.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D: List of Approved Products appended to these technical specifications.

2.02 MANUFACTURERS

A. ABS or Flygt Approved Only.

2.03 MATERIALS

A. All hardware and accessories shall be Type 316/316L stainless steel.

2.04 PUMPS AND ACCESSORIES

A. General

1. Stainless steel Type 316 nameplates identifying the name of the manufacturer, voltage, phase, rated horsepower, speed and any other pertinent data shall be attached to each pump.
2. All hardware: Type 316 stainless steel.
3. Pump Design: The pumps shall be capable of handling raw unscreened domestic wastewater and passing a minimum 3-inch diameter solid sphere. The required design performance is set forth in the below table:

DESIGN CRITERIA

	Raw Sewage
Number of Pumps	7
Design Rating Point Flow (gpm)	21,500
Design Rating Point TDH (ft)	62
Max. Rated/Nominal Speed (RPM) at 60 Hz	715
NPSH Available (ft)	33.0

Minimum Speed Rating Point Flow (gpm)	12,000
Minimum Speed Rating Point TDH (ft)	47
Minimum Runout Condition at Full Speed 60 Hz (gpm)	25,000
Minimum Pump Power Required (P2 HP) @ Design Rating Point	400
Minimum Water to Wire Efficiency (%) @ Design Rating Point	75
Motor Voltage	460
Max. Motor Current @ 100% Load, Amp	600

B. Casing: The stator casing and oil casing shall be of gray cast iron construction, with all parts coming into contact with sewage protected by a corrosion resistant paint in accordance with Section 09901 with both prime and finish paint to be completed at factory.

C. Guide Rail Base Assembly

1. There shall be no need for personnel to enter the wet well to remove or reinstall the pump(s). In a wet pit installation, the discharge base & elbow assembly shall be permanently installed in the wet well and connected to the discharge piping. In order to prevent binding or separation of the pump from the guide rail system, the pump(s) shall connect to the guide rail base automatically and firmly, guided by one or two guide bars extending from the top of the station to the discharge base elbow. Systems using guide cable in lieu of rigid guide bars or pipes are not acceptable.

2. A field replaceable Nitrile (Buna-N) rubber profile gasket, O-ring, or metal to metal seating shall accomplish positive sealing of the pump guide bracket to the discharge elbow. No portion of the pump shall bear directly on the floor of the sump. The guide rail system shall be non-sparking version, approved by Factory Mutual for use in NEC Class 1, Division 1, Group C&D hazardous locations.

D. Impeller:

1. Type: Channel impeller, enclosed, solids handling, maximum four vane design. The impeller shall be capable of passing a minimum of 4.75 inch solid sphere.

2. The impeller shall have a slip fit onto the motor shaft and drive key, and shall be securely fastened to the shaft by a Type 316 stainless steel bolt which is mechanically prevented from loosening by a positively engaged ratcheting washer assembly or keyed to shaft and retained with an expansion ring. The head of the impeller bolt shall be effectively recessed within the impeller bore or supporting washer to prevent disruption of the flow stream and loss of hydraulic efficiency. The impeller shall be dynamically balanced to the ISO 1940 G6.3 standard.

3. Material: Channel impeller shall be CA6MN stainless steel, ASTM A 743 CD4MCu or equivalent duplex Type stainless steel.

E. Wear Ring System: Replaceable wear rings, impeller and volute shall be securely fitted into the pump casing (volute). Casing wear ring shall be Type 316 stainless steel 1.4581 (AISI 318), and the optional impeller wear ring shall be Type 316 stainless steel 1.4571 (AISI 316Ti).

F. Pump Volute

1. The pump volute shall be single piece cast iron, EN-GJL-250 (ASTM A-48, Class 35 minimum) centerline discharge.

2. Volute passages shall be smooth, and large enough to pass any solids that may exit the impeller. The motor shall be attached to the volute by stainless steel bolts. The motor unit, with impeller attached, shall be removable from the volute without requiring removal of the impeller, and without disturbing the watertight integrity of the motor unit. The suction flange shall be integrated or bolted into the volute and its bolt holes shall be drilled and threaded to accept standard 24 or 32 inch (Depending on pump selected) ANSI class 125 flanged fittings.

G. Rotating Assembly

1. The rotating assembly (impeller, shaft and rotor) shall be dynamically balanced .

H. High Efficiency Motor

1. The motor shall be housed in a water tight cast iron, EN-GJL-250 (ASTM A-48, Class 35B minimum) enclosure capable of continuous submerged operation underwater to a depth of 65 feet, and shall have an IP68 protection rating. The motor shall be of the squirrel-cage induction design, NEMA type B. The copper stator windings shall be insulated with moisture resistant Class H insulation material, rated for 356 Fahrenheit. The stator shall be heat-shrink fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is unacceptable. The rotor bars and short circuit rings shall be made of cast aluminum.

Minimum Motor Efficiency at % Load		
100	**75**	**50**
93.6	93.7	92.6
Minimum Power Factor at % Load		
100	**75**	**50**
0.776	0.745	0.64

2. The motor shall be designed for continuous duty. The maximum continuous temperature of the pumped liquid shall be 104 Fahrenheit. The motor shall be capable of handling up to 10 evenly spaced starts per hour without overheating. The service factor (as defined by the NEMA MG1 standard) shall be 1.15. The motor shall have a voltage tolerance of +/- 10% from nominal, and a phase to phase voltage imbalance tolerance of 1%. The motor shall have a NEMA Class B temperature rise, providing cool operation under all operating conditions. Motors: Explosion proof FM approved for use in NEC Class I, Division I, Groups C & D hazardous locations. The surface temperature rating shall be T3A. The motor shall meet the requirements of NEMA MG1 Part 30 and 31 for operation on PWM type Variable Frequency Drives.

3. The power requirement for the actual units supplied shall not exceed the power output rating of the motor at all points on the performance curve, zero flow to run-out.

I. Open Loop Cooling System: Each unit shall be provided with an adequately designed cooling system. The cooling jacket shall surround the stator housing, thereby providing heat dissipation of the motor. Impeller back vanes shall provide the necessary circulation the pumped media through the cooling jacket. The impeller and back plate interface shall incorporate dimensional tolerances designed to prevent damaging particles from entering the cooling jacket. The cooling jacket shall be a non-clog design by virtue of these features. Provide inlet and outlet clean out ports on the cooling jacket for connection of portable flushing water. Ports to be threaded or flanged with removable caps. The cooling jacket shall surround the stator housing, thereby providing heat dissipation of the motor.

J. Thermal Protection: RTD (PT100) type temperature measuring devices shall be supplied for the motor winding and bearings to provide actual temperature measurement at these locations. In addition to RTD's for the motor winding, each phase of the motor shall contain a normally closed bi-metallic temperature monitor switch imbedded in the motor windings. These thermal switches shall be connected in series and set to open at 284 Fahrenheit +/- 5. They shall be connected to the pump monitoring panel to provide a high stator temperature shutdown signal, and are used in conjunction with external motor overload protection. The bi-metallic system must be connected to the control to provide positive shutdown of the motor in the event of an overheat condition. This is required in order to conform to FM and CSA rules for explosion proof equipment.

K. Mechanical Seals

1. Each pump shall be equipped with a mechanical seal system consisting of tandem mechanical shaft seals providing two complete levels of sealing between the pump wet end and the motor. The mechanical seal system shall consist of two totally independent seal assemblies operating in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The mechanical seals shall be of non-proprietary design, and shall be manufactured by a major independent manufacturer specializing in the design and manufacture of mechanical seals or proprietary pump manufacturer seals designed and manufactured in-house. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary solid silicon-carbide seal ring and one rotating solid silicon-carbide seal ring or WCCR. The stationary ring of the primary seal shall be installed in a seal holding plate of gray cast iron EN-GJL-250 (ASTM A-48, Class 35B minimum). The upper, secondary seal unit, located in the lubricant chamber, shall contain one stationary industrial duty carbon seal ring, and one rotating industrial duty chromium-steel seal ring or WCCR. Each seal interface shall be held in contact by its own spring system. The seals shall not require routine maintenance, or adjustment, and shall not be dependent on the direction of rotation for proper sealing. Each pump shall be provided with a lubricant chamber for the shaft sealing system which shall provide superior heat transfer and maximum seal cooling. The lubricant chamber shall be designed to prevent overfilling, and to provide lubricant expansion capacity. The drain and inspection plug shall have a positive anti-leak seal, and shall be easily accessible from the outside of the pump. The seal system shall not rely upon the pumped media for lubrication and the motor shall be able to operate continuously while non-submerged without damage while pumping under load. Lubricant in the chamber shall be environmentally safe nontoxic material.

2. In addition, two additional moisture sensing probes, one in the electrical connection chamber, and one in the motor chamber shall be provided. These probes shall send separate signals to the monitoring panel as described above, so that maintenance personnel are given an early warning of the presence of moisture in the respective sensing chambers.

L. Vibration Monitoring

1. A vibration sensor and shielded cables meeting requirements of electrical specification shall be provided as an integral part of the pump monitor and control system.

M. Shaft: The pump shaft and motor shaft shall be an integral, one piece unit designed to meet the maximum torque required at any normal start-up condition or operating point in the system. Each shaft shall be Type 329 duplex stainless steel material and shall have a polished finish with accurately machined shoulders to accommodate bearings, seals and impeller.

N. Bearings: Each pump shaft shall rotate on high quality permanently lubricated, greased bearings. The upper bearing shall be a cylindrical roller bearing which is electrically isolated from the bearing housing to prevent bearing damage from circulating currents when the pump is operated on a variable frequency drive. The lower bearings shall be a matched set of one heavy duty angular contact ball bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. L-10 bearing life shall be a minimum of 100,000 hours at flows ranging from ½ of BEP flow to 1½ times BEP flow (BEP is best efficiency point). The bearings shall be manufactured by a major internationally known manufacturer of high quality bearings, and shall be stamped with the manufacturer's name and size designation on the race. Generic or unbranded bearings from other than major bearing manufacturers are not acceptable.

O. Power Cable: The power cables shall be sized according to NEC standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be oil, water, and UV resistant, and shall be capable of continuous submerged operation underwater to a depth of 65 feet.

P. Cable Entry/Junction Chamber: The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.

Q. Special Tools and Spare Parts

1. Special Tools: Provide special tools for normal operation and maintenance in accordance with the pump manufacturer.

2. Spare Parts: The pump supplier will include at least one set of spare parts with a toolbox. Spare parts shall include, at a minimum, 2 mechanical seals and 2 sets of wear rings.

R. Factory Performance Testing

1. Motor Testing in accordance with ANSI/HI 11.6

   a. Provide testing of mechanically and electrically duplicate units. If not available, conduct motor efficiency and power factor tests at full load, 75 percent load and 50 percent load.
   b. Test motor integrity in a submerged condition.
   c. Dry run no load test.
   d. Motor electrical integrity test.
   e. Moisture and temperature sensors integrity test.

2. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater.

3. Provide witnessed performance tests as specified herein for all pumps, spare rotating assemblies and uninstalled spare pumps and motors.

4. Witness testing.

a. Pumps must be tested submerged
b. Run pump at full speed rating point for 60 minutes prior to start of any testing.
c. Full speed tests:

i. Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.
ii. Take readings to determine flow, differential pressure and wire to water efficiency.
iii. Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the job submergence as indicated.

5. Variable speed tests:

a. Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.
b. Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
c. Run a second test at a speed approximately midway between full and minimum speed.
d. Run addition tests for each reduced speed operating condition specified and indicated.

6. Factory tests on pumps:

a. Use job motors, one job variable frequency drive, and job suction tail pipes as indicated in drawing plan sheets M-08 and M-09 if test facility can accommodate. If not included manufacturer shall provide correction factor for suction tail pipe. Materials are shipped to the pump testing facility and used in these pump tests.

7. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

8. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

9. Testing Acceptance Grade and Tolerances:

a. ANSI/HI 11.6 Acceptance Grade: 1U.
b. Efficiency Tolerance: -0 percent.

c. If pumps do not meet the tolerances specified, trim the impeller or other appropriate modifications and retest until the specified results are obtained at no additional cost to the owner.

10. Tests of variable frequency motor controllers specified in Section 16260.

11. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.

12. Repeat tests until specified results are obtained.

13. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

14. Provide all travel and lodging expenses for the witness testing including four (4) individuals shall be paid for by the Contractor to and from the pump testing facility.

B. Pump Monitoring Panel

1. General

a. The Pump Monitoring Panel (PMP) shall include a 24Vdc powered pump monitor and controller. It shall interface through an internal bus network to an operator interface, seal leakage monitoring unit(s), temperature monitoring unit(s), and vibration monitoring unit(s) to provide a complete and functional pump station. The controller and its components shall be easily programmed and interpreted to yield a user friendly interface. It shall monitor from one to four pumps and shall be integrated into the PMP with additional functions included. The controller shall be capable of being configured for monitoring only with pump starting features disabled. It shall be supplied by a pump manufacturer who has been regularly engaged in wastewater control manufacturing for at least 5 years and be ANSI or UL listed and conform with NFPA and NEC.

2. Operation

a. The pump controller shall provide continuous monitoring of configurations from one to four pumps in a wet well through an interface from an analog measuring device (4-20ma DC).

b. The controller shall be connected to a graphical interface display, to incorporate a complete user interface where all settings will be performed. The display shall be the user interface where alarms, running data, and set points can be modified and viewed.

3. Components

a. The pump monitor and controller shall include 16 digital inputs, 16 digital outputs, 5 analog inputs and 4 analog outputs. It shall also include indication LED's to indicate status of inputs and outputs. The unit shall also include a power indicator and communication status LED's. The controller shall be a Sulzer PC441 or equal.

b. Provide additional units connected to the pump monitor and controller as necessary to provide the required advanced monitoring functions, including leakage monitoring, temperature monitoring, and vibration monitoring. Provide Sulzer modules CA 441 and CA 442 or equal.

c. The operator interface shall be a graphical dynamic interface used with the controller. It shall be of TFT type with a 480 x 272 pixels resolution incorporating 28 keys for programming and operation. The user interface shall include alpha-numerical formats, animated graphical symbols, and the ability to display trend curves on the screen. It shall have a NEMA 4X rating when installed on a dead-front door. The interface shall include a large color screen. It shall be networked to the controller through an internal CAN bus network. The interface shall be a Sulzer CA511 or equal.

d. The seal leakage monitoring unit shall connect to the controller through the CAN-bus network. It shall connect to up to 4 different seal probes. It shall be connected to from one to 4 pumps or for up to 3 separate alarms using one unit per pump. The unit shall be a Sulzer CA441 or equal.

e. The temperature monitoring unit shall connect to the controller through the CAN-bus network. It shall connect from one to four pumps or for up to 3 separate alarms using one unit per pump. The unit shall interface to up to (3) PT100 sensors as well as a bimetallic switch and a vibration analog sensor. The unit shall be a Sulzer CA442 or equal.

f. The vibration monitoring unit shall connected to the controller using a separate 4-20ma input from the vibration sensor.

4. Features

a. Controller – The Controller shall incorporate the following functions:

i. The controller shall have the ability to incorporate delays of trip point for alarms and to designate alarms as A type or B type.

ii. The controller shall record pump operating, fault history, and system events time stamped for up to 15 days, 16 channels, and 4096 events of history.

iii. The controller shall calculate energy consumption versus pumped volume and display the ratio of kWh/Mgal on the operator interface screen.

iv. The controller shall monitor each pump for moisture detection, temperature, and vibration.

v. The controller shall use a Modbus RTU/TCP communication protocol, converted internally to ProfiNet using a Modbus to ProfiNet converter.

5. Programming Software

a. Monitor and Configuration software shall be provided to program the system. It shall incorporate Windows 10 based software specifically for the purpose of creating the settings of all parameters in the controller. Communication with the controller shall be established via RS232, USB or modem (analog or GPRS) as a connection between the substation and computer. The Monitor and Configuration software shall also allow for downloading of data captured on the logging tables. Provide Sulzer's AquaProg software or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All materials and equipment shall be installed as shown on the Drawings and as recommended by the manufacturers.

B. Additional items of construction, such as concrete work, interior grouting, piping, vents, valves, controls, and other items necessary for the complete installation of the system shall conform to specific details on the Drawings and shall be constructed of materials conforming to the applicable portions of these Specifications.

3.02 FIELD PERFORMANCE TESTING

A. Comply with the requirements specified in Section 01680 and as specified herein.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions of horsepower and efficiency.

D. During tests, observe and record head, capacity, and motor inputs.

1. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

E. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

F. Repeat tests until specified results are obtained.

G. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

1. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

2. All calibrations must be within 30 days of the field testing.

3. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

H. Make all adjustments necessary to place equipment in specified working order at time of above tests.

I. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

J. Remove or replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.03 INSPECTION, TESTING AND CERTIFICATION

A. Inspection, Testing and Certification shall comply with Section 01650.

END OF SECTION

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SECTION 13100
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide lightning protection system on each building and structure consisting of air terminals, conductors, ground terminals, interconnection conductors, arresters, and other connectors or fittings required for a complete system.

B. All systems are to be designed, furnished and installed by a Lightning Protection Contractor.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).
2. 780: Lightning Protection Code.

B. Underwriters' Laboratories, Inc. (UL):

1. 96: Lightning Protection Components.
2. 96A: Installation Requirements for Lightning Protection Systems.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Shop Drawings:

1. Consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, installation instructions.
2. Shop drawings indicating type, placement, and location of protection devices, including cable attachments, grounding, mounting and any other details integral with the system.

C. Inspection and Maintenance: Provide a written recommended inspection and maintenance procedure, including periodicity of inspections.

D. Record Drawings: Provide a complete set of "as-constructed" drawings showing the location of all grounds as well as a detailed layout of type, size, location and method of installation of all downleads, roof cables, bonding leads and connections, air terminals, etc., and in the case where structural steel is used for downleads, the method and location of all roof and ground connections to the steel must be clearly detailed.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied.

C. Services of Manufacturer's Representative as stated in Section 01400 and as specified herein.

D. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

   a. 1 person-day.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   a. 1 person-day.

4. Performance Testing: Field performance test equipment specified.

   a. 1 person-day.

5. Service inspections during first two years of operation, for use at Owner's request, and exclusive of repair, malfunction or other troubleshooting service calls.

   a. 3 person-days, 3 trips

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in

installation, equipment or material shall be provided at no additional cost to the Owner.

E. Provide systems designed, furnished and installed by a Lightning Protection Contractor.

F. Provide a "Certificate of Compliance" for work performed after completion. The certificate should state that the following has been done:

1. The Contractor has complied with all requirements of Underwriters' Laboratories, Inc. Master Label Service as outlined in UL 96A including the completion and execution of the Master Label application form and the procurement and delivery of the U/L "C" plate to the Owner or his representative.

2. The lightning protection system ground system has been tested and interconnected to the facility grounding system as required by NFPA 70.

3. Record drawings have been turned over to the Owner or his representative.

G. Use UL listed components.

1.05 REQUIREMENTS OF REGULATORY AGENCIES:

A. Conform to UL 96 and 96A and NFPA 780.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Shipping:

1. Ship equipment and materials, complete with identification and quantity of items.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. Deliver spare parts at same time as pertaining equipment. Delivery to Owner after completion of work.

C. Storage:

1. Inspection and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts.

1.07 WARRANTY AND SERVICE:

A. Guarantee components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a period of 12 months.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Thompson Lightning Protection Company, St. Paul, MN.

B. Heary Brothers Lightning Protection Company, Springville, NY.

C. American Lightning Rod Co., Dover, NH.

2.02 MATERIALS:

A. Class I Materials: Provide conductors, fittings, and fixtures necessary to protect ordinary buildings and structures not exceeding 75 feet in height.

B. Materials, Class I. Table I gives minimum sizes and weights for air terminals, and main and secondary conductors. Secondary conductors which are used for bonding and interconnecting metallic bodies to the main conductor, and which will not be required to carry the main lightning current, may be reduced in size but not less than No. 6 AWG copper or equivalent. Provide main conductor size for interconnection to metal water systems, steam or hot water heating systems, or other metallic masses having a low resistance to ground.

C. Table I: Class I Material Requirements.

Type of Copper Conductor		**Standard**	**Metric**
Air Terminal, Solid	Min. Diameter	3/8-inch	9.5 mm
Air Terminal, Tubular	Min. Diameter		15.9 mm
	Min. Wall Thickness	0.032 inch	0.8 mm
Main Conductor,	Min. Size ea.	17 AWG	
Cable	Strand Wgt. per Length	187 lbs/1000 ft.	278 g/m
	Cross Sect. Area	57,400 cm	29 square mm
Main Conductor,	Thickness	16 AWG	
Solid Strip	Width	1 inch	25.4 mm
Secondary Conductor Cable	Wire Size	17 AWG	
	Number of Wires	14	14
Secondary Conductor Solid Strip	Thickness	16 AWG	
	Width	1/2 inch	12.7 mm

D. Where any part of a protection system is exposed to mechanical injury, provide protection by covering it with molding or tubing. If ferrous metal pipe or tubing is used around the conductor, connect the conductor electrically to the pipe or tubing at both ends.

E. Furnish conductors made of stranded copper.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Provide all material, equipment, and labor to install the lightning protection system as indicated and as specified.

B. No bend of conductor is to form an included angle of less than 90 degrees nor have a radius of bend less than 8 inches.

C. Interconnect all conductors, air terminals to form a two-way path from each air terminal horizontally or downward to connections with ground terminals.

D. Conductors may be coursed through air without support for a distance of 3 feet or less. With a 5/8-inch rod or its equivalent as a support, securely fastened at each end, a conductor may be coursed through air for a distance not to exceed 6 feet.

E. Install roof conductors to interconnect all air terminals and provide a two-way path to ground horizontally or downward from the base of each terminal.

F. Install at least two down conductors on any kind of structure. Location depends on placement of air terminals, size of structure, most direct coursing, security against displacement and location of metallic bodies, water pipes, and ground conditions. Separate down conductors as widely as practicable. For structures over 200 feet in perimeter, install one additional down conductor for each additional 100 feet of perimeter or fraction thereof.

G. Terminate each down conductor at a ground terminal.

H. Use connector fittings on all lightning conductors at "end-to-end" "tee" or "Y" splices. Attach them so as to withstand a pull test of 200 pounds. Make fittings for connection to metal tracts, gutters, downspouts, ventilators, chimney extensions, or other metal parts about the structure tight to the object by compression under bolt heads. Both crimp type and exothermic weld splicers of stamped or cast metal are acceptable under Class I requirements.

I. Securely attach conductors to the building or other object upon which they are placed. Use fasteners not subject to breakage. Furnish nails, screws and bolts, with which fasteners are secured, of the same material as the conductor or of such nature that

there will be no electrolytic corrosion in the presence of moisture because of contact between the different parts. Space conductor fasteners not more than 3 feet apart on all conductors.

J. All requirements covering exposed systems apply to concealed installations. Conductors are coursed the same except that they may be coursed behind the exterior wall facing, in concealed or embedded conduit, or embedded directly in concrete.

K. In a concealed installation where conductors are embedded in concrete, bond the reinforcing steel to the cable with a main size conductor. Bond reinforcing steel at the top and bottom of each embedded downlead.

L. Materials, installation methods and procedures are to be in accordance with UL 96 and 96A, NFPA 780, NEC and local electrical codes. Provide for and obtain a "Certificate of Compliance" for the work performed.

3.02 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 13210
PHYSICAL HYDRAULIC MODELING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Contractor shall arrange for and pay all costs associated with Physical Hydraulic Modeling as described herein for the Influent Pumping Station. Contractor shall provide all relevant information regarding the pumps selected by the Contractor to the hydraulic modeling firm selected.

B. The results of the Physical Hydraulic Modeling may result in changes to the internal shape of the influent isolation box and baffling; or the shape or depth of the self-cleaning wet wells; or the length and shape of the pump intake cones; or any combination of these. The final model report must be completed and approved before construction of structural reinforced concrete walls for the new IPS has begun or the new submersible pumps have been ordered.

C. This specification covers the requirements for Physical Hydraulic Modeling conducted in accordance with ANSI/HI 9.8. to evaluate the performance of the proposed pump intake designs with respect to the Hydraulic Institute (HI) Intake Design Guidelines and make all design modifications required to provide adherence to the requirements.

1. Objectives of the physical hydraulic model study:

a. Define the general flow characteristics from the influent sumps to the pump intakes.
b. Determine the existence and magnitude of adverse flow phenomena that may propagate to the pump suctions.
c. Investigate geometric modifications to the wet wells and transition from the influent line(s) to the pump suction to meet performance requirements and/or reduce station construction costs.
d. Document the satisfactory performance of the modified station for the range of operating conditions.

1.02 REFERENCES:

A. Hydraulic Institute (HI):

1. Current Standards.
2. 9.8: Rotodynamic Pumps for Pump Intake Design

1.03 MODELING FIRM QUALIFICATIONS:

A. The modeling firm shall have expertise in wastewater pump intake physical hydraulic modeling, and design review of overall layout of the pump stations considering approach flow hydraulics and operation and maintenance.

1. Acceptable Firms

a. Clemson Engineering Hydraulics, Inc.
b. Alden Research Lab
c. Northwest Hydraulic Consultants

1.04 MODEL DEVELOPMENT:

A. Provide a Froude-scaled, geometrically similar, undistorted three-dimensional model for the pumping stations model studies.

1. Provide calculations of the geometric scale for construction of the model based on ANSI/HI 9.8.

B. Include in the models the geometric details of the prototype design that will significantly affect the flow field in the intakes. The minimum required limits of the physical model, which shall include the following components:

1. A portion of the influent line through the influent box to ensure proper approach flow to each wet well. The influent box shall include flow columns as shown on the drawings. In addition, it shall include slide gates with the prototype design that can be manitulated to simulate gate closure to bypass one wet well side and partial gate closure to simulate the self-cleaning cycle of a wet well.

2. Wet well baffle walls, water guide, flow splitters, hydrocone for last pump, baffles and structural columns. The simulations shall also determine if a baffle wall or walls in lieu of the flow columns in the influent box should be considered, if additional baffle walls are needed and the location of the baffle walls, if needed. The simulations shall also determine if the water guide can be cut back from 24’ without negatively impacting the hydraulics.

3. Pump suction geometry excluding any internal pump bell vanes or bearing hubs (if present).

4. Locate the upstream model boundary sufficiently far upstream from the entrance to the wet wells to allow uniform flow to develop, while taking into account practical considerations of constructing the model.

5. Locate the downstream model boundary at the plane of the pump inlets.

C. HI has established a set of performance criteria for judging acceptability of pump approach flow conditions in a physical hydraulic model. The HI criteria will be applied and amended as follows:

1. No organized free-surface or submerged vortex activity is permitted. No vortex activity greater than a diffuse general rotation (Type 1 submerged per HI or weak Type 2 surface per Figure 9.8.45a) is acceptable at Froude-scaled model operation.

2. Each of eight time-averaged velocities measured at the pump throat should not deviate more than +/- 10 percent from the mean of these velocities.

3. The temporal fluctuation of velocities at each measurement location should not be excessive or periodic in nature. The standard deviation of velocity samples should be no more than 10 percent of the mean velocity at each location.

4. The level of pre-swirl of flow approaching the pump impeller location, as measured by a standard swirl meter, shall be less than 5 degrees from axial and steady, with no abrupt changes in rotational speed or direction. Model testing will use 2.5 degrees as a target.

1.05 MODEL DESIGN, CONSTRUCTION AND TEST PROGRAMS:

A. Provide the design of the a physical hydraulic model of the pumping stations with a geometric scale as determined using HI 9.8 as specified above.

1. Construct strategic portions of the model of clear plastic or equal such that flow patterns can be observed.

2. Construct all modifications of clear plastic or wood as appropriate but of a different color as the base model.

B. Provide the model designed such that modifications can be easily installed in the model.

C. Provide a testing program, sequence, and documentation procedures for all of the testing including vortexing, swirl, and velocities to meet the HI standards. Based on the knowledge of the design and HI standards, select various combinations of pumps to test which are representative of the worst expected conditions and at various water levels in the intake.

D. Provide scaled drawings of the model and detailed test program in PDF and CAD format for review and approval prior to model construction. After approval, construct the model with photographs provided weekly to document construction progress.

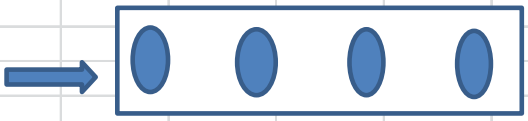
E. Prior to testing, calibrate all instruments (as needed) in accordance with latest HI standards and document the results.

F. Test the model to verify operational performance over the range of flows, number of pumps and water levels to be tested.

1.06 TEST PROGRAM:

A. Provide the testing for each model divided into the following tasks:

B. Testing Matrix:

Test	Pump Status				Operating Condition			Comments
Condition	1	2	3	4	Total Flow (gpm)	Flow/Pump (gpm)	WSE (ft)	
1.1	ON	OFF	OFF	OFF	12,000	12,000	73.00	Minimum Flow 1 Pump
1.2	ON	OFF	OFF	OFF	12,000	12,000	71.50	17 MGD
2.1	ON	OFF	OFF	OFF	21,500	21,500	76.00	Max Flow 1 Pump
2.2	ON	OFF	OFF	OFF	21,500	21,500	73.00	31 MGD
3.3	OFF	OFF	ON	OFF	12,000	12,000	73.00	Minimum Flow 1 Pump
3.2	OFF	OFF	ON	OFF	12,000	12,000	71.50	17 MGD
4.1	OFF	OFF	ON	OFF	21,500	21,500	76.00	Max Flow 1 Pump
4.2	OFF	OFF	ON	OFF	21,500	21,500	73.00	31 MGD
5.1	ON	ON	OFF	OFF	24,000	12,000	74.50	Min Flow 2 Pumps
								34 MGD
6.1	ON	ON	OFF	OFF	43,000	21,500	76.00	Max Flow 2 Pumps
								62 MGD
7.1	ON	ON	ON	OFF	64,500	21,500	77.50	Max Flow 3 Pumps
7.2	ON	ON	ON	OFF	64,500	21,500	74.50	93 MGD
8.1	ON	ON	ON	ON	86,000	21,500	77.50	Max Flow 4 Pumps
8.2	ON	ON	ON	ON	86,000	21,500	74.50	124 MGD
9.1	ON	OFF	OFF	OFF	20,000	20,000	Starting height	Cleaning Cycle w/Solids
							76.00	Inflow: 12,000 gpm
								
	4	3	2	1	*Pumps*			

C. Initial Design Testing:

1. Performed to evaluate the proposed design in accordance with the approved test plan. The specific test conditions will be determined in the test program submittal.

D. Design Modification Testing:

1. Performed following the initial design testing. Based on the results of the tests, the Designer will discuss possible design modifications to improve the flow conditions, if any are required.

   a. Including but not limited to an alternate design in leau of the flow columns in the influent box.

E. Witness Testing:

1. Performed at the selected Modeling Firm's laboratory.

2. Representatives from the Owner (two) and the Engineer (two) will travel to the laboratory for a one-day test to review model operation, review results of initial and design modification testing, and provide approval for commencement of final documentation testing.

3. Perform a test for self-cleaning of each wet well with solids of various specific gravities to determine effectiveness of the cleaning cycle.

4. Contractor shall include cost for travel (accomodations and airfare) for representatives of Owners and Engineers.

F. Documentation Testing:

1. Performed with the model after representatives from the Owner and the Engineer have observed and agreed that the design modifications meet the objectives of the overall project design. The operating conditions for the documentation tests will be determined in the testing program submittal.

1.07 TEST REPORTING AND VIDEO TAPING:

A. Upon completion of documentation testing, provide a draft report of the study for review and comment.

1. Provide a report for each model including but not limited to the following:

a. Introduction
b. Description of model fabrication
c. Scaling theory
d. Instrumentation
e. Test procedures
f. Discussion of test results
g. Conclusions and Recommendations
h. Tabulated test data
i. Drawings of the model test arrangement
j. Drawings of recommended design revisions and enhancements
k. Color photos of pertinent flow phenomena

2. Provide an electronic copy of the draft report in PDF format for review and approval.

B. Upon receipt and resolution of comments on the draft report, provide a final report

1. Submit six (6) hard copies and one electronic copy of each final report.

C. In addition to the written final report provide a video report summaring the model study.

1. Provide the video fully-narrated, video that includes study objectives, an explanation of scaling and modeling methods, footage of selected tests summarizing the performance of the initial design, selected intermediate

designs, and final documentation tests summarizing the performance with the recommended design, conclusions, and recommendations.

2. Submit six (6) copies in DVD format or on flash drives.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 13253
FRP ODOR DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Provide Fiberglass Reinforced Plastic odor ductwork for above ground odor control facilities. The system shall be complete and operational with all accessories, maintenance materials and services as shown and specified.

1.02 QUALITY ASSURANCE

A. Supplier's Qualifications: The supplier shall have experience in producing similar materials, and shall show evidence of five (5) installations in satisfactory operation for at least five (5) years.

B. Reference Standards: Comply with all applicable standards for design and construction.

C. Except where shown in the Contract Documents, the manufacturer shall be responsible for locating flexible connections and expansion joints to accommodate installation and thermal expansion, respectively.

D. The manufacturer shall be singularly responsible for the fabrication and performance of the above ground foul air exhaust ductwork.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Submit samples of the ductwork materials.
2. Manufacturer's data on all furnished equipment and appurtenances.
3. Details of construction and fabrication, including design calculations sealed by a Professional Engineer registered in the State of Florida showing that the duct meets the requirements in this Section. Submit details for flexible connectors, expansion joints, elbows, transitions, junctions, and straight ductwork. Include dimensioned laminate cross sections and flange fabrication and assembly details.
4. Specifications for laminate construction and joints.
5. Duct laying schedules, including locations of supports.
6. Installation drawings detailing all required joints, fittings, pipe supports, and equipment connections.
7. Shop drawings for actuators should include schematic control diagrams, electrical connection diagrams, and a complete description of the control system.
8. Detailed instructions for field joining of the ductwork, including quality control procedures.

9. Equipment operating characteristics and type and size of operator.

10. Catalog cut of dampers and actuators including materials of construction and dimensions.

11. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt the arrangement or details shown to the ductwork installation.

12. Damper information including leakage, performance data, and calculations showing ultimate strengths on blade and actuator to blade fastening. Include copies of AMCA 500D certified leakage rate test reports for sample dampers of a minimum of 5 different sizes, or of every size if less than 5 sizes are provided.

13. Handling and storage requirements for ductwork, joint kits, and resin systems.

14. Guarantee

15. Shop Tests

B. Operation and Maintenance Manuals

1. Submit complete installation, operation and maintenance manuals including copies of all approved shop drawings, test reports, maintenance data and schedules, description of operation and spare parts information. The manuals shall include, but not be limited to, instructions for the following odor control ductwork components in accordance with Section 01300:

a. Dampers
b. Joints
c. Fittings

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide FRP duct as manufactured by one of the following:

1. Augusta Fiberglass

2. Ershigs/Belco

3. Southeastern Fiberglass

4. Industrial Plastic Systems

5. Perry Fiberglass

6. Daniel Company

7. Engineered Composite Systems

8. Ameron International

9. L.F. Manufacturing

10. R.L. Industries

B. Both the Manufacturer and the installer shall demonstrate experience on at least 5 projects requiring similar fabrication and installation methods.

2.02 SERVICE CONDITIONS

A. The FRP piping system shall be designed and fabricated for odor control service to carry warm moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.

B. Design Conditions

1. Temperature: -10 to 120 degrees F
2. Pressure Rating: 25 psig
3. Design Operating Conditions:
   a. Prior to fan – negative 10-inches w.g.
   b. After fan – plus 6-inches w.g.
4. Gases conveyed: Odorous Air
5. Relative humidity – 30 to 100 percent
6. Maximum velocity – 3,500 feet per minute
7. Chemical Composition of the gases:
   a. Hydrogen sulfide: up to 400 ppm
   b. Chlorine gas: up to 1.0 ppm

2.03 COMPONENTS

A. In general unless indicated otherwise on the drawings, below-ground duct shall be HDPE, SDR 11, as specified in Section 15009; above-ground duct shall be FRP as described in this section. HDPE duct shall be air tested per Section 02604.

B. Where transitions occur from below-ground to above-ground odor ductwork, HDPE shall be installed approximately 12-inches above ground level. Connection to above-ground odor ductwork shall be flanged, with a gasket between adjacent flanges.

C. Ductwork shall be designed and constructed in accordance with ASME/ANSE RTP1 – latest revision.

D. Filament-wound, conforming to the requirements of ASTM D 2310, Type 1, Grade 2, Class E.

E. Contact molded reinforced laminate: Meet or exceed the requirements of ASTM C 582 and PS 15-69.

F. Shop spool duct and fittings as much as possible.

G. Minimize the use of flanges, with butt wrapped joints where required for installation.

H. Welded connections shall not be permitted where such connections would interfere with the removal of valves or equipment or create sections of duct too large for disassembly or for removal from structures.

I. Use butt joints for shop welded joints only, unless approved by the Engineer.

J. Ductwork shall have a flame spread rating of 25 or less.

K. The minimum wall thickness for the odor duct shall be as follows:

Nominal Diameter	Minimum Nominal Wall Thickness
3" to 24"	¼"
28" to 36"	3/8"
42" to 48"	½"
54" to 60"	5/8"
72" and over	¾"

L. Resin

1. Use premium corrosion resistant vinyl ester resin: Hetron 922FR by Ashland Chemicals, Derakane 510A by Dow Chemical, or equal. Add up to 3% antimony trioxide for flame spread resistance. The product shall have a Class 1 flame spread rating (25 or less).
2. Liner Resin: Premium grade and corrosion resistant.
3. UV Absorbers: Add UV absorbers to surfacing resin to improve weather resistance. Duct shall have UV protection as recommended by manufacturer suitable for outside use without painting.
4. Color: Use no dyes, pigments or colorants except in the exterior gel coat.
5. Use no fillers or thixotropic agents unless specified.

M. Reinforcement and Laminate

1. Construction: Inner surface (corrosion barrier), an interior layer and an exterior layer.
2. Inner Surface: Reinforce inner surface with a resin-rich surfacing veil, with a minimum 20 mils thickness. The inner surface shall be free of cracks and crazing with a smooth finish comparable to that achieved by the rotary contact molding method, with an average of not over two pits per square foot, providing the pits are less than 1/8-inch diameter and not over 1/32-inch deep. Pits shall be covered with sufficient resin to avid exposure of inner surface fabric.
3. Interior Layer: Construct interior layer of resin reinforced with at least two plies of chopped strand mat with 25 percent glass and 75 percent resin content, total thickness at least 100 mils.

4. Exterior Layer: the exterior layer or body of the laminate shall be of chemically resistant construction suitable for the service and providing additional strength necessary to meet the tensile and flexural requirements.

   a. For rectangular duct and transitions, chopped strand mat and woven roving layers shall be applied in alternating order to form the composite construction of 70 percent resin by weight. A continuous layer shall be achieved by staggering and lapping layers. The exterior surface shall be relatively smooth and coated to insure no exposed fiber. The top surface of horizontal rectangular duct shall be cambered to avoid ponding of rainwater.

   b. For round duct, filament winding per ASTM D 2996 shall be applied until the minimum wall thickness set forth by the design calculations and specifications is achieved. One layer of woven roving shall be applied after every 3/8" wall thickness of filament winding to allow for exotherming.

   c. Provide a shop applied resin gel coat of a color selected by the Engineer to the exterior of the duct. The final color of the finished joint shall match exactly that of the adjacent piece being joined. The FRP manufacturer shall provide the Contractor with sufficient materials and color pigment as required to fabricate all joints.

   d. There shall be no "soft spots" in any part of the laminate where insufficient catalyst was used and the minimum Barcol hardness shall be at least 90% of the resin manufacturer's established minimum.

5. Woven Roving: Type E glass, nominal 24 ounces per square yard, 4 by 5 weave, with silane type finish.

6. Continuous roving used in chopper gun for spray-up: Type E glass.

7. Continuous roving used for filament winding: Type E glass, with silane type finish.

8. Laminate Quality: Meet requirements of the visual acceptance criteria in ASTM D-2563, Level II for the interior and Level III for the exterior.

9. Reinforcing shall be factory installed with spacing between reinforcing located to avoid all hangers and support saddles.

10. After ductwork is assembled in spooled segment, all duct and filters shall receive a 12 mil exterior gel with UV inhibitors. The color of the gel shall be submitted for approval.

N. Gaskets: Full-faced, 1/8-inch thick, fabricated from ethylene propylene rubber (EPR).

O. Fasteners

1. Bolts: Type 316 stainless steel, ASTM A 193, Grade B8M hex head bolts.

2. Nuts: ASTM A 194, Type 316 stainless steel, Grade 8M hex head nuts.

3. Washers: Type 316 stainless steel.

4. Fabricate bolts in accordance with ANSI B18.2.

P. Flanges and Fittings

1. All fittings shall be of the same resin as and equal or superior in strength to the adjacent duct section, and shall have the same internal dimensions as the adjacent duct. All ducting and duct fittings shall be color coordinated.

2. Construction: Spray-up/contact molding or mitered/hand layup methods for fittings.

3. Thickness: Rated for specified pressure and vacuum, minimum thickness per PS 15-69.

4. Bell and spigot joints shall be sealed with a standard butt joint overlay as per PS 15-69. The interior opening between the bell and spigot joint shall be sealed with a resin paste so that no glass fibers are exposed and all voids are filled.

5. Total width of overlay for butt-wrap joints: 6-inches minimum for 6 to 30-inch duct; 10-inches minimum for 36-inch duct and larger.

6. Provide flanges with spot-faced back, flat and parallel with the flange face, of sufficient diameter to accept an SAE metal washer under the bolt head or nut. Drill per NBS PS 15-69 Table 2, having a minimum thickness of ¾".

7. Unless restricted by space constraints, bends shall have a minimum radius of 1.5 times the duct diameter. Under no circumstances shall bends have a radius less than 1.0 times the duct diameter. Duct elbows shall be smooth radius.

Q. Dampers

1. Furnish dampers for all odorous air duct as shown on the Drawings. All odor control dampers shall be FRP unless otherwise noted on the drawings as stainless steel. Dampers shall be butterfly type control dampers suitable for corrosive environments. Dampers shall include operator, actuator, handwheel, chain wheel, extension stem, worm and gear operator, operating nut, chain, wrench, and accessories, as necessary, for a complete operation. The dampers shall be designed to meet the following criteria:

   a. Construction: Round, flange ends.
   b. Body material: FRP.
   c. Disc material: FRP.
   d. Shaft, crank lever, and hand quadrant, when used: Type 316 stainless steel.
   e. Operator: Manual operated as shown on the Drawings. Operator shall be provided with means of locking in a selected damper position. Mark the extended damper shaft and align the operating handle to indicate the blade position.
   f. Flanges: All dampers shall have flanged ends. Provide Type 316 stainless steel bolts, nuts and washers.

g. Inside of frame shall be clean and smooth with no blade stops or similar projections.

2. Damper frames shall include through bolt holes for erection between flanged sections of connecting duct work. Damper shall include a firm, Viton, Fluorel, or EPDM seal securely fastened to blade. Leakage through damper in closed position shall not exceed 0.029 SCFM per inch of blade circumference at a pressure differential of 14.5-inches W.C.

3. Damper shall include adjustable double gland shaft seals just external of the frame. Shaft seals shall prevent air leakage from inside damper frame to outside atmosphere.

4. Damper shaft shall be continuous solid 316 stainless steel extending through the entire diameter of the damper and outside one damper bearing a minimum of 6-inches. Shaft shall be supported in sealed relubricatable ball bearings enclosed in cast iron housings mounted external to the damper frame.

5. Damper metal hardware shall be fabricated from 316 stainless steel. All parts shall be non-corrosive when subject to conditions and constituents described herein.

6. All dampers shall be hand wheel operated with OPEN-CLOSE indicators permanently affixed to the damper. Chain-wheel operators shall be provided on dampers installed higher than six (6) feet above finished floor (or grade). Chains shall be type 304 stainless steel or other corrosion resistant material.

7. All metal parts shall be isolated from corrosion. Dampers shall be located to isolate all inlet points and for ease of access for operation.

8. Dampers shall carry the AMCA Certified Ratings Seal for air leakage and shall be tested as specified hereinabove.

9. Provide an 8-inch x 8-inch hatch to inspect the damper blade and seal on all dampers greater than 24-inches in diameter.

10. Provide test part for balancing the odor control air flow rate from each structure.

R. Operators

1. Manual Operators

a. Operator force shall not exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator shall be used when force exceeds 40 pounds.

b. Operator shall be self-locking type or equipped with self-locking device.

c. Provide in actuator control enclosure.

S. Accessories

1. Hangers and Supports

a. All duct supports, interior and exterior, shall meet the requirements for supports of plastic piping stated in Specification Section 15020-Pipe Supports, except that hangers and supports for fiberglass duct shall generally be located not more than 10 feet on center.

b. All ducting shall be designed to be self-supporting between the duct supports shown on the Drawings. Loads to be considered shall include self-weight plus all applicable combinations of snow and/or wind loading in accordance with the Building Officials and Code Administrators National Building Code, latest edition. All ducting shall also be designed to withstand a vacuum pressure equal to the design static pressure of the scrubber fans as specified herein, acting concurrently with the above load combinations.

c. The maximum unsupported spans shall be as follows. Maximum hoop deflection at unsupported span lengths shall be 1% of the duct nominal diameter, including all service loads.

d.

Duct Inside Diameter (Inches)	Maximum Span (Feet)
3 – 14	10
16 – 42	18

e. It shall be the Contractor's responsibility to verify that duct adjacent to butterfly dampers shall be adequate to support the added weight of the damper given the location of the duct support system. If extra ribbing is required, it must be covered with fiberglass and bonded in such a fashion as not to come loose in transit or under vibration. The maximum deflection shall not exceed 2% at any given point over a ten-foot length.

f. All hangers and supports shall be manufactured from aluminum for corrosion resistance.

g. Duct supports located on the exterior of the building shall be designed to include the weight of the duct and to withstand all applicable combinations of snow and/or wind loading in accordance with the National Building Code (BOCA), latest edition. Exterior supports shall be located as shown on the Contract Drawings and shall be of the "saddle type" support as per the standard detail shown on the Drawings.

h. Provide saddles, guides, sleeves, sleeve liners, etc. as recommended by the manufacturer.

i. Provide supports with spacing as shown on the Drawings. Where no supports are shown on the Drawings, the scrubber manufacturer shall design the necessary supports and spacing, per the manufacturer’s requirements and Specification herein. Support and

hanger details and a detailed layout showing the location of all duct supports and hangers shall be submitted in the shop drawings.

j. All duct hangers shall be provided per SMACNA recommendations and manufacturers requirements. Hangers are to be securely fastened to avoid vibration and care shall be taken to install hangers so as to avoid creating conditions of stress in the finished installation.

k. Supports shall be designed to accommodate thermal expansion of the FRP ducts for a temperature range of 100 degrees F. through the use of sliding surfaces or location of expansion joints.

l. Coordinate location of supports to avoid conflicts with ductwork, piping, walking paths, etc.

2. Flexible Connections and Expansion Joints

a. Flexible connections and expansion joints shall be furnished and installed as determined by the manufacturer and where indicated on the Drawings. Flexible connections shall be used in rigid FRP ducting systems for lateral, torsional, angular and axial movement due to expansion/contraction and vibration. Flexible connections may also be utilized for minimal ducting alignment.

b. Flexible connections and expansion joints shall be constructed of multiple layers of vulcanized polyester tire cord fabric reinforcement, sandwiched between 60-70 durometer EPDM elastomer inner liner and exterior cover. Tire cord fabric shall be layered at an optimal bias angle with Resorcinol Formaldehyde latex for superior rubber-to-fabric bonding.

c. 316 stainless steel back up retainers and 316 stainless steel nuts, bolts and washers shall be provided.

d. All hardware and materials shall be suitable for hydrogen sulfide laden corrosive atmospheres. All materials shall also be capable of resisting UV rays.

e. Flexible connections and expansion joints shall be of seamless construction, built as one continuous piece with integral molded, hollow arched volutes permitting up to 4 inches of axial contraction and expansion.

f. Flexible connections shall be designed to allow for a minimum of 1 inch of offset movement in any direction.

g. Flexible connections shall be designed to withstand a maximum of 3 psi vacuum and 5 psi pressure.

h. Flexible connections shall be rated to withstand a maximum temperature of 220 °F continuous service with 250 °F intermittent spikes.

i. Flexible connections are to be provided for connections to fans or equipment shall be flanged. Supports shall be provided where necessary to avoid strain on the flexible connector. The Contractor shall verify flange dimensions, location and elongation requirements with the scrubber fan manufacturer.

j. Provide expansion joints where shown on the Drawings and where required to accommodate thermal expansion.

k. Provide flanges in accessible locations for removal of flexible connections and expansion joints.

3. Air Intakes

a. Provide screens on all duct intakes. Screens shall be removable for cleaning or replacement.

b. Intake hoods as shown on the Contract Drawings shall be fabricated from the same material as the ductwork.

2.04 SURFACE PREPARATIONS AND PAINTING

A. All non-galvanized, non-stainless steel metal surfaces shall be cleaned and shop primed in accordance with Section 09900.

B. After laminate inspection has been completed, touch-up duct with field applied resin gel coat. Match color to factory applied gelcoat, using resin supplied from duct manufacturer. Obtain Engineer's approval for uniform quality of field and factory applied gel coats.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling.

B. Prevent end damage and prevent dirt and moisture from entering ducts and fittings. Where possible, store ductwork inside and protect from weather. If necessary to store outside, store above grade and enclose with waterproof wrapping.

3.02 INSTALLATION OF FIBERGLASS DUCTWORK

A. Examine areas and conditions under which fiberglass ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

B. Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service.

C. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth.

D. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

E. Field Fabrication: Complete fabrication of work at project as necessary to match shop- fabricated work and accommodate installation requirements.

F. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment.

G. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

H. Provide 1 inch condensate drains with ball valves at low points along xxx of the ductwork to be selected by the Engineer at time of shop drawing review.

3.03 EQUIPMENT CONNECTIONS

A. Connect fiberglass ductwork to equipment as indicated on the drawings. Provide flexible connectors for each ductwork connection to equipment.

3.04 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.05 PAINTING

A. All paint and coatings shall be shop applied in accordance with Section 09900 - Painting, unless approved by the Engineer. Any painted surfaces that are damaged during handling, assembly, shipping, storage, and installation shall be cleaned, scraped back to soundly adhering paint, and repainted to equal the original painting received at the shop.

3.06 LEAKAGE TESTING

A. General: Perform air test of entire duct system.

B. Ductwork Testing:

1. The installed duct systems shall be pressurized to a test pressure or vacuum of 150 percent of the allowable operating vacuum.

2. All joints shall be soap tested for air leakage at the test pressure. All leaks shall be repaired in accordance with supplier recommendation subject to ENGINEER’s acceptance before system start-up.

3. Testing must be in accordance with a procedure submitted by the CONTRACTOR to the ENGINEER for approval. Testing must be witnessed by the ENGINEER.

3.07 BALANCING

A. The CONTRACTOR shall secure the services of an AABC Independent "Test and Balance" firm acceptable to the ENGINEER to perform final balancing of the scrubber system as follows:

1. Commencement of Work: Balancing shall not begin until the system has been completed and is in full working order, or, at the direction of the ENGINEER, any part thereof shall be placed in operation for the purpose of balancing.

2. Scheduling: The CONTRACTOR shall allow the balancing agency to schedule their Work in cooperation with all trades involved to comply with completion date.

3. Plans and Data: The CONTRACTOR shall furnish to the balancing agency one complete set of all approved equipment submittal data, up-to-date plans and shop drawings.

4. Performance Data: Air volume and velocity data shall be recorded and submitted to the ENGINEER. Air volumes and velocities shall be determined and tabulated at each air pickup. Dampers, control devices and fan dives shall be adjusted (including the exchange and installation of fan drive sheaves, as required) to obtain the indicated air quantities. All dampers shall be clearly and permanently marked at final setting for reported air balance. Reported CFM shall be permanently marked at each fan, damper and splitter. Work shall be performed in accordance with procedures and standards described in SMACNA Balancing and Adjusting Manual. Reports shall be made on SMACNA forms.

5. Operating Instructions: At the conclusion of the Work, the CONTRACTOR shall thoroughly instruct the OWNER's representatives in the efficient operation of the installation.

B. Air flow rates shall be balanced via use of dampers at each structure as follows:

Air Flow RATE per Structure

Old IPS inlet box	cfm	500
Existing IPS screening channels	cfm	2100
New outlet box	cfm	1100
New IPS pump station inlet box	cfm	1800
New IPS	cfm	4600

END OF SECTION

SECTION 13300
PROCESS INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The new Influent Pump Station will be integrated into the existing SWRF SCADA System network. Two new PLCs (one primary, one cold standby) will communicate via PROFINET with new pump VFDs and valve actuators.

B. The new IPS controllers will communicate with intelligent devices and other existing PLCs over PROFINET, and with the SWRF central SCADA system over Ethernet TCP/IP.

C. The PLCs and related control system equipment shall be proprietary, as manufactured by Siemens, to ensure compatibility with the existing control system.

D. The central SWRF SCADA System will be upgraded. Upgraded components include SCADA Servers, Historical server, operator workstations, network switches, and other components as shown on the drawings.

E. The existing Influent Pump Station PLC (PLC-04A) will be removed. Existing PLC 04A I/O that is no longer active will be abandoned. Existing I/O that remains active will be consolidated on new I/O modules in the existing location.

F. The SWRF SCADA fiber optic network will be expanded to include the new Influent Pump Station PLC(s).

G. A single Instrumentation System Supplier (ISS) shall furnish all services and equipment defined herein and in other Specification Sections as listed below under Related Work, and as shown on Instrumentation Drawings.

H. The ISS shall provide all materials, equipment, labor, and services required to achieve a fully operational system. The ISS shall design and coordinate the instrument and control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these Specifications and with related existing equipment.

I. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided by other suppliers under other Sections of these Specifications, shall be included whether they are shown on the instrument drawings or not.

J. Substitutions on functions or type of equipment specified will not be acceptable. In order to ensure the interchangeability of parts, the maintenance of existing equipment, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to ensure compatibility between all equipment, it shall be the responsibility of the ISS to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices or communications interface devices that might be required.

K. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detailed Drawings, Specifications, engineering data, instructions and recommendations of the equipment manufacturer as accepted by the Engineer.

L. To facilitate the Owner's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model to the extent possible.

M. Equipment removed in the course of this work shall be the property of the Owner. ISS shall coordinate with Contractor and Owner in the removal of all designated existing equipment.

N. The Orange County South Regional Water Reclamation Facility is an operating facility, and all work shall be coordinated with its operating personnel to minimize impact on its daily operation.

O. All equipment and installations shall satisfy applicable Federal, State, and local codes.

P. Supplementing this Section, the Drawings and the related Specification sections provide additional details showing panel elevations, instrument device schedules, functional requirements of the system, and interaction with other equipment.

Q. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner such that the monitoring and control functions are available when the equipment is ready to be placed into service.

1.02 RELATED WORK

A. The ISS shall furnish all materials, labor and services specified in the following Specification Sections required to ensure a single, coordinated system is supplied:

1. Section 13530 – Programmable Logic Controllers (PLC) and Digital Equipment
2. Section 13305 – Application Engineering Services
3. Section 13315 – Field Instrumentation
4. Section 13320 – Fiber Optic Data Highway Network
5. Section 13325 – Control Panels And Panel Mounted Equipment

B. Divisions requiring coordination shall include, but not be limited to, the following:

1. Division 11 – Equipment
2. Division 13 Special Construction
3. Division 15 – Mechanical
4. Division 16 Electrical

1.03 COORDINATION MEETINGS

A. The ISS shall schedule three (3) mandatory coordination meetings. The meetings shall be held at the Owner's or Engineer's offices and shall be attended by, as a minimum, attendance by the Owner, the Engineer, the ISS project engineer, the Application Programming Supplier (APS) as defined in Section 13305, and the Electrical Subcontractor.

1. The first meeting shall be held in advance of the first ISS shop drawing submittal. The purpose of the meeting shall be for the ISS to: summarize their understanding of the project; discuss the design intent and philosophy of each control loop to assist in development of loop narratives; discuss any proposed substitutions or alternatives; schedule testing and delivery milestone dates; discuss number and type of graphic display and report modifications; provide a forum for the ISS, APS, Engineer and Owner to coordinate hardware and software related issues; discuss exact number and content of submittals; and request any additional information required from the Engineer and Owner. The ISS should bring draft working documents to the meeting to provide the basis for the Engineer's and Owner's input into their development.

2. The second meeting shall be held after the first complete shop drawing package has been reviewed by the Engineer and returned to the ISS. The purpose of the second meeting is to discuss comments made on the submittal package; to refine scheduled milestone dates; and to provide a forum for any further required coordination, ensuring that the design intent is preserved.

3. The third meeting shall be held prior to factory acceptance testing. The purpose of this third meeting is to discuss any remaining coordination requirements.

1.01 SUBMITTALS

B. Submit Shop Drawings in accordance with Section 01300. These Shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Submittals shall be made electronically, with one hard copy maintained on-site by the Construction Manager.

C. Project Plan Submittal

1. The Project Plan shall provide an overview of the proposed system including the approach to work, proposed system architecture diagrams (both Ethernet and PROFINET/PROFIBUS), a preliminary bill of materials of major items to be provided, the proposed work schedule indicating milestones and meetings, project personnel and organization, overviews of testing procedures and training, and a paragraph by paragraph review of the Specifications indicating any proposed deviations.

2. The schedule shall illustrate all major project milestones including the following:

a. Schedule for all subsequent project submittals.

b. Tentative dates for all project design review meetings.
c. Schedule of manufacture and staging of all instrumentation and control system equipment.
d. Schedule for all tests.
e. Schedule for shipment of all instrument and control system equipment and all peripheral devices.
f. Schedule for equipment startup.
g. Schedule for all training.

3. The project personnel section shall include the project manager, project engineers and all field technicians/staff anticipated to be used on this project. Provide up to date resumés for all personnel identified.

4. The Project Plan must be submitted and approved before any further submittals will be accepted.

5. Provide the Project Plan in Project Management software format, such as MSProject or Primavera.

D. Instrumentation Submittal

1. This submittal shall provide complete documentation of all field instruments, panel components, and other instrument and control equipment not specified to be submitted elsewhere.

a. Provide data sheets for each component listing all model numbers, optional, and ancillary devices that are being provided. The data sheets shall be provided with an index and proper identification and cross referencing. They shall include but not be limited to the following information:

i. Plant Equipment Number and ISA tag number per the Loop Diagrams.
ii. Product (item) name used herein and on the Contract Drawings.
iii. Manufacturer's complete model number.
iv. Location of the device.
v. Input output characteristics.
vi. Range, size, and graduations.
vii. Physical size with dimensions, enclosure NEMA classification and mounting details.
viii. Materials of construction of all components.
ix. Instrument or control device sizing calculations where applicable.
x. Certified calibration data on all flow metering devices.

2. Provide equipment specification sheets which shall fully describe the device, the intended function, how it operates, and its physical, environmental and performance characteristics. Each data sheet shall have appropriate cross references to loop or equipment identification tags. As a minimum the specification sheets shall include the following:

a. Dimension, rigid clearances.
b. Mounting or installation details.
c. Connection.
d. Electrical power or air requirements.
e. Materials of construction.
f. Environmental characteristics.
g. Performance characteristics.

3. Detailed drawings covering control panels and/or enclosures which shall include:

a. Cabinet assembly and layout Drawings to scale. These shall include both front and rear layouts.
b. Loop drawings for all control loops.
c. Fabrication and painting specifications.
d. Color selection samples for selection by the Engineer.
e. Panel wiring diagrams showing all power connections to equipment within and on the enclosure, combined panel power draw requirements (volts, amps), breaker sizes, fuse sizes, and grounding. This wiring diagram shall be in ladder logic format and shall reference the appropriate Loop Drawing for continuations or details where required. Show all wire numbers and terminal block designations.

4. The submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the ISS to proceed with the detailed site preparation for all equipment.

5. This submittal shall include:

a. A list of and descriptive literature for tools, spares, expendables, and test equipment as specified in Instrumentation Specifications.
b. A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the ISS.
c. Unit and total costs for the additional spare items recommended for each subsystem.
d. Storage instructions for all spare parts.

E. Digital System Hardware Submittal

1. This submittal shall provide complete documentation of the proposed system equipment other than that included in the Instrumentation submittal: PLCs, communications equipment, peripherals, fiber optic cable, network interface hardware, media converters, etc.

2. Provide a complete system block diagram(s) showing in schematic form, the interconnections between major hardware components such as: panels, power supplies, PLCs, OITs, computer and peripheral devices, servers, local digital processors and like equipment. The block diagram shall reflect the total integration of all digital devices in the system and shall reflect any HMI locations. All components shall be clearly identified with appropriate cross

references to the location of each. The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.

3. Provide a data sheet and manufacturer cut sheets for each hardware component listing all model numbers, optional, auxiliary and ancillary devices that are being provided. The data sheets shall be provided with an index and proper identification and cross referencing.

4. The Digital System Hardware submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the ISS to proceed with the detailed site preparation for all equipment.

5. The ISS shall provide fiber optic power budget for each cable run in excess of 500 feet. Cable budget shall include transmitter power, receiver sensitivity, connector losses, cable losses and a 3 dB aging margin. Fiber optic transmission line shall maintain a minimum of 3 dB safety margin.

6. This submittal shall include:

   a. A list of and descriptive literature for tools, spares, expendables, and test equipment as specified in Instrumentation Specifications.
   b. A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the ISS.
   c. Unit and total costs for the additional spare items recommended for each subsystem.
   d. Storage instructions for all spare parts.

F. Testing Submittals

1. The test plan shall be submitted after all hardware submittals have been approved by the Engineer.

2. The test plan shall demonstrate that the ISS has designed and configured a system that meets the design specifications. The documents for the test plan shall be structured so that the Owner understands what the inputs are, what the predicted outputs should be and what the actual outputs are. The test plan should have sign off and date block for the ISS, the Engineer and the Owner, and where applicable, the APS.

3. The complete test plan should include as a minimum descriptions for the following:

   a. System hardware and software summary.
   b. A schedule for the testing describing the specific tasks to be performed and the time allotted for each.
   c. Communications test to the various PLCs for Discrete and Analog I/O data transfer.

d. Communications test to VFDs using PROFINET, to valve actuators using PROFINET, and any other intelligent devices using PROFINET or PROFIBUS.
e. 100 percent I/O point test including all spare points based upon the previously submitted System I/O list.

4. Test Procedures: Submit the procedures proposed to be followed during the test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests.

a. Preliminary test procedure submittals: Prior to the preparation of the detailed test procedures, submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and checklists. The same test forms may be used for unwitnessed and witnessed tests.
b. Test Procedure Submittals: After the preliminary test procedure submittals have been reviewed by the Engineer and returned stamped either "approved" or "approved as noted, confirm" submit the proposed detailed test procedures. Testing may not be started until all Testing Submittals have been approved.

5. Test Documentation: Submit a copy of the signed off test procedures upon completion of each required test.

G. Training

1. The training plan shall include:

a. Definitions of each course.
b. Specific course attendance.
c. Schedule of training courses including dates, duration, and locations of each class.
d. Resumes of the instructors who will actually conduct the training.

H. Refer to related sections of the specifications for other required submittals.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM).

1. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

B. International Society of Automation (ISA)

1. ISA-5.1 – Instrumentation Symbols and Identification
2. ISA-5.2 Binary Logic Diagrams for Process Operations
3. ISA-5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems
4. ISA-5.4 Instrument Loop Diagrams
5. ISA-5.5 – Graphic Symbols for Process Displays

C. American National Standards Institute (ANSI)

1. ANSI X3.5 Flowchart Symbols and Their Usage in Information Processing

D. National Electrical Manufacturers Association (NEMA)

1. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The ISS shall perform all work necessary to select, furnish, install, connect, and place into operation all hardware specified within this Division.

B. Actual installation of the system need not be performed by the ISS's employees; however, the ISS shall be responsible for the onsite technical supervision of the installation.

C. The ISS shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

D. The ISS shall be one of the following without exception:

1. Revere Control Systems
   2240 Rocky Ridge Rd.
   Birmingham, AL 35216
   TEL: (205) 824-0004

2. Curry Controls Company
   P. O. Drawer 5408
   Lakeland, FL 33807
   TEL: (863) 646-5781

1.06 SYSTEM DESCRIPTION

A. The responsibilities of the ISS shall include, but not be limited to, the following:

1. Furnish and install all field devices and instrumentation as shown on the Contract Drawings and called out in Sections 13300 and 13315.

2. Furnish and install the new PLC panels, fiber optic patch panels, and other control panels (except those indicated as furnished by others), as shown on the Instrumentation Drawings. Provide modifications to existing control panels as required. Panels and panel components shall conform to the requirements of Sections 13300, 13530 and 13325.

3. Demolish and/or decommission equipment in the existing Influent Pump Station as shown in the Drawings and I/O list. Disconnect all I/O associated with demolished, abandoned, or mothballed equipment. Remove disconnected I/O wiring.

4. Applications software programming, including PLC ladder logic, Human-Machine Interface (HMI) graphics, Operator Interface Panel (OIP) graphics, networking, redundancy, database, reports, and database programming, will be provided by the Applications Programming Supplier (APS), as defined in Section 13305.

B. ISS shall refer to the Contract Drawings and the Specifications for complete information concerning all equipment and services to be furnished under this contract.

1.07 DELIVERY, STORAGE AND HANDLING

A. Identification

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

2. A permanent plastic tag, black letters on white background, shall be firmly attached and permanently and indelibly marked with the instrument tag number, as given in the Drawings, to each piece of equipment supplied.

B. Storage

1. Equipment shall not be stored out of doors. Equipment shall be stored in dry permanent shelters including in line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be replaced by the ISS at his own cost and expense.

1.08 PROJECT/SITE REQUIREMENTS

A. Elevation. Equipment shall be designed to operate at a ground elevation of approximately 15 to 20 feet above mean sea level. Equipment mounted below grade shall be NEMA Type 4X, 6, or 6P.

B. Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 80 percent relative, non-condensing humidity. Provide closed-loop temperature control where required to prevent condensation.

C. Refer to Section 13325 for other environmental requirements.

1.09 TOOLS, SPARE PARTS AND EXPENDABLES

A. In addition to those defined in related Specification Sections, furnish the following, or approved equals.

B. Tools

1. Handheld multifunction calibrator, Fluke 754, with complete set of instrument modules, leads and clamps, belt holster, and spare batteries/battery charger.

2. Handheld calibrator for PROFIBUS instruments and networks, with complete set of instrument modules, leads and clamps, M12 connectors and T-pieces, and spare batteries/battery charger. Provide PROFIBUS Tester 5 (BC-700-PB) as manufactured by Softing Industrial, or approved equal.

3. Handheld calibrator for PROFINET instruments and networks, with complete set of power supply unit, patch cable, terminating plug, PC software, and carrying case. Provide Industrial Ethernet Tester BC-200-ETH as manufactured by Softing Industrial, or approved equal.

4. Include calibrator calibration software necessary to enable electronic retention of information.

C. Spares and Expendables

1. Spare parts shall be as defined in the related specification sections. All spare parts shall be new and unused.

2. All spare parts shall be individually packaged and labeled, and packed in a manner suitable for long term storage and adequately protected against corrosion, humidity and temperature.

3. Provide one quart of touch up paint, for each type and color used for all cabinets, panels, consoles, etc.

1.10 FINAL SYSTEM DOCUMENTATION

A. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished. The ISS shall submit the final documents after the review and acceptance of the Engineer as specified in Section 01300.

B. Provide at least the following documentation as a minimum:

1. A comprehensive index.

2. A complete "As Constructed" set of corrected and completed Shop Drawings.

3. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

4. Full specifications on each item.

5. System schematic drawings "As Constructed", illustrating all components, piping and electrical connections of the systems supplied under this Section.

6. Detailed service, maintenance and operation instructions for each item supplied.

7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

8. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic Drawings and instructions.

9. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

C. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation.

Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

E. If the ISS transmits any documentation or other technical information which he considers proprietary, such information shall be so designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

F. The requirements for the final documentation are as follows:

1. As built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the System resulting from the Factory and/or Field Acceptance Tests shall be incorporated in this documentation.

2. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the System in good operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:

a. Operation Information This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

b. Preventative Maintenance Instructions These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

c. Corrective Maintenance Instructions These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

d. Parts Information This information shall include the identification of each replaceable or field repairable module. All parts shall be

identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between the Instrumentation System Supplier's part number and manufacturer's part numbers shall be provided.

G. Electronic O&M Information

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals on CD-R or DVD-R. Electronic documents shall be supplied in PDF format or as specified below.

2. Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Word and .pdf format as applicable.

3. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat .pdf format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.

4. Each PLC, OIT, server, and PC shall be backed up onto CD-R or DVD-R after Final Completion and shall be turned over to the Owner. Provide all final as-built PLC, OIT, and HMI project files in their respective native formats. Each file must contain all instruction and rung comments.

PART 2 - PRODUCTS

2.01 GENERAL EQUIPMENT REQUIREMENTS

A. Instrumentation

1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals which are established standards for the water and wastewater industries.

2. Digital or discrete (on/off) control signals shall be 24 VDC. Analog measurement signals shall be 24VDC, 4-20 mA. No zero based signals will be allowed.

3. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

4. Wall- or surface-mounted instruments that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

5. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Electrical Drawings, to comply with the National Electrical Code.

6. All indicators and recorder read outs shall be linear in process units, unless otherwise noted.

7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent.

8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

9. All equipment, cabinets and devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

10. All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC compliant.

B. Electrical

1. All equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplied required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. Materials and equipment used shall be U.L. listed wherever available.

3. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

4. Existing signal and control wiring may be wired through intermediate junction boxes/termination cabinets. Note that all new wiring shall not utilize junction boxes or termination cabinets, but shall be connected directly between PLC or other control system panels, and field devices, equipment or motor control panels.

C. Appurtenances

1. Signal converters, signal boosters, amplifiers, power supplies, special cables, special grounding, isolation devices, and similar appurtenances shall be furnished as needed for proper performance of the equipment.

2.02 SCADA AND CONTROL SYSTEM EQUIPMENT

A. SCADA Servers

1. Provide, install, and configure new SCADA servers as shown on the drawings.

2. Meet the following requirements:

   a. Processors: Intel Xeon E5-2699A v4 2.4 GHz, 55M Cache, 9.60GT/s QPI, Turbo, HT, 22C/44T. Upgrade to Two Processors.
   b. 2 CPU Standard Processor Thermal Configuration
   c. Memory DIMM type and Speed: 2400MT/s RDIMMs
   d. Trusted Platform Module
   e. Chassis configuration: up to 16 2.5" hard drives, MLK
   f. Performance Optimized Memory Configuration Type
   g. Memory Capacity: 32GB RDIMM, 2400MT/s, Dual Rank, x4 Data Width
   h. RAID 5 configuration for H330/H730/H730P (3-16 HDDs or SSDs)
   i. PERC H730P RAID Controller, 2GB NV cache
   j. Hard Drives: 1.6TB Solid State Drive SATA Mix Use MLC 6Gbps 2.5in Hot-plug drive, S3610
   k. Broadcom 5720 QP 1Gb Network Daughter card
   l. Embedded Systems Management: IDRAC8 Enterprise, Integrated Dell Remote Access Controller Enterprise
   m. Internal SD Module with 1x 8GB SD Card
   n. Internal Optical Drive: DVD+/-RW, SATA
   o. Quick Sync Bezel
   p. Readyrails sliding rails with cable management arm
   q. Power Management BIOS Settings: Power Saving Dell Active Power Controller
   r. Power Supply: Dual, Hot-plug, Redundant Power Supply, (1+1), 1100W
   s. Power cords: NEMA 5-15P to C13 Wall Plug, 125 V, 15 Amp, 10 feet, power cord, North America
   t. Electronic System Documentation and OpenManage DVD Kit
   u. Operating System: Windows Server 2012R2, Standard Ed, Factory Inst, No MED, 2SKT, 2VM, NO CAL
   v. Windows Server 2012R2, STD OS Media Kit with Factory Inst STD DGRD images
   w. 10-pack of Windows Server 2012 User CALs
   x. PCle Risers with uo to 1, x8 PCle Slots +2, x16PCle Slots
   y. ProSupport Plus Hardware Support Services, 7 year Mission Critical 4 hour Onsite Service
   z. ProDeploy Plus Dell Server R Series 1U/2U Deployment services
   aa. Deployment Consulting 1 year 1 Case Remote Consulting Services
   bb. Keep Your Hard Drive, 7 years
   cc. Dell Proactive Systems Management
   dd. Manufacturer: Dell PowerEdge R730 Rack Server, no equal.

3. If the manufacturer/model specified is not available at the time of construction, or has been superseded by a newer model, coordinate and update specific model to be provided with the Owner/Engineer.

B. Desktop Server

1. Provide a desktop server as the new Change Management Desktop SQL Server.

2. Meet the following requirements:

a. Processor: Intel Core i5 or i7, Small Form Factor (SFF) with DVD+/-RW
b. 128GB SSD hard drive
c. 8GB RAM
d. USM keyboard and mouse
e. Display port to DVI adapter 6' cable
f. Three year basic parts warranty
g. Manufacturer: Dell OptiPlex 7040 Small Form Factor

C. Historical Server

1. Provide a Rack mount server as the new Historical Server.

2. Meet the following requirements:

a. 128GB SSD hard drive
b. 8GB RAM
c. USM keyboard and mouse
d. Three year basic parts warranty
e. Manufacturer: Dell PowerEdge 2950

D. Server Software

1. Provide the following software for each Server:

a. Microsoft Windows 10 Professional with IE 11
b. Microsoft Office 2013 Pro or Office 2016 Pro
c. All MS Office apps on the same PC must match version (i.e., Project, Visio, Word)
d. Active X controls: any application requiring the use of Active X controls must be pre-approved by OCU ISS desktop support. At a minimum, meet the following requirements:

i. Packaged as an .MSI file for installation/distribution from the command line.
ii. Must be installed and operated without end user administrator permissions.

e. Java 1.7_55: Only supported version of Java
f. Silverlight: latest version
g. Preference is given to any hosted solution not requiring installation of local software or configuration files.
h. Bomgar or WebEx for remote access

2. All software licenses provided shall be licensed and registered in the Owner's name.

E. Network Connectivity

1. Provide the following for Servers and PCs requiring network connectivity:

   a. AT&T wireless AirCard
   b. Cisco VPN or Shrewsoft VPN

2. Hosted applications must be accessible from devices with automatically assigned network settings (all settings automatically supplied by DHCP, no fixed addresses)

3. For any devices joined to the OCU ISS domain, meet the following requirements:

   a. OCU ISS must install the Operating System and software on the device
   b. OCU ISS must receive a copy of all software and installation instructions.
   c. Hardware must be a standard supported model. Refer to OCU's documentation for supported hardware.
   d. Kace management client and Kaspersky software must be installed.
   e. Must receive Windows updates and computer configuration changes via Active Directory policies.
   f. Only OCU ISS may have administrator rights.
   g. VNC and remote Desktop are not permitted.
   h. Devices must be the same hardware models OCU ISS supports (Optiplex 9010, 9020, 7040).

4. Provide written verification from the supplier/integrator/implementer, on company letterhead, indicating that Orange County standards will be followed when implementing system components.

F. Printers

1. Provide, install, and configure new Ethernet network printers as shown on the drawings.

2. Manufacturer/model: HP Color LaserJet Enterprise Flow MFP M880z+ NFC/ Wireless Direct (D7P71A), no equal.

3. If the manufacturer/model specified is not available at the time of construction, or has been superseded by a newer model, coordinate and update specific model to be provided with the Owner/Engineer.

G. Operator Workstation Monitors

1. Provide and install new Operator Workstation monitors as shown on the drawings.

2. Manufacturer/model: Dell U3415W, no equal.

H. Operator Workstation Computers

1. Provide and install new Operator Workstation computers as shown on the drawings.

2. Provide Dell Optiplex Desktop 3000 series computers, or approved equal.

I. Operator Interface Terminals (OITs)

1. Provide and install a new Operator Interface Terminal on the new Pump Control Panel as shown on the drawings.

2. Provide a panel-mounted PC, 24" LCD monitor, 1920x1080 resolution, VGA+DVI+HDMI, Side OSD, including rear screw/Clamp/VESA Mount with 5 wire Resistive Touch Screen, Intel Core i7-3770T Processor , 4GB Memory, 500GB HDD, 2xCOMs, 1xVGA, 1xHDMI, 4xUSB2.0, 2xSATA, 1xPS/2, Audio, 1xMini-PCIe, 2xGbE LAN.

3. Manufacturer: Provide I-Tech model EMCW2400C-i7, or approved equal.

4. Options: Provide Integrated Stainless Steel Front Bezel, I-Tech model SS_W2400

5. Software:

a. Provide Integrated Windows OS 7 Pro, 64 bit operating system
b. Provide GE Proficy WebSpace

2.03 LIGHTNING/SURGE PROTECTION

A. General

1. Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure. All contact points to be copper with nickel plating. The transient response of units shall be less than 1 nanosecond.

2. The surge protector should meet UL 1449, NEMA LS-1, and IEEE C62.41 Standards, as applicable. This requirement can be met using UL itself or a Nationally Recognized Testing Lab (NRTL) testing to UL standards, in accordance with FTC rules.

3. The manufacturer shall be Current Technology/ Joslyn, Dehn, EDCO, or Surge Suppression Inc. (SSI).

B. Installation

1. The following standards shall be observed:

a. All analog signal lines, or PROFIBUS or PROFINET “daisy chains”, that include an outdoor instrument and a control panel, shall be protected by surge suppressors at all termination points.
b. All 120VAC power to outdoor instruments shall be protected with a local surge suppressor mounted at the instrument, as indicated above. Main power to a panel should be on a circuit breaker.
c. Network cable (other than fiber optic) shall be protected at both ends if it runs beyond the walls of a structure.

2.04 TUBING AND FITTINGS

A. All instrument air header takeoffs and branch connections less than 2-inch size shall be 316 stainless steel.

B. All instrument shut off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. Fittings shall be Swagelok 316 stainless steel or equal and valves shall be Whitney 316 stainless steel or equal.

C. All instrument tubing shall be fully annealed ASTM A269 Seamless 316 stainless steel grade free of O.D. scratches having the following dimensional characteristics as required to fit the specific installation:

1. 1/4 in to 1/2 in O.D. x 0.035 wall thickness.
2. 5/8 in to 1 in O.D. x 0.049 wall thickness.
3. 1 in O.D. x 0.065 wall thickness.
4. 1 1/4 in O.D. x 0.065 wall thickness.
5. 1 1/2 in O.D. x 0.083 wall thickness.
6. 2 in O.D. x 0.095 wall thickness.

D. All process connections to instruments shall be annealed 1/2 in O.D. stainless steel tubing, Type 316.

E. All tube track shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as accepted by the Engineer during construction. Obtain in the field all information relevant to the placing of process control work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work.

B. Provide instrumentation loop diagrams that indicate the interconnection between the individual instruments. Two complete sets of As Constructed shop drawings shall be kept at the job site during all on site construction. Both sets shall be identically marked up to reflect any modifications made during field installation or start up. All markings shall be verified and initialed by the Engineer or his designated representative.

C. Following completion of installation and the operational readiness test, one set of the marked up drawings shall be provided to the Engineer, the other retained by the ISS for incorporation of the mark ups into final as built documentation. Record drawings shall be as called out in Section 01340 of these specifications.

D. The instrumentation installation details on the Contract Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.

E. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the ISS shall bear full responsibility for such violations and assume all costs arising therefrom.

F. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the ISS shall bear full responsibility for such violations and assume all costs arising there from.

G. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

H. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut off valves.

I. Field instruments requiring power supplies shall be provided with local electrical shutoffs and fuses as required.

J. Provide 316 stainless steel brackets and hangers for mounting of equipment.

K. The ISS shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the ISS shall be required to ship his material in sections sized to permit passing through restricted areas in the building. The ISS shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).

L. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

M. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

N. The ISS shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's review. He shall be responsible to ensure that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The ISS hereunder shall schedule and coordinate his work under this section with that of the electrical work specified under applicable Sections of Division 16.

3.02 TESTS (GENERAL)

A. The ISS shall test all equipment, hardware and software, to be furnished under this Contract at ISS's own facility before transporting it to the project site.

B. As a minimum, the testing shall include the following:

1. Unwitnessed Factory Test (UFT).
2. Witnessed Factory Test (WFT).
3. Operational Readiness Tests (ORT).
4. Functional Demonstration Tests (FDT).
5. Performance Acceptance Test (PAT).

C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

D. All tests shall be conducted in accordance with prior Engineer reviewed procedures, forms, and check list. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

E. Copies of these sign off test procedures, forms, and check lists will constitute the required test documentation.

F. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.

G. The ISS shall coordinate all testing with the Engineer, the Applications Programming Supplier (APS), all affected Subcontractors, and the Owner.

H. The Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the previously accepted test procedures.

I. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

J. No equipment shall be shipped until the Engineer has received all test results and the system is ready for shipment.

K. The ISS shall furnish the services of servicemen, all special calibration and test equipment and labor to perform the field tests.

3.03 UNWITNESSED FACTORY TESTS (UFT)

A. The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All control loops and programs shall be tested. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/functions.

B. All panels and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, specifications, and Contract Drawings.

C. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.

D. All PLC, OIP, and HMI software programming, including the integration of PROFIBUS DP, PROFINET, and Ethernet networked devices, must be completed and debugged by the APS prior to the Unwitnessed Factory Test. UFT test results shall include full testing of software and programming.

3.04 WITNESSED FACTORY TEST (WFT)

A. Implicit in the scheduling of the Witnessed Factory Test is the assumption that the ISS has determined through his own tests and quality assurance programs that the equipment is ready for shipment.

B. Prior to start of the Witnessed Factory Test, all previous unwitnessed test results shall have been submitted to the Engineer for review and approval.

C. All system tests specified for the Unwitnessed Factory Test shall be repeated, including software and programming tests.

D. After the Unwitnessed Factory Test approval has been received by the ISS, the ISS shall notify the Engineer, the APS, and the Owner in writing that the system is ready for the Witnessed Factory Test, and allow the Engineer and/or Owner to schedule a test date within 30 days of receipt of the "Ready to Test" notification. At the time of notification, the ISS shall submit any revisions to the detailed test procedure previously approved by the Engineer.

E. The purpose of the test shall be to verify the functionality, performance, and stability of the hardware and software. The system must operate continually for 100 hours

without failure before the test shall be judged successful. Successful completion of this test, as determined by the Engineer, shall be the basis for approval of the system to be shipped to the site.

F. The various tests performed during the Engineer and/or Owner witnessed factory demonstration test shall be designed to demonstrate that hardware and software fulfill all the requirements of the Specifications. The test conditions shall resemble, as closely as possible, the actual installed conditions. Any additional hardware or software that may be required to successfully verify system operation shall be supplied at no cost.

G. The test shall perform but not be limited to the following:

1. Demonstrate operability, and conformance to Specifications and to approve Shop Drawings, of all equipment.

2. 100 percent point check of all I/O including all wiring.

3. Check of all Loops on a loop-by-loop basis, using the programs as installed on all provided equipment, including both OIPs and PC HMI.

4. Demonstrate operability of the data communication network and all devices in it, under anticipated full load conditions.

5. Demonstrate failure modes of all equipment, such as loss of network communications, loss of main power, and loss of CPU in a redundant pair.

H. During the test for a period of time equal to at least 20 percent of the test duration, the Engineer's and/or Owner's representative shall have unrestricted access to the system.

I. All analog control panels shall be included in these tests.

J. All deficiencies identified during these tests shall be corrected and retested prior to completing of the Witnessed Factory Test as determined by the Engineer.

K. The following documentation shall be made available to the Engineer at the test site both before and during the Witnessed Factory Test:

1. All Contract Drawings and Specifications, addenda, and change orders.

2. Master copy of the test procedure.

3. List of the equipment to be tested including make, model and serial number.

4. Design related hardware submittal applicable to the equipment being tested.

L. The Witnessed Factory Test shall generally cover a period of no more than 3 days. The daily schedule during these tests shall be as follows:

1. Testing and meetings: Nominally 8 hours per day; 10 hours per day if required to meet schedule.

2. Morning meetings to review the day's test schedule.

3. Evening meetings to review the day's test results and to review or revise the next day's test schedule.

4. Unstructured testing period by the witnesses.

M. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

N. All costs associated with the Witnessed Factory Testing, including travel, parking, rental car, upscale accommodation and food for one Engineer and up to three of the Owner's representatives, shall be the responsibility of the ISS and shall be included in the Contract price.

O. Should the Witnessed Factory Test fail to perform as required, it shall be rescheduled as many times as necessary to provide a complete working system as specified herein. ISS shall be responsible for all costs associated with Factory Testing for Engineer and Owners' representatives as stated above for each additional test.

3.05 OPERATIONAL READINESS TEST (ORT)

A. General: Prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, tested, and documented) that it is READY for operation.

B. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop by loop and component by component basis to ensure that it is in conformance with related submittals and these Specifications.

1. The Loop/Component Inspections and Tests shall be implemented using Engineer forms and check lists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the ISS:

    a. Project Name.
    b. Loop Number.
    c. Tag Number for each component.
    d. Checkoffs/sign offs for each component.

        i. Tag/identification
        ii. Installation
        iii. Termination wiring
        iv. Termination tubing
        v. Calibration/adjustment

    e. Checkoffs/sign offs for the loop.

        i. Panel interface terminations
        ii. I/O interface terminations
        iii. I/O signal operation
        iv. Inputs/outputs operational: received/sent, processed, adjusted
        v. Total loop operation

    f. Space for comments.

2. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign off by the ISS:

a. Project Name.
b. Loop Number.
c. Component Tag Number of I/O Module Number.
d. Component Code Number Analog System.
e. Manufacturer (for Analog system element).
f. Model Number/Serial Number (for Analog system).
g. Summary of Functional Requirements. For example:

i. For Indicators and Recorders: Scale and chart ranges
ii. For Transmitters/Converters: Scale and chart ranges
iii. For Computing Elements: Function
iv. For Controllers: Action (direct/reverse) control Modes (PID)
v. For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
vi. For I/O Modules: Input or output

h. Calibrations. For example:

i. For Analog Devices: Required and actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
ii. For Discrete Devices: Required and actual trip points and reset points.
iii. For Controllers: Mode settings (PID).
iv. For I/O Modules: Required and actual inputs or outputs for 0, 10, 50, and 100 percent of span, rising and falling.

i. Space for comments.
j. Space for sign off by the ISS.

3. The ISS shall maintain the Loop Status Reports and Components Calibration sheets at the job site and make them available to the Engineer/Owner at any time.

C. These inspections and tests do not require witnessing. However, the Engineer will review and initial all Loop Status Sheets and Component Calibration Sheets and spot check their entries periodically and upon completion of the Operational Readiness Tests. Any deficiencies found shall be corrected.

3.06 FUNCTIONAL DEMONSTRATION TEST (FDT)

A. Prior to startup and the Functional Demonstration Test, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the operational readiness tests.

B. Once the facility has been started up and is operating, a witnessed Functional Demonstration Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop and site by site basis.

C. Loop specific and non-loop specific tests shall be the same as specified under Operational Readiness Test except that the entire installed system shall be tested and all functions demonstrated.

D. Updated versions of Shop Drawings shall be made available to the Engineer at the job site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available to the Engineer at the job site both before and during testing.

E. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.

3.07 PERFORMANCE ACCEPTANCE TEST (PAT)

A. After completion of the Operational Readiness and Functional Demonstration Tests, the ISS shall be responsible, with respect to all components and services provided under this Section, for operation of the entire system for a period of 5 consecutive days, under conditions of full plant process operation, meeting all process requirements, without a single non field repairable malfunction.

B. During this test, plant operating, ISS and APS personnel who have an intimate knowledge of the hardware and software of the system shall be present as required.

C. While this test is proceeding, the Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.

D. Any malfunction during the tests shall be analyzed and corrections made by the ISS and/or the APS as appropriate. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction during this test period, which cannot be corrected within 24 hours of occurrence by the ISS's personnel, or more than two similar failures of any duration, will be considered as a non-field repairable malfunction.

F. Upon completion of repairs by the ISS, the test shall be repeated as specified herein.

G. In the event of rejection of any part or function, the ISS shall perform repairs or replacement within 90 days.

H. The total availability of the system shall be greater than 99.0 percent during this test period. Availability shall be defined as "Avail. = (Total Time Down Time)/Total Time". Down times due to power outages or other factors outside the normal protection devices or back up power supplies provided, shall not contribute to the availability test times above.

I. Upon successful completion of the 5 day PAT and subsequent review and approval of complete system final documentation, the system shall be considered complete and the one year warranty period shall commence.

3.08 TRAINING

A. The cost of Owner training programs shall be included in the Contract price.

B. Operator Training

1. Operator training shall be conducted prior to the Performance Acceptance Testing.

2. All Technicians, Operators, Engineers, and Managers of the Treatment Facility will require training on the System. The Instrumentation System Supplier shall be responsible for providing detailed Operation and Maintenance (O&M) Manuals and training courses. The ISS shall include the APS in conducting training.

3. The O&M Manuals shall include specific details of the equipment supplied and details of operations specific to this Project. The training courses will deal with fundamentals of Programmable Logic Controller (PLC) and Digital Equipment hardware and software, field devices, and maintenance.

4. All instructors must be intimately familiar with the operation and control of the Owner's facility.

5. The training shall be structured as follows:

    a. The system training program shall be structured such that the operating personnel will understand the system's operation, and the functions available in the system.
    b. The level and amount of training will be based on the understanding of the individual staff members. Preventive and corrective maintenance of system devices and hardware shall be presented.
    c. A number of basic theory courses shall be provided to give the operators an appreciation of how the system can help them perform their jobs.

6. The ISS/APS shall provide detailed manuals and shall include specific details of equipment supplied and operations specific to the project.

7. The ISS/APS shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.

8. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

9. On Site Training for operator personnel shall deal with fundamentals of system hardware and software, field devices, instrumentation calibration and maintenance. Training shall cover all aspects of the instrumentation and controls system. Training is expected to cover a period of not less than three (3) eight-hour days.

C. Portal Training

1. Provide a customized manufacturer training course focused on the TIA Portal Programming, and including other programming aspects as appropriate for the SWRF application. Structure training to include portions of standard training courses offered by Siemens SITRAIN. Coordinate course structure and schedule with Owner staff and Siemens SITRAIN. Include aspects of:

a. SIMATIC S7 with TIA Portal
b. S7 Programming 1, 2, 3
c. SIMATIC HMI with TIA Portal
d. TIA Portal WinCC Comfort/Advanced Panel Configuration

2. Course shall be 4 1/2 days in length, conducted on-site in the SWRF Training facility.

3. Base course structure on including 8 OCU attendees.

3.09 WARRANTY / MAINTENANCE REQUIREMENT

A. A written maintenance contract executed by the ISS shall be provided to the Owner for onsite warranty services. This contract shall include all labor and emergency calls providing on site response within 24 hours, to provide complete system operability for a period of one year after the successful completion of the PAT.

B. Provide standard manufacturers' warranties for all equipment supplied, including instrumentation, all SCADA and Control System equipment, process monitoring/control equipment, and associated hardware and software. Warranties shall be extended as necessary to cover the period of one year after successful completion of the PAT. Warranties shall cover products and labor.

3.10 CONTROL SYSTEM DIAGRAMS AND DETAILS

A. To assist the ISS in determining the scope of work, Process & Instrumentation Diagrams (P&IDs) and Details are provided. Unless specifically stated otherwise, the ISS shall be responsible for providing all instrumentation, control equipment and auxiliary devices necessary to perform the functions specified herein and as shown and described on these diagrams. Any auxiliary devices such as lightning/surge protectors, relays, timers, signal isolators, signal boosters, etc. which are necessary for operation shall be included, whether or not they are specifically shown or tabulated on the Drawings.

B. The intent of the P&IDs is to describe in as much detail as practical, the hardware, software and functional requirements of a process measurement and control system. They are not intended to describe all required functionality, such as alarming (fail to start, fail to stop, etc.), process interlocks, alarm buffering and deadbands, scaling, ranging, or any other program functions expected by best practice. These functions are required. Neither are the P&IDs intended to convey requirements for conduit and wiring between panels or system components. This information is included in appropriate Electrical Specifications and Drawings.

END OF SECTION

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SECTION 13305
APPLICATION ENGINEERING SERVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. All work done under this Section, and as shown on Instrumentation Drawings and indicated in Related Work, other than that provided by the Instrumentation System Supplier (ISS) as defined in Section 13300, shall be provided by an Applications Programming Supplier (APS).

B. The APS shall provide all applications programming and services required to achieve a fully integrated and operational system. The APS shall coordinate the control system for proper operation with related equipment and materials under other sections of these specifications and with related existing equipment, especially with the ISS.

C. Auxiliary and accessory programming structures necessary for system operation or performance shall be included whether or not they are shown on the Contract Drawings.

D. All equipment shall be controlled in full conformity with detail Contract Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer.

E. To facilitate the Owner's future operation and maintenance, PLC programming and human interface development shall utilize standards as agreed upon by the Owner and Engineer.

F. The Orange County South Water Reclamation Facility (SWRF) is an operating facility, and all work shall be coordinated with its operating personnel to minimize impact on its daily operation.

G. Supplementing this section, the Contract Drawings and related specification sections provide additional details showing instrument device schedules, functional requirements of the system, and interaction with other equipment.

1.02 RELATED WORK

A. Divisions requiring coordination shall include, but not be limited to, the following:

1. Division 1 - General Requirements
2. Division 11 - Equipment
3. Division 13 - Special Construction
4. Division 15 - Mechanical
5. Division 26 - Electrical

1.03 COORDINATION MEETINGS

A. The APS shall participate in meetings as defined in Section 13300.

1.04 SUBMITTALS

A. Submit shop Drawings in accordance with Section 01300. These Shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Each submittal shall be securely bound with an index and sectional dividers. Drawings shall be reduced to a maximum size of 11-in x 17-in for inclusion within the binder. Separate submittals shall be as follows:

1. Operator Interface and Process Control Strategy
2. O & M Data

B. Submittal Descriptions

1. Operator Interface and Process Control Strategy

a. This submittal shall cover the specific plant control schemes as well as the details of the plant reports and process graphic displays.
b. The submittal shall contain the semifinal details of all logs, reports, and process graphic displays. The specifics of what shall appear on each display and what calculations are required to support them shall be developed and submitted.
c. Submitted process graphic displays shall be no less than 8-1/2 inches by 11 inches and in full color.
d. A complete listing of all signals to be collected for long term historical information shall be provided. This listing shall include frequency of data sampling and duration for which the data shall be immediately accessible.
e. A complete listing of all signals to be collected for trend display shall be provided. This listing shall include frequency of data sampling and duration for which the data shall be immediately accessible.
f. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Specifications. Included with each diagram shall be:

i. Brief scope of the Control Function
ii. Listing of all scanned inputs to the control function
iii. A loop narrative for each control loop
iv. Any assumptions made in developing the program
v. I/O database listing showing all field inputs and outputs (i.e., AI, DI, AO, DO) associated with the control function.
vi. Cross reference list of all I/O showing to which I/O modules or software modules they are linked

vii. Listing of all operator inputs/outputs to and from the control function. Any special HMI or OIT displays related to the function shall be illustrated. A description of the operation of any panels shall be described as it relates to the control function.

viii. Failure contingencies shall be described in detail.

ix. This submittal shall cover all of the associated ladder logic developed under this Contract required to implement the control functions specified.

x. Submit annotated ladder logic in 8-1/2" x 11" format and as a PDF file on CD-ROM for all logic developed. Annotation shall be 3 lines of 6 characters each for every logic contact. In addition, each network or rung shall be annotated so that a non-technical person can read and easily comprehend what control function the rung or network is performing.

g. This submittal shall also include copies of the PLC I/O configuration tables, I/O reference usage table, complete cross reference to specific rung used of all inputs, outputs, internal coils, data registers, and special purpose coils. In addition, any special switch settings or hardware configuration requirements such as communications port configurations shall be described in detail and submitted.

2. HMI graphics programming will be integrated into the existing iFIX/Proficy HMI SCADA System. Submit integration plan for this activity, including graphic installation, database updates, trend updates, historical data collection and storage, and reporting.

3. O & M Data. Provide O & M Data per Sections 01300 and 13300.

1.05 REFERENCE STANDARDS

A. Instrument Society of America (ISA)

1. ISA-5.1 – Instrumentation Symbols and Identification

2. ISA-5.2 - Binary Logic Diagrams for Process Operations

3. ISA-5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems

4. ISA-5.4 - Instrument Loop Diagrams

5. ISA-5.5 – Graphic Symbols for Process Displays

B. American National Standards Institute (ANSI)

1. ANSI X3.5 - Flowchart Symbols and Their Usage in Information Processing, 1987.

1.06 QUALITY ASSURANCE

A. The APS shall be one of the following:

1. Revere Control Systems

2240 Rocky Ridge Rd.
Birmingham, AL 35216
TEL: (205) 824-0004

2. Curry Controls Company
P. O. Drawer 5408
Lakeland, FL 33807
TEL: (863) 646-5781

3. ITG Technologies
11235 St. Johns Industrial Pkwy N., Suite 2
Jacksonville, FL 32246
TEL: (904) 425-4760

4. No Exceptions

B. The ISS and APS may be the same firm.

1.07 SYSTEM DESCRIPTION

A. The APS is responsible for providing all programming and configuration services to accomplish the control and monitoring functions as described in the contract specifications and drawings. The APS shall provide all programming functions including but not limited to control strategies and communications, including the integration of controls using Ethernet and ProfiNet networking protocols. The APS shall also provide all programming and configuration services necessary to produce the operator interface (graphic displays, trends, historical archive, reports, etc.) as described in the Specifications and Drawings.

B. The APS shall coordinate with the ISS in the selection of programmable logic controller (PLC) components, OIT hardware, software, and any other equipment, to ensure that they are adequate for application needs.

C. The ISS will purchase all hardware and software, and deliver it to the APS for programming and configuration. After completion of the Witnessed Factory Test, the APS shall deliver all hardware to the ISS for installation on site. At substantial completion, the APS shall deliver all software to the Owner.

D. The APS shall develop and provide all graphic screens for the systems provided. The graphics shall be designed and function with the plant's existing Human Machine Interface (HMI) software. The developed graphic displays shall represent all existing and new process flow paths and all associated equipment. All processes and equipment shown on the P&ID drawings shall also be shown on the process graphics in a similar manner.

1.08 PROGRAMMING AND CONFIGURATION GUIDELINES AND DELIVERABLES

A. General

1. Upon OIT power on or reset, the system shall automatically boot to, and begin running, the OIT application. Alarms, displays, etc. shall be

functional. User login shall be required for access to all runtime or development functions. Access levels shall be as defined elsewhere in this Section.

2. The Windows environment shall be masked, and not normally available to the Operator. Login shall be required for access to the Windows environment.

3. It is intended that the OIT computers only be used for the OIT applications software.

B. Real Variables Processing

1. Real Variables shall represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at their selected scan frequency, and perform the proper conversions and scaling to obtain the instantaneous engineering values. These values shall be used to update real-time data on OIT/HMI displays, check for alarm conditions, and store for use in the historical files. Scan rate for all analog inputs shall be maximum one minute.

2. The instantaneous values of all variable data shall be displayed on the appropriate HMI screen, and shall be added to the historical database whenever the present value exceeds a preprogrammed compression dead band. The compression dead band will be field adjusted by the ISS to provide for maximum storage utilization.

3. Provide for storage of historical data for an adjustable file period of daily, weekly, monthly, quarterly, or yearly period for the purpose of trends or data analysis.

4. Variables such as rate of flow shall have their instantaneous values integrated with respect to time and their quantities totaled. The storage of each of these totals shall be done on an hourly basis into the historical file.

C. Calculated Variables Processing

1. Calculated variables shall represent process parameters for which there are no direct analog inputs to the system. These variables shall utilize Real Variables, and manually entered constants or laboratory data to compute their value. The computer system shall perform periodic real time calculations upon selected database parameters. Calculations shall be operator configurable, including: PLUS, MINUS, MULTIPLY, DIVIDE, EXTRACT ROOTS, INTEGRATE, DIFFERENTIATE, AND BOOLEAN LOGIC.

2. There shall be two types of calculated variables defined:

a. Calculated Variables which utilize one or more Real Variables and/or manually entered constants. These variables shall be treated in the same manner as Real Variables and shall have the same attributes as Real Variables (including alarming and control), with the exception that the calculation shall be performed automatically every 5 seconds.

b. Calculated Variables which are used only for the Daily, Monthly, and Annual Operation Summary reports, and which utilize laboratory input data shall be computed once a day for inclusion in the Daily report and stored for use in the Monthly and Annual reports. The capability to display these variables shall be provided.

D. Manual Input Data Handling

1. The application software shall provide the capability to manually enter data from any operator's OIT/HMI screen/keyboard. This data shall consist of additional values for the current data file (e.g., laboratory analyses), inserting alarm limits, setpoint changes, adjustments to process constants, control system setpoint changes, and system tuning parameter adjustments.

2. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the data entry device prior to incorporation to the database.

E. Graphic Displays

1. The OIT/HMI system shall support multiple display types including lists, graphics, trends, etc. The ISS/APS shall provide all OIT/HMI Screens necessary for the efficient operation of the system and process as described herein.

2. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers.

3. Generally, graphic displays shall consist of three parts, a menu bar, a process area, and an alarm summary area. The menu bar shall have shortcut buttons to a full page alarm summary, report viewers, HMI network status. It shall also provide a navigational device (such as a pull-down menu) that allows any screen to be called up. The Process area shall show the overview, or more detailed displays. The Alarm area shall show the last four alarms and status. Design of the graphic displays shall maximize the area available for the process area section.

4. Design graphic displays and operator interface functions following current standards and conventions in use at the SWRF.

5. Graphic displays shall make maximum use of the colors available. Colors for status such as open/close, start/stop shall be the same as the indicators on the existing process control system.

6. All items that can be manipulated shall indicate this property by displaying some visual change, such as a bounding box, on mouse-over.

7. The system shall allow the operator to manually control the status of pumps, valves, etc. as indicated on the Drawings. Control shall be provided via a pop- up box, called by clicking on the device, which shall accept keyboard and GUI manipulation. There shall be no secondary acknowledgement required for any

issued command. Equipment that is sensitive to rapidly changing start-stop commands shall be protected by timers in the PLC that enforce a minimum delay between commands. This delay condition shall be indicated, and shall not lock the control pop-up, or otherwise prevent navigation to other displays. Manually entered setpoints, or other variables shall have filters that refuse incorrect settings.

8. Index displays: Provide Index display(s) as a complete and logical listing of the names and number of all screens.

9. Graphics capability shall include conditional color (i.e., where the color of a symbol or value changes upon some condition), and dynamic graphics (i.e. vary symbol presentation based upon its analog value). A hierarchical structure for the displays with a maximum of four levels should be employed. Graphic displays provided shall include:

   a. Process Overview. This shall present the overall process in limited detail to allow the operator to view the complete plant process on a single display.
   b. Individual process schematics. Each process area shall be indicated with a separate graphic. Each display shall depict all elements involved in that particular process area (e.g. pumps, tanks, valves, flowmeters, etc.).
   c. System Status. Provide displays of this type for the Control System Architecture (based on Drawing I-4) and for the Electrical System (graphical and/or text screen). Indicate through color the status of each sub-system (e.g. PLC, communications links, etc.).

10. The Color Code for equipment status is the following: On – Red – Open; Off – Green – Close; Trouble – Yellow– Fail. Equipment that is in alarm shall be flashing until the alarm is acknowledged.

11. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be operator adjustable from the operator interface, with the appropriate access.

12. Pop-ups shall provide the following features:

   a. All status indications, in colored text, pertinent to the device.
   b. All interlocks and permissives, in colored text, pertinent to the device.
   c. All control buttons pertinent to the device.
   d. Process variable display or PID control pop-ups, where needed, shall be in graphical and numerical form. Provide bar graphs that indicate current value, the alarm limits, and if applicable, setpoint and output values.

13. Data Entry displays. Where required, provide pop-ups for manual data entry.

14. Trend control. The operator shall be able to define trends of any variable in the system database (real-time trending) or in the historical database (historical trending) as follows:

a. Trend displays shall present the operator with multiple options (e.g., with or without limits, time scale).
b. A cursor line or point shall be provided which can be moved along the curve to obtain exact readings at any point.
c. It shall be possible to overlay different trend curves to facilitate the comparison of related parameters.
d. It shall be possible to trend up to four different parameters on the same scale, each parameter being represented by a different color.

F. Alarm/Equipment Status Reporting

1. Alarm and Event Logging

a. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.
b. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The status monitoring shall be capable of being disabled and/or suppressed from the operator's console. The equipment status log shall include the time, equipment name, tag number, and the particular change in status. The log file shall be in a readily readable format, such as CSV.
c. The alarm and event log(s) shall be available in an open file format for viewing or printing on demand. Alarm information shall consist of point identification number, point name, time of occurrence, and type and priority of alarm.

2. Alarm and Status Reports

a. Equipment and Point Status Summary Report. This report shall list the status of all points in the system, including contact inputs, real variables with analog inputs, and calculated variables. This report will be initiated manually, and shall consist of the tag number, tag name, and its current status (i.e., Running, Off, High, Low, Active, Disabled, ON-scan, OFF-scan, etc.).
b. Alarm Summary Reports

i. Provide the ability to generate reports listing alarm data for:

I. the current day;
II. the previous day;
III. all points currently in alarm;
IV. disabled alarms;
V. current lockout/tag out status;
VI. alarm validation.

ii. Normally, this report shall be initiated manually but provision shall be made so that it may be initiated automatically every day if desired.

iii. The capability shall be provided to sort both daily and current alarm summary reports by operator defined groups. (i.e., print all power failure alarms, all suppressed alarms, etc.)

G. Control Standards

1. The following control standards shall be implemented in conjunction with all project drawings. Include these features where applicable as described herein, whether indicated directly in the P&IDs or not.

2. All programming and development functionality of each PLC shall be available via the Ethernet network. This capability shall be password protected to allow access by supervisory personnel who are given clearance by the Owner.

3. All instrument and equipment data registers that are available for a given device through a digital network (e.g. Profinet) shall be mapped to tags in the associated facility PLC, whether called out in the Drawings and Specifications or not. Only the points actually required for system functionality shall be polled, displayed, recorded and/or trended. The other registers shall be left disabled for future use.

4. For all "package systems" provided by vendors other than the ISS, coordinate with the equipment submittals to verify the I/O and data points that are shown in the Loop Diagrams.

H. Disagreement Alarms

1. For all controlled devices such as pumps, valves, gates, etc., if the device is commanded to Start or Stop (or Open or Close) by the PLC, and the device feedback state does not match the commanded state within a preset time delay, an equipment Disagreement Alarm is generated by the PLC for display and alarming at the HMI, and the device is commanded to Stop (valves shall remain in the last state).

2. If a duty pump, or system, is commanded to start and does not start within the preset time, the standby pump, or system, shall be commanded to start.

3. If a device feedback state does not match the commanded state at any time, excluding the change of state described above, an equipment Failure Alarm is generated by the PLC for display and alarming at the HMI and the device is commanded to Stop (valves shall remain in the last state).

4. The default time delay for all equipment shall be 90 seconds.

5. After a Disagreement Alarm occurs the device cannot be started (or Opened/Closed) again until a Reset has been issued by the Operator at the HMI.

6. All controlled devices with feedback shall indicate Failure alarms on the associated process graphic displays even if not shown on the Drawings.

7. All analog alarms generated in the PLC or at the HMI (such as a high level alarm) shall be generated as follows: If the analog point's value exceeds or drops below the alarm limit value for a preset time period, then an alarm shall be generated. To eliminate excessive alarm reporting, the analog point shall remain in alarm until the analog point's value returns beyond the limit set by the analog limit deadband. Only the alarms shown in the Loop Diagrams shall be configured; standard process limit alarms (i.e. low- low, low, high, high-high) that are not used shall be disabled in the software.

8. For analog measurement points (such as level, flow, pressure, speed, position, etc.) where indicated on the drawings, if the value of the analog point changes by more than a preset deadband since the last time the analog point was scanned, a Rate-of-Change Alarm shall be generated at the HMI. The alarm shall remain in effect until it is logged at the HMI and the change in value falls to less than the preset deadband the next time the analog point is scanned. All analog points shall indicate a Rate-of-Change Alarm on the associated process graphic displays even if not shown on the loop drawings

9. For analog measurement points, an Out-of-Range alarm shall be generated when the signal exceeds its proper span, either below 3.6mA or above 20.4mA. All analog points shall indicate a Rate-of-Change Alarm on the associated process graphic displays even if not shown on the loop drawings.

10. For analog measurement points, if a value is within 2% of its minimum engineering unit value, it shall be set to its minimum value for HMI display purposes. I if a value is within 2% of its maximum engineering unit value, it shall be set to its maximum value for HMI display purposes.

11. For all process analyzers, store the last good value measured, and hold it for an adjustable period in the event the input signal goes out of range. This period shall be no less than 1 minute for all analyzers. Note that this "last good value" shall be distinguished from an actual good value by turning on the Out-of-Range alarm, and by changing the color of the value on the HMI screen.

12. For PID loops, if a pump is commanded to maintain a specific process parameter, and the process feedback signal deviates from the setpoint by a preset deadband for a preset time period, a Setpoint Deviation Alarm is generated by the PLC for display and alarming at the HMI.

13. All tuning parameters for each PID in the PLC shall be available at the server/workstations for monitoring and adjustment even if not shown on the loop drawings. Tuning trends shall be provided to monitor the PID functions. However, these parameter settings shall be password protected to allow access by supervisory personnel who are given clearance by the Owner.

14. PID loop control shall be suspended whenever a process variable or final control element associated with that loop has lost power or signal, as determined either by the Disagreement Alarms described above, or by power monitoring data.

15. All automatic pump starts and stops in response to a PID loop shall include operator-adjustable time delays and methods to prevent wind-up.

16. All alarm and control setpoints shall be adjustable by the Operator even if not shown on the drawings. However, these setpoints shall only be accessible by individuals logged in with appropriate access levels as defined herein.

17. Run times for all motorized equipment shall be totalized in the PLC, except where the total is available from the equipment electronics itself, and indicated at the HMI with one (1) hour resolution even if not shown on the drawings. The total runtime shall be resettable from the HMI; however, this reset shall be password protected to allow access by supervisory personnel who are given clearance by the Owner.

18. Start Counts for all motorized equipment shall be totalized in the PLC and indicated at the HMI even if not shown on the drawings. The start counts shall reset on a daily basis.

19. All analog points shall be historically logged. The hourly maximum, minimum and average values for that point shall be calculated and stored.

20. All flows shall be totalized in the PLC, except where totals are available from the flowmeter itself. Yesterday's total flow and today's flow shall be indicated at the HMI even if not shown on the drawings. The total flows shall be resettable from the HMI; however, this reset shall be password protected to allow access by only the Operators who are given clearance by the Owner.

I. Reports

1. The final format of all reports shall be developed by the APS and Owner following Contract Award. All reports shall be capable of automatic and on-demand printing. All reports shall be archived for future use.

2. All reports built by the APS will utilize a web interface to the County's existing SQL Server with Visual Studio, to enter data or otherwise access a report. Coordinate with Owner.

3. All reports shall include the ability to manually edit data in case of data loss, and for manual entry for equipment not connected to the HMI. Manual entries shall be flagged in the database, and the spreadsheet cell shall be shaded in the printed report or otherwise clearly indicated.

4. The following reports shall be provided:

   a. Alarm Reports as described elsewhere in this Section.
   b. Daily Analyzer Report. Min/Max/Average for Day plus each of 24 Hours.
   c. Daily Operational Lab Sheet. Min/Max/Average for Day plus each of 24 Hours.
   d. Network Uptime Report. Monthly report. 0-100% uptime for each distinct SCADA node (Server, Workstation, PLC, etc.) and for each network device.

J. System Database

1. The structure of the system database shall be hierarchical, and initial configuration of the database shall be performed by the APS. The database shall have the following features:

    a. Analog Inputs: Point identification number; point name; current value; scan period assigned; the type of raw input either linear or non-linear, and if nonlinear, the linearization used; instrument input range (reasonability limits); high and low emergency and advisory alarm limit pairs; instantaneous and sustained rate of change alarm limits, flags for Return-to-Normal alarms; and physical termination point information.
    b. Contact Inputs: Point identification number; point name; current status; normal state; scan period assigned; and physical termination point information.
    c. Analog Outputs: Point identification number; point name; current status; and physical termination point information.
    d. Contact Outputs: Point identification number; point name; current status; period of actuation if momentary; and physical termination point information.

2. Historical Data Management. The following features shall be provided for processing and storage of system historical data:

    a. Data Processing. The real time application for calculations shall pass averages accumulated totals (as applicable) for all Control System variables to the Historical data base. The primary server shall transfer the averages to the redundant machine.
    b. Data Storage. Historical data and Maintenance Management data shall be retained on the Network Attached Storage (NAS) device for a minimum of 1 year.
    c. Data archiving. Hourly and daily data, laboratory data, logs, and administrative data, shall be automatically archived to the NAS as they are generated.

K. Security

1. Access levels shall be as follows, with each succeeding level having all the capabilities of the prior levels as well as its own as described.

    a. Guest. Guest is the default login mode. Guest can view all operational screens (process, alarms, trends), but is strictly view only.
    b. Operator. Operator can start/stop equipment, open/close valves, set equipment auto/manual, make setpoint changes, and manage alarms. Operator cannot perform certain functions restricted to Lead Operator.
    c. Lead Operator. Lead Operator can modify setpoints related to compliance instruments. Coordinate with Owner for more Lead Operator restricted functions.
    d. Administrator. Administrator can reset flow or equipment totals, change PID parameters or analog scaling.

2. Workstations shall logout after being idle for 10 minutes, and default to Guest login.

3. All HMI login and logout activity shall be recorded. The log file shall be in a readily readable format, such as CSV.

PART 2 - PRODUCTS

2.01 SUPPLEMENTARY CONTROL NARRATIVES

A. The following control narratives are provided as supplements to the schematic and written information provided in the Instrumentation Drawings. Not all controls are represented in this Section. All questions and proposed alternatives should be coordinated with the Engineer and/or the Owner.

B. Influent Pump Station Pumps. The following control strategy will reside within PLC-04A and will be programmed by the APS. The APS shall program the SCADA Interface Panel to communicate with all Influent Pump VFDs and integrate all miscellaneous signals.

1. Each pump shall operate in a "HAND-OFF-AUTO" operation from its own VFD.

   a. When the pump is selected OFF the pump will remain off.
   b. When the pump is selected HAND, the pump will remain on until selected off. Switching the HOA switch from HAND to AUTO requires moving through the OFF position.
   c. When the Pump is selected AUTO, the pump will operate as determined by the PLC according to the wetwell level or remote manual operator request.
   d. In either HAND or AUTO positions, the pump will be stopped by any alarm detection from the pump monitoring unit.

2. A pump is Available for automatic PLC control if its local HOA switch is in the AUTO (Remote) position, its soft control mode selector on SCADA is in AUTO, it has no current alarms, its chamber's inlet gate is open, and it has not been designated Out of Service.

3. During normal operation all Influent Pumps in Remote Automatic control will be placed in service. One radar level sensor in the IPS Inlet Box will provide the level signal to function as the process variable. Two radar level transducers shall provide the level within the two Influent Wetwell Chambers, and will be available as backups to the Inlet Box sensor, and also for use during cleaning cycles. Provide the operator with the ability to manually select the level sensor used to define the process variable. Two high level switches and two low level switches shall also be supplied. A high discharge pressure switch shall also be supplied on each wetwell chamber's discharge header. High discharge pressure will generate an alarm, but will not cause pumps to stop.

4. If a wetwell chamber's Inlet Gate is closed or it is in an active Clean Cycle, generate a "Not Available" message and disable automatic control of the pumps in that chamber.

5. The pumps shall start and stop and their speed adjusted as required to maintain an acceptable wetwell level.

6. Pumps in each wetwell shall be designated as Lead, Lag1, Lag2, and (future)Lag3. Lead/Lag1/Lag2/Lag3 designation within a wetwell shall shift automatically when a pump stops on a first-on first-off basis, such that when the first pump started (Lead) is stopped, its designation shall shift to the last Lag, and the remaining pumps shall advance in the sequence.

7. Wetwells shall also be designated as Lead and Lag. Wetwell Lead/Lag status shall alternate when all Available pumps stop. Pump starts/stops shall alternate between wetwells.

8. When the level in the wetwells rises to the Lead pump start setpoint, the Lead pump in the Lead wetwell will be started, at minimum speed.

9. A "Lag Pump Start" (or Next Pump Start) command shall be generated when the wetwell level is greater than the setpoint (including a deadband) and all running pumps are at full speed (including an adjustable time delay).

10. When an additional pump is called to start, the speed control output to the VFD(s) shall be ramped down to a designated minimum speed setting and maintained there until the additional pump is running and its check valve open.

11. In normal operation, the PLC shall modulate the speed(s) of the running pump(s) to maintain the wetwell level at an operator-entered level setpoint. The PLC shall use a PID algorithm to generate a control output that shall be used to control each pump's VFD. The same control output shall be used for each running pump that is available and in remote, automatic control.

12. Monitor running pump speeds for continued low speed operation. When any pump has been operating at low speed (adjustable) for four (adjustable) hours, temporarily increase pump speed to maximum for 30 seconds (adjustable) to reduce clogging and grit deposition in the motor cooling jacket.

13. Lead/Lag positions shall be automatically assigned based on pump availability and most recent run status. The operator may manually reassign pump Lead/Lag1/Lag2/Lag3 positions and wetwell Lead/Lag assignments from the HMI.

14. If both the Lead pump in the Lead wetwell and Lead pump in the Lag wetwell are running and at full speed, the next Lag pump to start shall be the Lag1 pump in the Lead wetwell. If three or more pumps are running, the next pump to start shall be the Lag1 pump in the chamber with the fewest pumps running. A maximum of five pumps shall be allowed to run at any time.

15. In remote automatic, when a Pump Stop command is generated, the available, running pump that was first to start shall be stopped, based on the following.

If 2 or more pumps are running, it shall be the pump that started first, if both chambers have an equal number of pumps running. If both chambers do not have an equal number of pumps running, then stop the pump that started first in the chamber with the most pumps running.

16. A "Pump Stop" command shall be generated when the wetwell level is less than the setpoint (including a deadband) and all running pump(s) are at minimum speed (including a time delay). If only one pump is running, has been at minimum speed, and the wetwell level falls below a Lead Pump Stop setpoint, the pump shall stop.

17. Upon activation of the high level switch PLC-04A shall automatically ramp all running pumps (up to five) to maximum speed and generate a "Pump Start" command and generate a SCADA system alarm. Pump speed ramping and starting shall be controlled to prevent high inrush current.

18. Upon activation of the low level switch PLC-04A shall automatically stop all running pumps and generate a SCADA system alarm.

19. Each chamber is provided with five additional float switches for use by the Backup Pump Control Panel (BPCP). The PLC will normally provide an output to the BCPC that inactivates it. In the event that the PLC is not available, this output will be off, and the BPCP will assume control of the pumps in both chambers based on the float positions. Each chamber will have floats designated: all pumps off, start Lead pump, start Lag1 pump, start Lag2 pump, and start (future)Lag3 pump.

20. Each Influent Pump is equipped with a check valve limit switch on its discharge check valve. If a pump is running and the check valve remains closed for 10 seconds (adjustable), the PLC shall generate a "No Flow" alarm for that pump and remove it from service.

21. If a pump's Available status changes while it is running, the PLC shall issue a stop command to that pump and shift it to the Lag2 sequence position. An alarm will be issued and the pump will remain unavailable until manually reset.

22. Either chamber of the wetwell may be placed out of service or in Cleaning Mode by the operator. The SCADA System will automatically place a chamber out of service if its 8' inlet gate is fully closed as determined by closed position proximity switch.

23. If one chamber of the wetwell is out of service, the pumps for that wetwell shall be stopped and unavailable and its level sensor is disabled for control purposes. When in Cleaning Cycle the pumps are available only in manual control.

24. A soft selector switch shall be provided on the OIT/SCADA screen to allow the operator to switch between Remote Manual and Remote Automatic control. This switch is only functional when the pump HOA switch is in the AUTO position.

C. Wetwell cleaning cycles will be conducted manually. During cleaning cycles, wetwell pumps and gates shall be controlled manually. All pumps in the wetwell chamber to be cleaned will be placed in manual control, the pump in the deep end of the wetwell will be run at full speed (in either Remote Manual or ON at the HOA), and all other pumps in that chamber shall be off (either in Remote Manual or OFF at the HOA). The 8' influent gate to that chamber may require manual modulation to manage the flow into the chamber.

D. The radar level sensors in each wetwell chamber and the Inlet Box are both monitored by the PLC and compared for agreement. If an excessive discrepancy is detected, an alarm shall be generated. The level sensor in the Inlet Box is normally used as the primary process variable for pump speed control. The operator shall be able to manually select which of the three level signals is to be used by the PLC PID controller for level control.

E. A pump shall be automatically stopped if an alarm (high temperature, high moisture, or high vibration) is received from its pump monitoring unit.

F. Influent Pump Station 54" Gates 1 - 6

1. The 54" IPS Gates are not motorized. Gates shall be operated in fully open or fully closed positions.

G. Influent Pump Station 8' Gates 7 and 8

1. The 8' IPS Gates are motorized and controlled locally and manually only. Open limit and closed limit positions shall be displayed at SCADA.

H. Setpoint Screen:

1. Vertical sliders shall be provided for each setpoint in the system. Include:

a. Lead Pump Start level setpoint
b. Lead Pump Stop level setpoint
c. Wetwell Level setpoint

I. General

1. The following conditions shall provide an alarm to SCADA:

a. Wetwell High Level
b. Wetwell Low Level
c. IPS Pump/VFD/RVSS Fail
d. IPS Pump check valve fail to close
e. Cleaning Cycle Initiation
f. High Discharge Pressure

2. The following conditions shall provide an alarm to SCADA and remove the corresponding pump from service:

a. Pump No Flow Alarm (Pump running but check valve closed)
b. Pump/VFD Fail
c. Pump High Temperature
d. Pump High Vibration

e. Pump High Moisture (Leak) alarm

PART 3 - EXECUTION

3.01 TESTS (GENERAL)

A. The APS shall test all programming, configuration and networking services to be furnished under this Contract. The APS shall conduct its testing as an integral part of, and in coordination with, the Instrumentation System Supplier's required testing as defined in Section 13300.

3.02 WARRANTY / MAINTENANCE REQUIREMENT

A. A written maintenance contract executed by the APS shall be provided to the Owner for on-site warranty services. This contract shall include all labor and emergency calls providing on-site response within 24 hours, to provide complete system operability for a period of one year after the successful completion of the Performance Acceptance Test.

B. The costs for the one-year maintenance service contract shall be included inthe APS's Contract Price.

END OF SECTION

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SECTION 13315
FIELD INSTRUMENTATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The General Provisions of Section 13300 apply to this Section.

B. Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.

1.02 RELATED WORK

A. Refer to Section 13300.

1.03 SUBMITTALS

A. Refer to Section 13300.

1.04 REFERENCE STANDARDS

A. Refer to Section 13300.

1.05 QUALITY ASSURANCE

A. Refer to Section 13300.

1.06 SPARE PARTS

A. Provide a list of all recommended spare parts and expendables, including recommended quantities.

B. Furnish one year's supply of items recommended by the Manufacturer of the equipment for each component.

C. Provide one spare gas detector of each type, and new, unused calibration gas kit.

D. Provide other spare parts as indicated on the individual device specifications.

PART 2 - PRODUCTS

2.01 FLOAT SWITCH

A. Type: Ball float switch.

B. Functional/Performance:

1. Differential: 3.5 inches.
2. Switch Rating: Standard, 7 amps at 120V AC, 3 amps at 240V AC.

C. Physical:

1. Float: Polypropylene or PVC, 3 inch by 4.25 inch.
2. Switch: Snap action, activated by a ball rolling within a switching tube. Totally encapsulated “environmentally friendly” non-mercury switch.
3. Cable: Heavy duty, PVC jacketed, integral to float. Length as required.

D. Options/Accessories Required:

1. Provide 316 stainless steel mounting hardware.
2. The floats shall be mounted on a vertical 316 stainless steel 1” diameter pipe inside the wetwell, to be provided and installed by the Contractor. Refer to detail D on Drawing I07 for typical installation.
3. The lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the wetwell.
4. Provide a single sealed wetwell penetration for float switch cables.
5. Provide a NEMA 4X termination enclosure, 316 stainless steel or cast aluminum construction, outside the wetwell with terminals for all floats and tapped as required for conduit connections. Include isolation relays and intrinsic safety barriers.
6. Mount termination enclosure on 316 stainless steel unistrut supports.

E. Manufacturer:

1. Anchor Scientific, Eco-Float
2. Approved equal

F. Units To Be Supplied By ISS:

1. 570 LSHH 1A : Influent Pump Station Wetwell High Alarm Level
   a. Elevation: TBD
2. 570 LSHH 1B : Influent Pump Station Wetwell High Alarm Level

a. Elevation: TBD

3. 570 LSLL 1A : Influent Pump Station Wetwell Low Alarm Level
   a. Elevation: TBD

4. 570 LSLL 1B : Influent Pump Station Wetwell Low Alarm Level
   a. Elevation: TBD

2.02 CHECK VALVE/GATE LIMIT SWITCH

A. Provide a limit switch assembly on each Influent Pump discharge check valve.

B. Provide fully opened and fully closed limit switches on the 8' Wetwell Inlet gates.

C. Provide a limit switch assembly that meets the following requirements:

1. Positive Acting, indicating closed/not closed check valve status, full open/not full open and full closed/not full closed on the inlet gates.
2. SPDT
3. UL listed
4. Rugged, dependable, weather-proof
5. Stainless steel construction

D. Provide a limit switch designed for installation on the check valves and gates provided. Include mounting brackets suitable for installation.

E. Units To Be Supplied By ISS:

1. 570 ZSH: Influent Pump 1 Check Valve Open
2. 570 ZSH: Influent Pump 2 Check Valve Open
3. 570 ZSH: Influent Pump 3 Check Valve Open
4. 570 ZSH: Influent Pump 5 Check Valve Open
5. 570 ZSH: Influent Pump 6 Check Valve Open
6. 570 ZSH: Influent Pump 7 Check Valve Open
7. 117 ZSH: Inlet Gate 7 Opened
8. 117 ZSL: Inlet Gate 7 Closed
9. 118 ZSH: Inlet Gate 8 Opened
10. 118 ZSL: Inlet Gate 8 Closed

2.03 PRESSURE GAUGE / PRESSURE SWITCH

A. Type:

1. Bourdon tube or diaphragm actuated pressure gauge.
2. Pressure limit switches as needed per Loop Diagrams.

B. Functional/Performance:

1. Accuracy: Plus or minus 2.0 percent of span or better.
2. Switch Rating – DPDT relay, 10A @ 120VAC.
3. Switch Setpoint – Fully adjustable over entire span, accurate to 1.0 percent of span. Provide dual setpoint switch where indicated.

C. Physical:

1. Case: Phenolic shock resistant or Type 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/ atmospheric compensation. Gauge shall be capable of being liquid filled in the field or at the factory.
2. Window: Clear acrylic or shatter proof glass.
3. Bourdon Tube: Type 316 stainless steel.
4. Connection: 3/4 in NPT.
5. Gauge size: 4-1/2" diameter minimum.
6. Pointer travel: 270 degree arc.
7. Range: As indicated in the instrument device schedule.

D. Options/Accessories Required:

1. Shutoff valve: Each gauge shall have a process shutoff valve which can also be used as an adjustable pressure snubber.
2. Where required by the process and/or shown on the Process & Instrumentation Diagrams, provide a diaphragm seal between the process fluid and the instrument(s). Diaphragm seal shall be welded metal type, threaded connection, 316SS construction.
3. Spare Parts. Furnish one (1) complete spare unit for every ten (10) or less of each type/range of units provided. Spares shall be fully assembled and calibrated with diaphragm seals, ready for installation.
4. Manufacturers:
    a. Ametek/U.S. Gauge
    b. Dresser/Ashcroft
    c. Dwyer/Mercoid
    d. Wika

E. Units To Be Supplied By ISS:

1. 570 PSH : Influent Wetwell 1A Discharge Pressure High
2. 570 PSH : Influent Wetwell 1B Discharge Pressure High

2.04 RADAR LEVEL SENSOR

A. Type: Pulse radar level sensor/transmitter.

B. 2-wire, K-band 25 GHz horn antenna.

C. Functional/Performance:

1. Range: 20m (66 ft)
2. Process Temperature: -40 to 200 °C (-40 to 392 °F)

D. Physical:

1. Aluminum, polyester powder coated enclosure
2. NEMA 4X.
3. 316L stainless steel antenna

E. Options/Accessories Required:

1. Provide 316 stainless steel mounting hardware.
2. Provide a single sealed wetwell penetration for each level sensor.
3. Mount termination enclosure on 316 stainless steel unistrut supports.
4. Follow manufacturer's installation instructions. Mount sensor to avoid interference from wetwell walls or other obstructions.

F. Manufacturer:

1. Siemens SITRANS LR250 Horn Antenna
2. Approved equal

G. Units To Be Supplied By ISS:

1. 570 LIT 1A: Influent Pump Station Wetwell Level
   a. Elevation: Top of wetwell
2. 570 LIT 1B: Influent Pump Station Wetwell Level
   a. Elevation: Top of wetwell
3. 570 LIT 1B: Influent Pump Station Wetwell Level
   a. Elevation: Top of wetwell

2.05 ULTRASONIC LEVEL/FLOW METER

A. Type: Ultrasonic level sensor and flow transmitter.

B. Operating principle: Measurement of open channel flow through a Palmer-Bowlus flume using an ultrasonic level sensor/transmitter. Calculates flow based on pipe dimensions and channel level using Palmer-Bowlus flow equation.

C. Functional/Performance:

1.	Range:	0.3 to 15m (1 to 50 ft)
2.	Error:	0.25% of range
3.	Resolution:	0.1% of range
4.	Temperature Compensation:	-58 to 305 °F
5.	Operating Temperature:	-4 to 122 °F

6. Ensure at least 8 pipe diameters of straight channel exist upstream of the flume.
7. Auto False Echo suppression for fixed obstruction avoidance.

D. Physical:

1.	Enclosure rating:	NEMA 4X
2.	Input Voltage:	100 to 230 VAC
3.	Installation:	Mount sensor over centerline of channel, 18” (flume size/2) upstream of flume throat ramp, minimum

4. Provide wall mount style transmitter. Mount transmitter inside sunshield adjacent to manhole. Orient transmitter display to face north.

E. Display

1. Local four-button programming, alphanumeric display to indicate flow rate, totalized values, settings, and faults.

F. Options/Accessories Required:

1. Provide 316 stainless steel mounting hardware for sensor and transmitter enclosure, including vertical pole and U-bolts for transmitter installation.
2. Provide SmartLinx PROFIBUS DP communication option. Include components necessary to communication with plant PLC network, including SmartLinx system.
3. Provide 304SS sun/weather shield designed for use with the transmitter.
4. Follow manufacturer’s installation instructions.

G. Manufacturer:

1. Siemens MultiRanger 200 HMI
2. Transducer : EchoMax XRS-5, suitable for open channel application.

H. Units To Be Supplied By ISS:

1. 190 FIT : Influent Flow Manhole B

2.06 TEMPERATURE SWITCH

A. Type:

1. Thermostat, provides a normally open contact that closes when an adjustable temperature limit has been exceeded.
2. Thermostatic bimetal sensor element
3. Snap action contact
4. Adjustable in units of degrees F.

B. Units To Be Supplied By ISS:

1. 570 TS Electrical Building Temperature Switch

2.07 SMOKE ALARM

A. Type: Ionization

B. Alarm Current: 34 mA at 120 VAC

C. Standards: UL

D. Humidity range: 0 – 85 % RH, non-condensing/non-freezing

E. Units To Be Supplied By ISS:

1. 570 XS Electrical Building Smoke Alarm

2.08 HVAC SYSTEM MONITORING

A. Provide Ethernet connection between JENsys HVAC JENE PC1128 unit and Ethernet switch in PLC 04A panel.

B. Provide configuration and programming necessary to communicate HVAC data to the SCADA System.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install components per manufacturer's recommendations, with detectors, sensors, transducers, etc., located in close proximity to their related components.

END OF SECTION

SECTION 13320
FIBER OPTIC DATA HIGHWAY NETWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide fiber optic cables as indicated and as specified.

B. Provide fiber optic patch panels, terminal connectors, and ancillary equipment.

C. All fiber cables shall be tight bound, tight buffered, 24 fibers per cable.

D. Do not use splices.

E. Provide fiber optic pull boxes based on fiber optic cable with a maximum allowable pulling tension of 600 lbs (2700 N).

F. Provide patch panels, terminal connectors, and ancillary equipment needed for a complete installation.

G. Testing

1. Provide comprehensive testing of the fiber optic cable and all other products and work to demonstrate full compliance with Contract Documents and referenced standards.

2. Testing will be performed at various stages:

   a. Prior to installation
   b. Installed
   c. Termination
   d. Segment (from both ends)
   e. End to end (from both ends)

3. Testing will be performed with a Fiber Testing System

   a. System will consist of the following, minimum:

      i. OTDR – Optical Time Domain Reflectometer
      ii. Equipment to detect number and location of connectors within a segment.
      iii. Inspection device (video probe) to inspect connectors for end-face contamination.
      iv. Loss/length and power meter.
      v. Testing equipment manufacturer's software to organize testing data.

vi. Testing will be conducted for both 850 and 1300 nm.

4. All testing devices must have NIST calibration with certificate demonstrating calibration occurred within one calendar year.

5. Prepare a testing plan.

1.02 SUBMITTALS

A. Unless otherwise specified, provide all submittals prior to ordering products or pulling any cables.

B. Submit to the Engineer, in accordance with Section 13300, the following:

1. Complete manufacturer's product data. Product data shall be provided for the data highway cables, connectors, patch panels, spares and test equipment. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts and any power supply requirements.

2. Outline drawings of termination cabinets showing dimensions, cables, jumpers, and associated hardware for termination.

3. Installation Test reports as specified.

4. The ISS shall provide a fiber optic power budget for each cable run in excess of 500 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses and a 3db aging margin. Fiber optic transmission line shall maintain a minimum of 3db safety margin.

C. Manufacturer's Instructions.

D. Testing

1. General:

a. See Specification Section 01330 for requirements for the mechanics and administration of the submittal process.
b. See Section 01330 for additional requirements.

2. Product Data:

a. Submit complete product data on all testing equipment and other specified components.
b. Include NIST certificates for all equipment.

3. Testing plan as described herein.

a. Develop a narrative that identifies the goals for testing.
b. Identify procedures and test setup.
c. Document work-flow and identify requirements of testing at various phases of construction.

d. Prepare a schedule of tasks with the anticipated time required to complete each task.

4. Sample Test Forms

a. Submit proposed test forms and example test output for each required test.
b. Test forms and example testing equipment outputs shall be reviewed by the Engineer without resubmittal required before starting any testing.

5. Anticipated Performance Report.

a. This report will identify the theoretical loss for each termination and conductor for each strand in each cable.
b. Report anticipated end to end performance for each segment.
c. Prepare a spreadsheet in Microsoft Excel with each loss value.

1.03 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. NFPA-70 - National Electrical Code (NEC) Article 770.

B. Underwriters Laboratories, Inc. (UL)

1. UL 1581 VW-1 - Vertical Tray Cable Flame Test
2. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts.
3. UL 910 - UL Standard for Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.

C. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Standard 383 - Flame Retardancy.

D. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)

1. TIA/EIA 492-CAAB.
2. TIA/EIA-492CAAA Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers.
3. TIA-568B.3: Commercial Building Telecommunications Cabling Standard part-3
4. TIA-568C: Generic Telecommunications Cabling for Customer Premises
5. TIA/EIA 598-C: Optical Fiber Cable Color Coding.

6. TIA/EIA 606-A: Administration Standard for Commercial Telecommunications Infrastructure.

7. TIA/EIA-455: Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.

E. National Electrical Code Article 770, Optical Fiber Cable and Raceways

1. NFPA 70

F. Fiber Optic Test Method and Instrumentation

1. DOD-STD-1678

G. Insulated Cable Engineers Association, Inc. (ICEA):

1. S-104-696: Standard for Indoor-Outdoor Optical Fiber Cable.

H. Telecommunications Industries Association/Electronic Industries Association/ American National Standards Institute (TIA/EIA/ANSI):

1. 455-78-B, Optical Fibers - PART 1-40: Measurement Methods and Test Procedures - Attenuation.

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic suppliers who have been providing these types of materials for the past three years. The Fiber Optic suppliers shall provide personnel capable of providing technical assistance and fiber testing during installation.

B. The installation of fiber optic cabling system materials furnished under this Section shall be performed by the fiber manufacturers certified installation contractor who has been installing these types of materials for the past three years. The installer shall be MDIS certified with current qualifications provided by the fiber optic cable manufacturer.

C. All cabled optical fibers shall be 100% attenuated tested. The attenuation of each fiber shall be provided with each cable reel.

D. The cable manufacturer shall be ISO 9001 registered.

E. The Engineer shall determine whether a product is an "Approved Equal" based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the manufacturer's data sheets in order to be accepted as an "Approved

Equal." Supplier must furnish five (5) working installation references for any alternate equipment along with owner, contact, and telephone number.

F. All optical fibers shall be 100 percent attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

G. Measure bulk cable loss prior to installation.

1.05 DELIVERY, STORAGE AND HANDLING

A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

B. When the length of an order requires a large wooden reel the cable will be covered with a three (3) layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

C. Test tails shall be at least two (2) meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.

D. Wooden reels shall be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.

E. The attenuation shall be measured at 850 nm and 1300 nm for multimode fibers. The manufacturer shall ship the test results along with the fiber.

F. Packaging

1. The completed cable shall be packaged for shipment on non-returnable wooden reels. It is the responsibility of the Contractor to determine all required cable lengths.

2. Top and bottom ends of the cable shall be available for testing.

3. Both ends of the cable shall be sealed to prevent the ingress of moisture.

4. Each reel shall have a weather proof reel tag attached identifying the reel and cable.

5. Each cable shall be accompanied by a cable data sheet.

1.06 EQUIPMENT IDENTIFICATION

A. Each fiber shall be labeled at each termination point. Conductor or circuit identification shall be applied at specified points with circuit numbers or other identification stamped on terminal boards when provided, or on the cable itself in such a manner that the identification is visible around the cable's circumference.

B. Each fiber shall be identified in junction boxes, pull boxes, terminal boxes, and cabinets. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper self-adhesive wire markers are not acceptable.

1.07 WARRANTY

A. The Contractor shall be a manufacturers' certified installer and shall provide a twenty-year extended warranty program; and shall also provide written warranty certification and evidence of current program membership.

B. The Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of twenty years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Engineer to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The Owner will incur no costs for service or replacement of parts during the warranty period of twenty years. All third party warranties shall be passed through from the Contractor to the Owner.

C. The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the National Electrical Code (NEC), the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

D. The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guide.

E. The Contractor shall warrant that the system shall accommodate traffic at the levels specified in the Specification.

PART 2 - PRODUCTS

2.01 FACTORY QUALITY CONTROL

A. All fiber cables and related products shall be thoroughly tested at the factory prior to shipment.

B. Factory test results shall be documented and traceable. Tests shall include identification of test procedures and equipment used. The individual performing the factory tests shall be clearly identified on the test documentation and shall sigh and date test report.

C. Minimum Factory Testing requirements are as described below for Pre-Installation Tests.

D. Submit Factory Test documentation promptly to Owner's Representative. Factory Test documentation for each reel must be reviewed (without resubmittal required) by the Engineer prior to performing any field tests on the reel.

E. Factory test results will be used as a baseline for field tests.

2.02 MANUFACTURERS

A. Corning Cable Systems

B. Or approved equal.

2.03 FULLY WATER BLOCKED FIBER OPTIC CABLE (OUTDOOR/INDOOR)

A. General Considerations

1. The cable shall meet all requirements stated in the specification. Refer to the Control System Block Diagram to determine cabling requirements.

2. Furnish cable containing twenty-four (24) fibers. Each buffer tube shall contain up to 12 fibers.

3. Provide stainless steel ST style connectors for all fiber optic connections. The connectors shall be designed for use with 62.5/125 micron cable, and shall be capable of operating in a range of 0 to 80 degrees C. Each connector shall cause a maximum signal attenuation of 1.6 dB. Connectors shall be provided by Siecor. All fiber optic cables shall be tested for performance and loss after termination and installation to verify that at least a 3 dB power safety margin is obtained between all transmitters and receivers. Test data for each fiber and safety margin calculations for each fiber path shall be provided to the Owner and Engineer after installation to verify conformance with this specification.

B. Fiber Characteristics

1. All fibers in the cable must be usable fibers and meet required specifications.

2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

3. Multimode: The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492A-1989, "Detail Specification for 62.5 µm Core Diameter/125 µm Cladding Diameter Class la Multimode, Graded Index Optical Waveguide Fibers."

a. Core diameter: 62.5 + 3.0 µm.
b. Cladding diameter: 125.0 + 2.0 µm.
c. Core-to-Cladding offset: < 3.0 µm.
d. Cladding non-circularity: < 2.0 %.
Defined as: [1 - (min. cladding dia./ max. cladding dia.)] x 100
e. Core non-circularity: < 5.0 %.
Defined as: [1 - (min. core dia. / max. core dia.)] x 100
f. Coating diameter: 245 + 10 µm.
g. Colored fiber diameter: nominal 250 µm.
h. Graded index.
i. Numerical Aperture: 0.275 + 0.015 µm.
j. Limited to the fiber runs of no more than 1000' between electronics

4. The coating shall be a dual layered, UV-cured acrylate applied by the fiber manufacturer.

5. The coating shall be mechanically strippable. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

C. Fiber Specification Parameters

1. Required Fiber Grade - Maximum Individual Fiber Attenuation.

2. The minimum normalized bandwidth of multimode optical fibers shall be > 160 MHZ•km at 850 nm and > 500 MHZ•km at 1300 nm.

3. The fiber manufacturer shall proof-test 100% of the optical fiber to a minimum load of 100 kpsi.

D. Specifications for Cables

1. Cable shall be flame-retardant, UV stabilized, fully water blocked for use in indoor/outdoor applications. Cable shall be suitable for installation in duct, aerial, and riser environments. Cable shall meet UL OFNR specifications and not require transition splicing upon building entry in order to meet fire codes. The cable shall be the FREEDM series as manufactured by Siecor or approved equal.

2. Optical fibers shall be placed inside a buffer tube.

3. Each fiber shall be distinguishable by means of color coding according to TIA/EIA-598-A, "Optical Fiber Color Coding." Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be 0.04 inch (1 mm).

4. Buffer tubes containing fibers shall be color coded with distinct and recognizable colors according to TIA/EIA-598-C, "Optical Fiber Color Coding."

5. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

6. Buffer tubes shall be kink resistant within the specified minimum bend radius.

7. Fillers may be included in the cable core to lend symmetry to the cable cross-Section where needed.

8. The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

9. The cable core shall contain a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents. Cable shall contain water blocking threads between tubes.

10. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

11. The tensile strength shall be provided by the central member, and additional dielectric yarns. The dielectric yarns shall be helically stranded evenly around the cable core.

12. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

13. All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene (MDPE). The minimum normal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

14. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service

15. The cable jacket shall contain no metal elements.

16. Cable jackets shall be marked with manufacturers' name, sequential meter or foot markings, the year of manufacture, and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within + 1 % of the length markings. The marking shall be in contrasting color with the cable jacket. The height of the marking shall be approximately 2.5 mm.

17. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 600 N (135 lbf) long term installed.

18. The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be -30°C to +70°C.

19. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," for multimode fiber, the average change in attenuation shall not exceed 0.50 dB/km with 80% of the measured fibers not exceeding 0.25 dB/km.

E. General Cable Performance Specifications

1. When a one meter static head or equivalent continuous pressure is applied at one end of a one meter length of unaged cable for 24 hours, no water shall leak through the open cable end. When a one meter static head or equivalent continuous pressure is applied at one end of a one meter length of aged cable of one hour, no water shall leak through the open cable end. The aging cycle is defined as exposing the cable to +85 + 2°C for 168 hours and two cycles of -40°C to +70°C with cable held at these temperatures for 24 hours. The water penetration test is completed at the end of the 24-hour hold. Testing shall be performed in accordance with the industry standard test, FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

2. When testing in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable," the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at +65°C.

3. The cable shall withstand a minimum compressive load of 440 N/cm (250 lbf/in) for armored cables and 220 N/cm (125 lbf/in) for non-armored cables applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for ten minutes. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater the 0.1 dB at 1550 nm (SM). The average increase in attenuation for the fibers shall be < 0.20 dB at 1300 nm (MM). The repeatability of the measurement system is typically + 0.05 dB or less. No fibers shall exhibit a measurable change in attenuation after load removal.

4. When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles at a rate of 30 + 1 cycles per minute around a sheave diameter not greater than 20 times the cable diameter. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically + 0.05 dB or less. The average increase in attenuation for the fibers shall be < 0.20 dB at 1300 nm (MM). For armored cables, the inside or outside of the armor surface shall be inspected for fractures. Any visible cracks causing separation of the armor shall not have propagated more than 5 mm. The outer cable jacket shall not exhibit evidence of cracking or splitting when observed under 5x magnification.

5. When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," the cable shall withstand 25 impact cycles. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically + 0.05 dB or less. The average increase in attenuation for the fibers shall be < 0.40 dB at 1300 nm (MM). The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.

6. When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a tensile load of 2700 N (608 lbf) applied for one hour (using "Test Condition II" of the procedure). In addition, the cable sample, while subjected to a minimum load of 2660 N (600 lbf), shall be able to withstand a twist of 360 degrees in a length of less than 3 meters (9.9 feet). The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically + 0.05 dB or less. The average increase in attenuation for the fibers shall be < 0.40 dB at 1300 nm (MM). The cable shall not experience a measurable increase in attenuation when subjected to the rated residual tensile load, 890 N (200 lbf).

7. When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 2 meters will withstand 10 cycles of mechanical twisting. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically + 0.05 dB or less. The average increase in attenuation for the fibers shall be < 0.40 dB at 1300 nm (MM). For armored cables, the inside or outside of the armor surface shall be inspected for fractures. The cable jacket will exhibit no cracking or splitting when observed under 5x magnification after completion of the test.

8. When tested in accordance with FOTP-181, "Lightning Damage Susceptibility Test for Optic Cables with Metallic Components," the cable shall withstand a simulated lightning strike with a peak value of the current pulse equal to 105 kA. A damped oscillatory test current shall be used with a maximum time-to-peak value of 15 µs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time to half-value of the waveform envelope shall be from 40 - 70 µs.

2.04 TESTING SYSTEM TO BE USED BY CONTRACTOR

A. System shall consist of the following, minimum, plus equipment as needed to meet all specified testing requirements:

1. OTDR – Optical Time Domain Reflectometer
2. Equipment to detect number and location of connectors within a segment.
3. Inspection device (video probe) to inspect connectors for end-face contamination.
4. Loss/length and power meter.
5. Launch cables, 150 meters.
6. Testing equipment manufacturer's software to organize testing data.
7. Other equipment as required to perform all specified testing.

B. Manufacturers:

1. AFL Noyes – OTDR with built in Optical loss meter, M310 Enterprise OTDR Quad Wavelength 850/1300.
2. LED Laser Quad wavelength Optical Loss Light Source _OLS4 (Used with 310 OTDR)
3. Digital Fiber Scope – DFS1.
4. Software documentation – TRM compatible with Owner's existing software.

2.05 PATCH CABLES, FIBER CONNECTORS

A. Manufacturers

1. Corning Cable Systems
2. Or approved equal.

B. Connectors

1. All optical fibers within each 24 fiber cable are to be terminated.
2. Provide ceramic or composite style ST connectors for all fiber optic fibers. The connectors shall be designed for use with 62.5/125 micron multimode cable. Each connector shall cause a maximum signal attenuation of 1.6 dB. Connector specifications shall be as follows:
   a. Insertion loss (typical): 0.5 dB
   b. Durability (mating cycles): 1000 (minimum)
   c. Repeatability: Less than 0.2 dB
   d. Operating Temperature: minus 40 to plus 75 degrees F

C. Fiber Optic Patch Cables and Connectors

1. Fiber optic patch cable shall be 2 fiber zipcord 62.5/125 micron multimode riser rated cable, tight buffered, protected by Kevlar-type strength material.

2. Connectors/jumpers shall be terminated on each end, connectors matched to the equipment provided.

3. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

2.06 PATCH PANELS AND SPLICES

A. Patch Panels: Suitable for wall mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch block with connectors and ground lugs as indicated. Panels shall be NEMA 1 or 12 construction for use in indoor, air-conditioned areas, or NEMA 4X construction for outdoor and process areas, and shall be lockable. Patch Panels shall be suitable for multimode system operation at 850 and 1300 nm. The Patch Panels shall be sized to handle the number of fibers indicated on the drawings. All fibers shall be terminated in the Patch Panel. Provide Corning/Anixter model WCH-04P or approved equal.

B. Fusion Splicer

1. Fusion Splice equipment shall be turned over to County upon completion of work.

2. Fusion Splicer shall be AFL Fujikura 70S Fusion Splicer Kit, including cleaver, battery, and cord, or approved equal.

3. Provide 50 connectors suitable for fusion splicing.

C. Pigtail Splicing

1. For termination of fiber cables at a termination or connector panel (patch panel), with one end of a piece of cable preconnectorized and the other end unterminated for splicing to the cable that needs to be terminated. Splicing and connectors shall meet the requirements listed in this Section.

2. A splice/termination tray shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure. Splice tray shall be compatible with the selected patch panel and installed for easy access to the spliced cable sections.

3. Pigtail assemblies shall match fiber cable type and model.

4. Manufacturer shall be Corning Cable Systems or approved equal.

2.07 SPARE PARTS AND TEST EQUIPMENT

A. Spare Parts

1. Provide twenty (20) spare ST style connectors.

2. Provide ten (10) spare patch cables with ST connectors (both ends) terminated.

3. Provide ten (10) spare pigtail cables with ST connectors (one end).

B. Test Equipment

1. One (1) complete fiber optic connector termination tool kits. The kit shall be UNICAM by Corning Cable Systems or approved equal.
2. Optical Test Meter. Multi-mode capability with ST style connectors. Provide data storage, Windows based software and necessary cabling for report printouts. Meter shall be OTS series as manufactured by Corning Cable Systems or approved equal.
3. Optical Power Source. 850/1300 nm single and multi-mode with Visual Fault Locator (VFL). Unit shall be compatible with the Optical Test Meter and be OS series as manufactured by Corning Cable Systems or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Provide all material, equipment and labor to install and test the fiber optic cables as indicated and as specified.

B. Installation shall be in accordance with the National Electrical Code.

C. Installation shall comply with EIA/TIA Standards 568 and 569.

D. Fiber optic cables shall be continuous from component to component as shown on the Drawings. Intermediate fiber splices shall not be allowed.

E. Provide delivery, storage, and handling of materials and equipment in accordance with Section 01600.

3.02 INSTALLATION

A. All fiber optic cables shall be installed in accordance with NECA/FOA-301 2009, Installing and Testing Fiber Optics. These requirements shall be in addition to requirements specified in this section. If there is any conflict, the more stringent requirement shall apply.

B. All cable shall be installed in conduit. Inspect all conduits and ground boxes prior to pulling cables. Rod and swab out ducts prior to installing cables.

C. Inspect raceway prior to pulling cables. Notify the Engineer of any conditions which would prevent installation of the specified cables, before proceeding with the installation. Rod and swab out ducts prior to installing cables.

D. Install non-breakout cables in conduit systems inside buildings and structures.

E. Identify all equipment used for pulling Fiber Optic Cable in conduits. Identify all equipment used to limit torque/force on cable. Break away swivels or torque limiting devices are acceptable.

F. Pull cables prior to attachment of connectors.

G. Pull cables by directly pulling only on the strength member.

H. Lubricate cables with lubricants specially formulated for fiber cabling jackets during installation. Do not exceed cable manufacturer's specifications for tensile strength and bending radius. Tight loops, kinks, knots or tight bends shall not be allowed during installation. Pulleys used to aid in the installation of the fiber optic cable must be sized according to the minimum bending radius. Do not exceed maximum pulling strength limits of the cable during installation. Monitor cable pull tensions at all times during the installation of the cable using a remote sensing puller, strain gauge or running line tensionmeter. The pulling tension of all fiber cables during installation shall be recorded using a strip recorder. The printout of the strip recorder shall be submitted to the Engineer.

I. Provide breakout kits, signal transceivers, power supplies, patch panels, pigtails and jumpers as required and as indicated to install a complete data highway communications network. Patch panels shall be wall mounted.

J. Support cables in riser conduits at intervals as required by National Electric Code.

K. Installation tools and materials shall be approved by the cable manufacturer.

L. If the Siecor Unicam connector system is not used, the polishing process of terminal connectors shall be a two stage wet process using 3.0 micron lapping film for an initial polish followed by 0.3 micron lapping film for the final polish.

M. Within manholes, protect cable by providing flexible, corrugated, polyethylene slit duct. Connect slit duct to duct bank by using hose clamps. Support duct at ten (10) foot intervals.

3.03 TERMINATION

A. Terminate cables in accordance with ANSI/TIA 568.

B. Fan out fibers to allow flexibility and ease of installations for future expansion at connection points. Provide a metal or high density plastic fan-out collar to relieve the stress on the individual fibers. To protect the individual fibers, provide sleeves from the fan-out collar to the terminal point. Terminate all fibers in each cable with a suitable connector as specified below.

C. Fiber connectors shall be bayonet-type with "twist-lock" mounting for quick and secure installation. Connectors shall be pull-proof with a durable ceramic tip to protect the

fibers from damage during installation and frequent rearrangements. "Push-pull" couplings are unacceptable. Provide a sample of the connector to the Engineer for inspection and acceptance prior to installation.

D. Provide all equipment, mounting kits and consumable materials required for a proper installation as defined by the manufacturer.

E. Each individual cable shall be clearly and uniquely identified. Tag each cable at each ground box, junction box, and pull box, and other exposed locations. At a terminal cabinet or backboard provide a type written directory listing the cable, identification code and type of signal. The directory shall be mounted within the termination cabinet or on the backboard and protected by a clear plastic cover.

F. Provide a minimum of 20 feet (6 meters) of neatly coiled, slack fiber optic cable at each terminal cabinet, backboard, or manhole for flexibility.

G. All devices must have NIST calibration with certificate demonstrating calibration occurred within one calendar year.

H. Fiber termination equipment includes the following:

1. Provide one Cleaver for 24 strand fiber.
2. Manufacturer: CT-30 – High Precision Fiber Cleaver with FC-01 Fiber Collector
3. Substitutions: Permitted.

Cleaver		
1.	Blade positions	16 rotational, 3 height positions
2.	Blade life	48,000 operations
3.	Cleave angle	0.5 degrees
4.	Fiber collector	Fiber collector for scrap fiber ends

3.04 IDENTIFICATION

A. Label each termination point.

B. Identify each cable on both ends and in all manholes and pull points it goes through. Tag each cable in junction boxes, manholes and hand holes. Provide permanent nylon/plastic tie-wrap type tags with waterproof markings.

C. Label each cable, buffer tube and fiber with permanent waterproof typewritten tags.

3.05 FIELD AND FUNCTIONAL TESTING

A. Testing Overview:

1. Prior to installation: Test bulk fiber optic cable while still on the reel. This test will be performed within two (2) days of arrival. Documentation must be submitted to Owner prior to installing fiber optic cable in conduits.
2. After installation in conduit: Test installed fiber. Documentation must be submitted to Owner prior to performing any termination.
3. End to end testing: Test each cable segment from termination location to termination location.

B. General:

1. The Contractor shall conduct tests of the fiber optic system in accordance with these provisions. All test results shall meet or exceed manufacturer specifications and the performance requirements of this Section.
2. Any fiber that does not meet or exceed manufacturer specifications and the requirements of this Section shall be replaced at the Contractor’s expense. Tests are to be performed on each fiber of each cable.
3. Testing shall be performed at four separate stages: (1) the factory, (2) after delivery but prior to installation, (3) after installation but prior to termination, and (4) after installation and termination.
4. Prior to conducting any tests, the Contractor shall provide the Engineer with detailed descriptions of test procedures for review and approval.
5. Pre-installation tests and Post-installation tests shall be witnessed and signed off by the Engineer or Owner’s Representative.
6. The Contractor shall provide the Engineer with a copy of the manufacturers' test procedures and quality assurance procedures for information. If the manufacturer recommends any tests that are not described in this Section, these additional tests shall be performed by the Contractor, at no additional cost to the Owner. Any additional performance requirements recommended by the manufacturer shall be met with these additional tests, and shall be considered part of the test requirements of this section.
7. The Contractor shall provide documentation certifying that the fiber optic cable has passed each testing stage. Provide separate documentation for each testing stage result.
8. Attenuation tests shall be performed with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum. Multimode fibers shall be tested at 850 and 1300 nm.
9. OTDR tests performed on fiber cables shall be performed with the aid of a launch cable at least 150 meters in length; longer if required by any referenced standard or recommended by the manufacturer. OTDR pulse width settings shall be

adjusted to a maximum setting of 1/1000th of the cable length or 10 nanoseconds.

10. All tests required to ensure the satisfactory installation, adjustment, operation, and performance of all equipment and materials erected and installed under this specification, shall be performed by the Contractor.

11. The Contractor shall furnish all test equipment, meters, instruments and miscellaneous equipment and perform all work required for the tests.

C. Pre-installation Tests:

1. Prior to installation, the Contractor shall conduct pre-installation tests on all fiber optic cable to be used for the project. The purpose of these tests is to verify that the cable conforms to the manufacturer's specifications, and is free of defects, breaks and damages by transportation, storage, and manufacturing processes. Pre-installation tests also provide baseline data for comparison to post-installation tests.

2. Upon arrival at the site, the cable and reel shall be physically inspected for damage. All fibers shall be tested with the Optical Time Domain Reflectometer (OTDR) for fiber integrity. Fiber lengths should be consistent with the cable manufacture data and traces shall yield no point discontinuities. Submit testing results to Engineer for review.

3. The attenuation of each optical fiber shall be tested in one direction at 850 and 1300 nm.

4. The cable shall not be installed until completion of this test sequence and results submitted to the Engineer for review and acceptance.

5. Any cable that does not meet or exceed manufacturer specifications during the Pre-Installation Test shall be unacceptable and be replaced with a new segment of equal cable.

6. In addition, all fibers in a cable shall exhibit similar performance test results. If any individual fiber’s test results for any parameter are more than 20% greater or lesser than the statistical range (one standard deviation) of the other fibers in the cable, the entire cable shall be subject to rejection and replacement, at the sole discretion of the Engineer.

7. A new cable segment provided to replace an unacceptable/rejected cable segment shall be tested to demonstrate acceptability.

8. Copies of the test results shall be submitted to the Engineer within 5 days after the test.

D. Post-installation Tests:

1. For all post-installation tests the Contractor shall notify the Engineer and Owner’s Representative a minimum of two working days in advance. Regardless,

all tests shall be witnessed; do not proceed without a written waiver from the Owner's Representative.

2. The Contractor shall test each fiber optic cable, after installation, to ensure that the fiber has been installed without damage or changes to fiber properties, as follows.

3. The installed tests shall demonstrate that all fibers meet manufacturer's specifications, that each fiber meets the fiber performance specifications in this Section, and that all fibers perform within 5% of the test results documented in the Pre-Installation tests. OTDR traces at both 8500 nm and 1300 nm wavelengths shall not display any unexplained losses, reflectance events, or other discontinuities.

4. If the test results do not meet these criteria, the cable shall be unacceptable and shall be corrected or replaced to specification at the Contractor's expense. The replacement cable shall be tested to demonstrate acceptability.

5. Copies of the test results and traces shall be submitted to the ENGINEER.

E. Test Reports:

1. The Contractor shall furnish the Engineer three copies of all test reports showing the results of all tests specified herein.

2. Test forms shall clearly label the test type, the test location, test date, wavelength, index of refraction, cable identification, fiber type, fiber number, fiber color, and the result of the value of the tested parameter.

3. All OTDR traces shall be supplied on printed hard-copy, and on CD media in PDF format. Test reports shall state "PASS" or, "NOT PASSED."

F. Site Test and Inspection:

1. Subsequent to the Post-Installation testing, the fiber network shall be placed into service and functional tested along with the control system and network components.

3.06 TRAINING

A. Provide half day training for up to three (3) students on termination techniques and testing prior to installation.

B. Provide training as soon as possible following submittal of proposed fiber optic cable.

3.07 WARRANTY

A. The Contractor shall submit a warranty certificate from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for twenty (20) years, commencing at the time of final acceptance by the Owner.

END OF SECTION

SECTION 13325
CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The General Provisions of Section 13300 apply to this Section.

B. Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.

1.02 SUBMITTALS

A. Refer to Section 13300.

1.03 DELIVERY, STORAGE AND HANDLING

A. Instruments shall be blocked and tied to prevent damage during shipment. Front-panel mounting instruments shall be removed and prepacked in their original containers for shipment.

B. Accessories, drawings, instruction bulletins, etc., shall be packed and shipped with the panel.

C. Refer to Section 13300.

1.04 SPARE PARTS

A. In accordance with Section 13300, provide the following spares and consumables:

1. Fuses: 20 percent of each size and type used, but no less than ten of each size and type.
2. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.
3. Relays: One (1) spare unit for every ten (10) of each type installed, minimum one.
4. Panel-Mounted Lights and Switches: One (1) spare mechanism for every ten (10) of each type installed, minimum one; plus 10 units or 20 percent of bulbs and colored lenses installed, whichever is more.
5. Corrosion Inhibiting Vapor Capsules: Provide 10 of each type and size used.

1.05 WARRANTY

A. Refer to Section 13300.

PART 2 - PRODUCTS

2.01 GENERAL

A. Refer to Section 13300.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300.

2.03 CONTROL PANEL - GENERAL REQUIREMENTS

A. Furnish and install the panels per Specifications and Drawings.

B. The construction and wiring shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear, and sides of the panels.

C. Unless otherwise specified on applicable panel drawings, all panels shall be of the fully enclosed type designed for use with high-density instrumentation mounting.

D. All panel doors shall have a 3-point latch, with a lock installed in the door handle. Locks for each local panel provided under this Contract shall be keyed alike.

E. The instruments designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

F. Conductors running from the field to the panels shall be continuous without splices, except at junction boxes. The junction boxes shall have terminal blocks with 20 percent spare terminals. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance. Cables entering panels shall be multiconductor. Conduit and multiconductor cables entering panels shall be sealed to prevent the intrusion of gas and moisture.

G. Multiconductor cable shall be used between junction boxes and the panels.

H. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Mounting

orientation shall be in accordance with the requirements of each component. Components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and ISS's data.

I. The internal framework of each panel shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete.

J. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

K. All panels shall be supplied with suitable nameplates which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be approximately 1-in x 3-in constructed of white and black laminated, phenolic material having engraved Micarta letters approximately 1/8-in high, extending through the white face into the black layer. Nameplates shall be beveled and attached to panels with epoxy glue or 3M VHB tape.

L. Control panels shall be built in a UL 508 shop and shall be UL labeled and listed.

2.04 CONTROL PANEL - MATERIALS AND CONSTRUCTION

A. General

1. All panels located in indoor climate-controlled areas shall be of NEMA 12 construction and shall be labeled by Underwriters Laboratories. Freestanding panels shall be constructed of 12 gauge or thicker sheet steel, suitably braced internally for structural rigidity and strength. Wall or Unistrut mounted panels shall be 14 gauge or thicker steel. All exposed welds, seams, or edges shall be ground smooth. Front panels or panels containing instruments shall be 10 gauge or thicker sheet steel, reinforced to prevent warping or distortion. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three point latches.

2. All panels located in outdoor areas, or in indoor areas that are not air conditioned, and where otherwise specified in the Contract Documents, shall be of NEMA 4X construction and shall be labeled by Underwriters Laboratories. NEMA 4X panels, whether wall or Unistrut mounted panels or freestanding panels, shall be of all 316 Stainless Steel construction. Minimum thickness shall be 12 gauge for freestanding panels, 14 gauge for wall or Unistrut mounted panels. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three-point latches. Panels with door clamps instead of three-point latching will not be accepted. Interior panels

of 10 gauge steel construction shall be provided where necessary for instrument mounting.

3. Provide explosion-proof enclosures where required in hazardous areas.

4. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel details. Front access doors with mounted instruments or control devices shall be sized to permit door opening without interference from flush mounted instruments. All doors shall open a minimum of 90 degrees.

5. Refer to panel details and other Drawings for approximate panel size and equipment layout.

6. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

7. Support Structures. Do not use expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions. Do not use power-actuated fasteners and devices.

B. Finish Requirements

1. Coordinate with Section 13300.

2. All sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

3. Panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

4. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.

5. All FRP panels located in direct sunlight shall be provided with a protective coating to prevent discoloration and cracking.

6. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.

7. Panel exterior color shall be ANSI 61 Gray.

C. Manufacturer: All panels shall be by Hoffman, Rittal, or Hammond.

2.05 CONTROL PANEL - TEMPERATURE CONTROL

A. The internal temperature of all panels shall be regulated so as not to exceed 100 degrees Fahrenheit. Should sufficient heat be generated within a panel where dissipation cannot be adequately accomplished with natural convection, an air conditioner shall be provided. Under no circumstances shall the panel cooling equipment compromise the NEMA rating of the panel.

B. NEMA 4X rated panels that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

2.06 CONTROL PANEL - CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Instruments Model Zerust VC or Hoffman Engineering Model A-HCI. Corrosion inhibitors shall not be installed and activated until the panel is delivered to the site.

2.07 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. Panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with the National Electrical Code. Wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring/connection diagrams. Wiring and connection diagrams shall comply with ISA-5.4 and shall be submitted by the manufacturer as part of the Shop Drawings for review by the Engineer.
2. Power and low voltage DC signal wiring shall be routed in separate wire ways. Crossing of the two system wires shall be at right angles.
3. Power wire shall be 12 AWG Type THHN/THWN stranded and shall be insulated for not less than 600 volts unless specified otherwise. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90°C.
4. Control and signal wire shall be 1 pair 16 AWG stranded. Analog signal wire shall be shielded. Conductors shall be of tinned copper construction.

5. Electronic Communications cable (such as RS-232) shall be low-capacitance, double-shield cables consisting of twisted pairs with 22 AWG stranded conductors and PVC jacketing.

6. Wire colors shall be:

Line Power	Black
Neutral	White
AC Control	Red
DC Control	Blue
DC common	Gray
Equipment/Chassis	GroundGreen
Externally-Powered Interlocks	Yellow

7. Wiring shall terminate at a master terminal board, rigid type and numbered.

8. Terminal blocks shall be arranged in vertical rows and separated into groups (Power, AC control, DC signal, and alarm). Terminal strips shall be provided for the purpose of connecting all control and signal wiring. Terminal blocks shall be Phoenix style, IEC rated, Allen-Bradley or similar, with the appropriate voltage rating (600 volts minimum).

9. Each 4-20 mA analog signal loop shall be individually fused. Each group of discrete loops for a common piece of equipment shall be fused.

10. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by using stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives. Provide Panduit or approved equal.

11. Wire connectors shall be the hook fork type with insulated barrel for crimp type compression connection to the wire.

12. Each wire shall be provided with a numbered heat shrink tubing identification marker, with the same number at both ends. Numbering shall be in accordance with the Control Panel Drawings and shall include the instrument Loop Number. Identification markers shall be pretyped. Handwritten markers or paper markers will not be permitted.

13. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-in of the side panel or adjacent terminal.

14. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.

15. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

16. Each panel shall have a magnetic reed switch pair mounted to the frame of each door, that will indicate a common panel intrusion condition in the PLC within that panel, when any door is opened. Magnetic reed switches shall be heavy-duty, GE Magnetic Contacts model 2505A or approved equal.

17. Each panel shall have a specification grade duplex convenience receptacle mounted internally within a stamped steel device box with appropriate cover.

18. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

19. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

20. Each panel, where applicable, shall be provided with analog signal isolation (I/I) where analog signals are sent from one panel or console to another.

21. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical and electronic equipment. Surge suppressor grounding shall be accordance with the manufacturer's recommendations. Refer to Section 13300.

22. Each panel shall be provided with a fused power disconnect switch.

23. All wiring to hand switches and the like which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

24. Panels shall have an initial installed capacity of I/O (terminal blocks, fuses, surge suppressors, interposing relays as required) plus a minimum of twenty-five percent (25%) active spare I/O points of each type, and twenty-five percent (25%) room for future I/O points. All new, existing, and future I/O points shown on the Drawings or discovered in field investigation shall be included in the total count for the purpose of determining spares.

B. Print Storage Pockets

1. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the laminated prints required to service the equipment.

2.08 DIRECT CURRENT (DC) POWER SUPPLY

A. Provide a 24 VDC power supply in the control panel to power instrument loops, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

B. Control panels that are principally designed to house Profibus DP or ProfiNet fiber optic modules shall include battery backup capability.

C. Components shall meet the following requirements:

1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

2. Output voltage: 24 VDC.

3. Output voltage adjustment: 5 percent.

4. Line regulation: 0.05 percent for 10 volt line change.

5. Load regulation: 0.15 percent no load to full load.

6. Ripple: 3 mV RMS.

7. Operating temperature: 32 to 140 degrees Fahrenheit.

8. Batteries: sealed high-temperature type with charger.

D. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity. Battery shall be sized to support full load operation for 30 minutes upon loss of power.

E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

G. Power supply shall be manufactured by Siemens, or approved equal.

2.09 PANEL COMPONENTS

A. Pilot Type Indicating Lights

1. Type: Heavy duty oil-tight type which utilizes a low voltage lamp.

2. Functional/Performance:

   a. Units shall be provided with low voltage lamps suitable for the voltage supplied. Lights supplied with 120VAC power shall have integral reduced voltage transformers.
   b. Lamps shall be replaceable from the front of the unit.
   c. Units shall be push-to-test.

3. Physical:

   a. Lens color shall be as indicated on the instrument device schedule. Lens shall be approximately 1-1/4-in diameter.
   b. Provide legend faceplates engraved to indicate the required function of each device.
   c. Units shall be rated NEMA 13 for indoor panels. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.

4. Manufacturers:

   a. Microswitch

b. Allen Bradley
c. General Electric
d. Square D

B. Rotary Hand Switches and Push Buttons

1. Type: Control devices shall be heavy duty, oil-tight type with stackable contact blocks.

2. Functional/Performance: Provide contact arrangement and switching action as required for the control system specified.

3. Physical:

a. For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide silver sliding contacts rated 5 amps at 125VDC, for electronic (millivolt/ milliamp) switching provide contacts rated 1 amp at 28VDC.
b. Push buttons shall have flush type operators. Selector switches shall have knob or wing lever operators.
c. Units shall be rated NEMA Type 13 for indoor service. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.
d. Provide legend plates denoting switch/push button position/function.

4. Options/Accessories Required:

a. Provide lock-out-push buttons, key-operators, etc., as indicated on the instrument device schedule.
b. Provide make-before-break bridging contacts where required.

5. Manufacturers:

a. Microswitch
b. Allen Bradley
c. General Electric
d. Square D

C. Industrial Relays and Time Delays

1. Type: Industrial heavy duty relays.

2. Functional/Performance:

a. Contact arrangement/function shall be as required to meet the specified control function specified.
b. Contacts shall be rated 10 amps continuous at 600 volts.
c. Relays shall be provided with convertible contact blocks.
d. Pneumatic time delay relays shall be used on time delays less than 180 seconds and shall be adjustable.
e. Solid state time delay relays shall be used on time delays between 180 seconds and one hour.

3. Options/Accessories Required:

   a. Provide all mounting rails, etc. that are required.

4. Manufacturers:

   a. Microswitch
   b. Allen Bradley
   c. General Electric
   d. Square D

D. General Purpose Relays and Time Delays

1. Type: Units shall be of the general purpose plug-in type.

2. Functional/Performance:

   a. Coil voltage shall match supply voltage.
   b. Contact arrangement/function shall be as required to meet the specified control function.
   c. Mechanical life expectancy shall be in excess of 10,000,000 operations.
   d. Duty cycle shall be rated for continuous operation.
   e. Units shall be provided with integral indicating light to indicate if relay is energized.
   f. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
   g. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

3. Physical:

   a. For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide contacts rated 5 amps at 28VDC, for electronic (milliamp/ millivolt) switching applicator provide gold plated contacts rated for electronic service.
   b. Relays shall be provided with dust and moisture resistant covers.

4. Options/Accessories Required:

   a. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
   b. Provide mounting rails/holders as required.

5. Manufacturers:

   a. Eagle Signal Controls
   b. Allen Bradley
   c. Potter & Brumfield

E. Signal Relay Switches (Current Trips)

1. Type: Solid state electronic, dual setpoint.

2. Functional/Performance:

   a. Input - 4-20 mA
   b. Output - Isolated contact output, double pole double throw, rated 5 Amps at 120 VAC.
   c. Accuracy - 0.1 percent.
   d. Protection - Provide RFI protection.
   e. Deadband - Adjustable between 0.1 and 5.0 percent of span.
   f. Setpoint Adjustment - Provide graduated dial for each alarm set point from 0 to full scale. Alarms shall be adjustable to trip on rising or falling input signal.
   g. Repeatability - Trip point repeatability shall be at least 0.1 percent of span.

3. Physical:

   a. Mounting - Suitable for mounting in an enclosure or high density instrument rack.

4. Options/Accessories Required:

   a. Mounting rack or general-purpose enclosure as required.

5. Manufacturers:

   a. Acromag
   b. Moore Industries
   c. AMETEC Rochester Instrument Systems

PART 3 - EXECUTION

3.01 INSTALLATION

A. The panels shall be installed at locations as shown on the Drawings.

B. Panels shall be factory tested prior to shipment. Field installation shall consist only of setting the panel in place and making necessary electrical and conduit connections.

C. Refer to Section 13300.

3.02 TESTS (GENERAL)

A. Refer to Section 13300.

END OF SECTION

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SECTION 13530
PROGRAMMABLE LOGIC CONTROLLER (PLC) AND DIGITAL EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The General Provisions of Section 13300 apply to this Section.

B. All the Work in this Section shall be the product of the Instrumentation System Supplier (ISS). Components and enclosures may be provided to the ISS by sub-suppliers and/or manufacturers, but the packaging of these components and the production of the final product shall conform to this specification and shall be the sole responsibility of the ISS.

1.02 SUBMITTALS

A. Refer to Section 13300.

1.03 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.04 SPARE PARTS

A. In addition to the spare parts listed in other instrumentation sections, provide the following:

B. Programmable Logic Controller (PLC) and associated equipment:

1. Provide one (1) spare plus one for every ten (10) of any given component supplied.
2. Provide one (1) spare CPU battery for each CPU supplied.
3. Provide a spare removable nonvolatile memory card for each new and modified PLC, pre-loaded with the as-built program for that PLC.

C. Networking equipment: one (1) spare plus one for every ten (10) of each type of Ethernet and PROFIBUS/PROFINET communications device supplied.

D. Ethernet patch cables, CAT-6: One (1) per every five (5) furnished.

PART 2 - PRODUCTS

2.01 PANEL MOUNTED OPERATOR INTERFACE TERMINALS (OITS)

A. Panel Mounted Operator Interface Terminals (OITs) shall be mounted on control panels where indicated on the Drawings, and shall be set up to run the OIT application software.

B. Performance

1. CPU: x86.
2. 24 MB User Memory
3. Communication: PROFINET interface, MPI/PROFIBUS DP interface
4. Ports (minimum): 1 RS422/485 combined, 2 Industrial Ethernet (RJ-45), 2 USB 2.0, 1 USB Mini B.
5. Display: 15-inch widescreen TFT touchscreen color LCD, 1280x800 resolution.
6. Operating System: Windows CE 6.0, GE Proficy WebSpace.

C. Physical

1. Environment: NEMA 4; Class I Division 2.
2. Operating Temperature: 0-50˚C with 10-85% RH.
3. Power: 24 VDC, 1.5A consumption.

D. Manufacturer: I-Tech or approved equal.

2.02 ETHERNET SWITCH – OPTICAL SWITCH MODULE (OSM)

A. General: Provide managed Ethernet switch(es) for the control network as shown in the Drawings and specified herein.

B. Switches shall also function as media converters, converting between fiber optic and CAT6 cable.

C. Physical Features:

1. Fiber ports: 100Mbit/s ST(BFOC)
2. Copper ports: 12
3. Transfer rate: 10/100 Mbit/s
4. Operating temperature: 32 to 130 degrees F
5. Power: 24 VDC
6. Enclosure: Metal case. Provide 35mm DIN-rail mounting for industrial environments, as required for the location.

D. Network Features:

1. CLI
2. MIB support
3. Port mirroring
4. PROFINET I/O diagnostics
5. Switch - managed
6. SNMP V3 protocol supported

E. Manufacturers:

1. Siemens Scalance model X212-2, with 12 RJ-45 ports and 2 fiber optic ports, no substitution.
2. Siemens Scalance model X224, with 24 RJ-45 ports, no substitution.

2.03 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. ISS shall furnish and install PLC equipment as required by the Drawings and the following Specification and in accordance with the attached data sheets, including all necessary auxiliary equipment, in order to provide a fully integrated and working system.

B. Components shall be chosen from the list in this Section and assembled such that the intended function is achieved. In general, each PLC shall be equipped with one (1) CPU and one (1) Power Supply per rack, input/output modules as needed, and any communication modules needed to interface with remote I/O racks, the existing plant network, or other network devices. Furnish all cables, connectors, and ancillary devices necessary for the complete functioning of each PLC. Any components needed that are not listed shall be by Siemens or those recommended by Siemens, or its authorized representative in writing.

C. PLCs shall be configured such that one PLC functions as primary, is connected to the PROFINET and Ethernet networks, and to the local I/O via the PROFINET switch. The second PLC shall function as a cold backup, with identical application programming as the primary PLC, but no physical connection to either network.

D. The system shall include in each location:

1. Two PLC processors, each in its own power supply and rack, configured such that one PLC/rack is primary, and the second PLC/rack is programmed and available as cold standby.
2. Two Network Interface modules, one for PROFINET, one for SCADA Ethernet, in each PLC rack.
3. Patchcords and cables as necessary

E. Provide a minimum of twenty-five percent (25%) active spare I/O points of each type, and twenty-five percent (25%) room for future I/O modules in each PLC. All new, existing, and future I/O points, as shown on the Drawings or discovered in field investigation, shall be included in the total count for the purpose of determining the quantity of spares required.

F. CPU usage shall be tested, and shall not exceed 50% of capacity under full load conditions. ISS shall coordinate with APS (Application Programming Supplier) to ensure that the CPU and RAM selected are adequate to the application needs.

G. Distribute series of I/O points across multiple modules and racks so as to eliminate a single point of failure. For example, if there are two identical pumps, terminate the I/O for each pump in a different card and a different rack with separate power supply where possible.

H. Components used shall be manufactured by Siemens, and selected from the following list:

Product Description	Article Number
Siemens Simatic CPU 1516-3 PN/DP	6ES7516-3AN01-0AB0
Memory Card, 256 MB	6ES7954-8LL02-0AA0
Load Current Supply PM 190W, 120/230 VAC, 24VDC, 8A	6EP1333-4BA00
IM 155-5 PN HF	6ES7155-5AA00-0AC0
System Power Supply, PS 60W 24/48/60V DC	6ES7521-1BH00-0AB0
Digital Input Card DI 16x24 VDC HF	6ES7521-1BH00-0AB0
Digital Output Card DQ 16x24 VDC/0.5A HF	6ES7522-1BH01-0AB0
Analog Input Module AI 8xU/R/RTD/TC HF	6ES7531-7PF00-0AB0
Analog Output Module AQ 4xU/I HF	6ES7532-5ND00-0AB0
Mounting Rail S7-1500, 482 mm, for 19” cabinets	6ES7590-1AE80-0AA0
Mounting Rail S7-1500, 2000 mm,	6ES7590-1BC00-0AA0
Front Connector, push-in system for 35mm modules, 40-pin	6ES7592-1BM00-0XB0

Product Description	Article Number
SIMATIC STEP 7 Professional COMBO SUS Standard	6ES7810-5CC04-0YE2
Communication Module, CM 1542-1, PROFINET Controller	6GK7542-1AX00-0XE0
Communication Processor, CP 1543-1, Industrial Ethernet	6GK7543-1AX00-0XE0

2.04 COMMUNICATION

A. The PLC system shall support the installation of multiple communication modules into the PLC's backplane to bridge or route control and information data between different networks. A message shall be capable of being routed through up to four chassis (eight communication hops).

B. Provide an external unmanaged network interface module for connection to the Facility Ethernet fiber optic network. Provide N-Tron model 306FX2-ST where two pairs of multimode fiber optic connections are required, and N-Tron model 305FX-ST where one pair of multimode fiber optic connections is required.

C. WiFi Access Point

1. Provide Scalence W786 AP 5GHz WiFi outdoor access point hardware.
2. Provide Scalence omni-directional antenna.
3. Configure access point hardware consistent with existing equipment, and integrate into existing facility SCADA WiFi network.
4. Conduct a site survey with the manufacturer's equipment to determine locations for WiFi access points that will provide optimum coverage.
5. Install hardware in locations determined by site survey.
6. Route conduit and PoE network cabling from PROFINET switch location and PoE modules to WiFi access point locations.
7. Provide and utilize standard Scalence mounting hardware as appropriate for mounting locations.
8. Follow manufacturer's instructions for installation and wiring.
9. Provide lightning protection between the Scalence W786 and the antenna.
    a. Provide lightning protector LP798-1N
10. Provide surge protection on PoE cable.

D. Power-over-Ethernet Module

1. Provide separate floating 48VDC power source for each Scalence W786 access point unit.

2.05 POWER SUPPLY

A. The PLC shall operate in compliance with electrical service of:

1. 85 to 265 VAC (120 to 220 VAC nominal), single phase, 47 to 63 Hz

B. A single, main power supply shall be integral to each chassis and have the capability of supplying 1.2V, 3.3V, 5V and 24V power directly to the chassis backplane.

C. The power supply shall monitor the incoming line voltage for proper levels and include an easily viewed indicator to show status of the DC power applied to the backplane.

D. A power disconnect switch to disable power to the PLC shall be easily accessed by the operator.

E. The power supply shall provide electronic protection:

1. At the time of power-up, the power supply shall inhibit operation of the controller and I/O modules until the DC voltages are within specifications.
2. The power supply shall automatically shut down the PLC system when its output power exceeds 125% of its rated power.
3. The power supply shall be fused.

2.06 UNINTERRUPTIBLE POWER SUPPLY (UPS) FOR CONTROL PANELS

A. Unless otherwise indicated on the Drawings, the power supplied to all microprocessor-based equipment within a PLC control panel shall be protected by an Uninterruptible Power Supply (UPS) installed within the panel. The UPS shall prevent spikes, sags, surges, noise, and harmonics from adversely affecting digital equipment.

B. UPS input and output shall be galvanically isolated from one another. Input power shall be 120 VAC, 60 Hz. Output power may be 120VAC, 24VDC, or as needed to support connected equipment.

C. UPS shall contain internal backup batteries sufficient to allow all connected equipment to run continuously for no less than 45 minutes at full load. Provide load calculations which show these requirements to be met. If internal batteries are insufficient to meet this demand, provide additional batteries necessary in a separate enclosure.

D. UPS shall include normally closed contact outputs for “On Battery” and “Low Battery/Fault”, which shall be picked up by the PLC for operator notification.

E. UPS units shall be UL508/1778 labeled and capable of being mounted within UL508 approved cabinets without derating.

F. UPS shall be Allen-Bradley 1609-D, or approved equal.

G. Furnish and install a UPS maintenance bypass switch that will permit removal of the UPS for service while maintaining 120VAC power to all panel components. Provide a contact output indicating "UPS Bypassed" to the PLC for operator notification.

2.07 PLC SOFTWARE

A. ISS shall purchase, and turn over to the APS for use in application development, the following software. The software licenses shall be in the Owner's name, and shall be turned over to the Owner upon conclusion of the project.

1. Two (2) licenses of Step 7/V14 Professional Combo License.
2. Two (2) licenses of TIA Portal WinCC Advanced V14.
3. Two (2) licenses of the PROFIBUS configuration software utilized.

PART 3 - EXECUTION

3.01 GENERAL

A. Refer to Section 13300

3.02 EXAMINATION

A. The supplier shall verify that jobsite is ready to receive equipment.

3.03 INSTALLATION

A. Installation shall be in compliance with all manufacturer requirements, instructions and contract drawings, including:

1. Space surrounding the PLC to maintain adequate cooling.
2. Conditioning of space surrounding the PLC enclosure to maintain the manufacturer's ambient temperature and humidity ranges.
3. Accessibility of PLC diagnostic lights, communication ports and memory modules –these components shall be free from obstructions at all times.

B. Control Panels

1. As specified in Section 13325 – Control Panels and Panel Mounted Equipment.
2. The supplier shall provide all required cables and connectors to interface with other control system equipment.

3. The supplier shall ensure that communication media, analog signals and discrete I/O wiring are properly protected in accordance with manufacturer recommendations.

C. Existing I/O

1. Existing PLC 04A I/O is shown in Exhibit A. Existing I/O to be disconnected and abandoned is shown in strikethrough. Remove remaining I/O from existing PLC 04A and reterminate as remote I/O as shown on the Drawings.

Exhibit A: Existing PLC 04A I/O List

Description	Type	Address	Tag	Rack/Slot
Influent Box Hi Hi Level	DI	I0.0	ST-04A-200-LSHH	Slave 3 Slot 4
Influent Wetwell Hi Hi Level	DI	I0.1	ST-04A-231-LSHH	Slave 3 Slot 4
Influent Wetwell Lo Lo Level	DI	I0.2	ST-04A-200-LSLL	Slave 3 Slot 4
~~Motorized Influent Screen No. 1 Run Status~~	~~DI~~	~~I0.3~~	~~ST-04A-201-RS~~	~~Slave 3 Slot 4~~
~~Motorized Influent Screen No. 1 High Torque Status~~	~~DI~~	~~I0.4~~	~~ST-04A-201-WSH~~	~~Slave 3 Slot 4~~
~~Motorized Influent Screen No. 3 Run Status~~	~~DI~~	~~I0.5~~	~~ST-04A-203-RS~~	~~Slave 3 Slot 4~~
~~Motorized Influent Screen No. 3 High Torque Status~~	~~DI~~	~~I0.6~~	~~ST-04A-203-WSH~~	~~Slave 3 Slot 4~~
~~Bar Screen No. 1 Remote Status~~	~~DI~~	~~I0.7~~	~~ST-04A-201-HS~~	~~Slave 3 Slot 4~~
Spare	DI	I1.0		Slave 3 Slot 4
Spare	DI	I1.1		Slave 3 Slot 4
Spare	DI	I1.2		Slave 3 Slot 4
Spare	DI	I1.3		Slave 3 Slot 4
Spare	DI	I1.4		Slave 3 Slot 4
Spare	DI	I1.5		Slave 3 Slot 4
Spare	DI	I1.6		Slave 3 Slot 4
Spare	DI	I1.7		Slave 3 Slot 4
~~Influent Pump No. 1 (variable speed) Pump Remote Status~~	~~DI~~	~~I2.0~~	~~ST-04A-241-HSC~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 1 (variable speed) Speed Remote Status~~	~~DI~~	~~I2.1~~	~~ST-04A-241-HSD~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 1 (variable speed) Run Status~~	~~DI~~	~~I2.2~~	~~ST-04A-241-RS~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 1 (variable speed) Trouble Status~~	~~DI~~	~~I2.3~~	~~ST-04A-241-XS~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 3 (variable speed) Pump Remote Status~~	~~DI~~	~~I2.4~~	~~ST-04A-243-HSC~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 3 (variable speed) Speed Remote Status~~	~~DI~~	~~I2.5~~	~~ST-04A-243-HSD~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 3 (variable speed) Trouble Status~~	~~DI~~	~~I2.6~~	~~ST-04A-243-XS~~	~~Slave 3 Slot 5~~
~~Influent Pump No. 1 Pump Selected for VFD-A~~	~~DI~~	~~I2.7~~	~~ST-04A-241-HSF~~	~~Slave 3 Slot 5~~

Description	Type	Address	Tag	Rack/Slot
Spare	DI	I3.0		Slave 3 Slot 5
Spare	DI	I3.1		Slave 3 Slot 5
Spare	DI	I3.2		Slave 3 Slot 5
Spare	DI	I3.3		Slave 3 Slot 5
~~Influent Pump No. 3 Pump Selected for VFD-B~~	~~DI~~	~~I3.4~~	~~ST-04A-243-HSF~~	~~Slave 3 Slot 5~~
Spare	DI	I3.5		Slave 3 Slot 5
Spare	DI	I3.6		Slave 3 Slot 5
Spare	DI	I3.7		Slave 3 Slot 5
Influent Pump Station Hydgrogen Sulfide Analyzer CH1	DI	I4.0	ST-04A-251-ASH	Slave 3 Slot 6
Influent Pump Station Combustion Gas Analyzer CH4	DI	I4.1	ST-04A-253-ASH	Slave 3 Slot 6
Influent Sump Hi Level	DI	I4.2	ST-04A-255-LSH	Slave 3 Slot 6
Influent Eye Wash Station In Use	DI	I4.3	ST-04A-256-FS	Slave 3 Slot 6
Influent Pump Station Room Hi Hi Temp (motor room)	DI	I4.4	ST-04A-258-TSHH	Slave 3 Slot 6
Influent Pump Station Room Lo Lo Temp (control room)	DI	I4.5	ST-04A-258-TSLL	Slave 3 Slot 6
Influent Pump Sta Odor Control Sys Fan No. 1 Run Status	DI	I4.6	ST-04A-261-RSA	Slave 3 Slot 6
Influent Pump Sta Odor Control Sys Fan No. 1 Trouble	DI	I4.7	ST-04A-261-XSA	Slave 3 Slot 6
Spare	DI	I5.0		Slave 3 Slot 6
Spare	DI	I5.1		Slave 3 Slot 6
Spare	DI	I5.2		Slave 3 Slot 6
UPS Bypass	DI	I5.3	UPS-BY	Slave 3 Slot 6
UPS Common Alarm	DI	I5.4	UPS-CA	Slave 3 Slot 6
UPS on Inverter	DI	I5.5	UPS-1	Slave 3 Slot 6
Panel Intrusion	DI	I5.6	PLN-1	Slave 3 Slot 6
OSMTP62 Fault	DI	I5.7	OSMTP62	Slave 3 Slot 6
Influent Pump Station Supply Fan No. 1 Run Status	DI	I6.0	ST-04A-271-RS	Slave 3 Slot

Description	Type	Address	Tag	Rack/Slot
				7
Influent Pump Station Supply Fan No. 1 Trouble Status	DI	I6.1	ST-04A-271-S	Slave 3 Slot 7
Influent Pump Station Supply Fan No. 3 Run Status	DI	I6.2	ST-04A-273-RS	Slave 3 Slot 7
Influent Pump Station Supply Fan No. 3 Trouble Status	DI	I6.3	ST-04A-273-S	Slave 3 Slot 7
Influent Pump Station Exhaust Fan No. 1 Run Status	DI	I6.4	ST-04A-281-RS	Slave 3 Slot 7
Influent Pump Station Exhaust Fan No. 1 Trouble Status	DI	I6.5	ST-04A-281-S	Slave 3 Slot 7
Influent Pump Station Exhaust Fan No. 3 Run Status	DI	I6.6	ST-04A-283-RS	Slave 3 Slot 7
Influent Pump Station Exhaust Fan No. 3 Trouble Status	DI	I6.7	ST-04A-283-S	Slave 3 Slot 7
Influent Pump Station Supply Fan No. 5 Run Status	DI	I7.0	ST-04A-285-RS	Slave 3 Slot 7
Influent Pump Station Supply Fan No. 5 Trouble Status	DI	I7.1	ST-04A-285-S	Slave 3 Slot 7
Influent Pump Station Supply Fan No. 7 Run Status	DI	I7.2	ST-04A-287-RS	Slave 3 Slot 7
Influent Pump Station Supply Fan No. 7 Trouble Status	DI	I7.3	ST-04A-287-S	Slave 3 Slot 7
Influent Pump Station Exhaust Fan No. 9 Run Status	DI	I7.4	ST-04A-289-RS	Slave 3 Slot 7
Influent Pump Station Exhaust Fan No. 9 Trouble Status	DI	I7.5	ST-04A-289-S	Slave 3 Slot 7
Spare	DI	I7.6		Slave 3 Slot 7
Spare	DI	I7.7		Slave 3 Slot 7
Influent Wetwell Hi Hi Level	DI	I8.0	ST-04A-232-LSHH	Slave 4 Slot 4
Influent Wetwell Lo Lo Level	DI	I8.1	ST-04A-232-LSLL	Slave 4 Slot 4
~~Motorized Influent Screen No. 2 Run Status~~	~~DI~~	~~I8.2~~	~~ST-04A-202-RS~~	~~Slave 4 Slot 4~~
~~Motorized Influent Screen No. 2 High Current~~	~~DI~~	~~I8.3~~	~~ST-04A-202-ISH~~	~~Slave 4 Slot 4~~
Spare	DI	I8.4		Slave 4 Slot 4
Spare	DI	I8.5		Slave 4 Slot 4
Spare	DI	I8.6		Slave 4 Slot 4
Spare	DI	I8.7		Slave 4 Slot 4
Spare	DI	I9.0		Slave 4 Slot 4
Spare	DI	I9.1		Slave 4 Slot

Description	Type	Address	Tag	Rack/Slot
				4
Spare	DI	I9.2		Slave 4 Slot 4
Spare	DI	I9.3		Slave 4 Slot 4
~~Influent Pump No. 4 (constant speed) Pump Remote Status~~	~~DI~~	~~I9.4~~	~~ST-04A-244-HSC~~	~~Slave 4 Slot 4~~
~~Influent Pump No. 4 (constant speed) Run Status~~	~~DI~~	~~I9.5~~	~~ST-04A-244-RS~~	~~Slave 4 Slot 4~~
~~Influent Pump No. 4 (constant speed) Trouble Status~~	~~DI~~	~~I9.6~~	~~ST-04A-244-XS~~	~~Slave 4 Slot 4~~
~~Influent Pump No. 4 Selected for VFD-A~~	~~DI~~	~~I9.7~~	~~ST-04A-244-HSF~~	~~Slave 4 Slot 4~~
~~Influent Pump No. 6 (variable speed) Pump Remote Status~~	~~DI~~	~~I10.0~~	~~ST-04A-244-HSC~~	~~Slave 4 Slot 5~~
~~Influent Pump No. 6 (variable speed) Speed Remote Status~~	~~DI~~	~~I10.1~~	~~ST-04A-244-HSC~~	~~Slave 4 Slot 5~~
~~Influent Pump No. 6 (constant speed) Run Status~~	~~DI~~	~~I10.2~~	~~ST-04A-244-HSC~~	~~Slave 4 Slot 5~~
~~Influent Pump No. 6 (constant speed) Trouble Status~~	~~DI~~	~~I10.3~~	~~ST-04A-244-HSC~~	~~Slave 4 Slot 5~~
Spare	DI	I10.4		Slave 4 Slot 5
Spare	DI	I10.5		Slave 4 Slot 5
Spare	DI	I10.6		Slave 4 Slot 5
Spare	DI	I10.7		Slave 4 Slot 5
Influent Pump Sta H2S Analyzer (bar screen exp unit)	DI	I11.0	ST-04A-252-ASH	Slave 4 Slot 5
Influent Pump Station Combust Gas Analyzer (H2S Hi Level)	DI	I11.1	ST-04A-254-ASH	Slave 4 Slot 5
Influent Eye Wash Station Status	DI	I11.2	ST-04A-257-FS	Slave 4 Slot 5
Influent Pump Sta Odor Control System Fan No. 2 Run Status	DI	I11.3	ST-04A-262-RSA	Slave 4 Slot 5
Influent Pump Sta Odor Control System Fan No. 2 Trouble	DI	I11.4	ST-04A-262-XSA	Slave 4 Slot 5
Spare	DI	I11.5		Slave 4 Slot 5
Spare	DI	I11.6		Slave 4 Slot 5
~~Influent Pump No. 6 Selected for VFD-B~~	~~DI~~	~~I11.7~~	~~ST-04A-246-HSF~~	~~Slave 4 Slot 5~~
Influent Pump Station Supply Fan No. 2 Run Status	DI	I12.0	ST-04A-272-RS	Slave 4 Slot 6
Influent Pump Station Supply Fan No. 2 Trouble Status	DI	I12.1	ST-04A-272-XS	Slave 4 Slot 6
Influent Pump Station Supply Fan No. 4 Run Status	DI	I12.2	ST-04A-274-RS	Slave 4 Slot

Description	Type	Address	Tag	Rack/Slot
				6
Influent Pump Station Supply Fan No. 4 Trouble Status	DI	I12.3	ST-04A-274-XS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 2 Run Status	DI	I12.4	ST-04A-282-RS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 2 Trouble Status	DI	I12.5	ST-04A-282-XS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 4 Run Status	DI	I12.6	ST-04A-284-RS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 4 Trouble Status	DI	I12.7	ST-04A-284-XS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 6 Run Status	DI	I13.0	ST-04A-286-RS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 6 Trouble Status	DI	I13.1	ST-04A-286-XS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 8 Run Status	DI	I13.2	ST-04A-288-RS	Slave 4 Slot 6
Influent Pump Station Exhaust Fan No. 8 Trouble Status	DI	I13.3	ST-04A-288-XS	Slave 4 Slot 6
Spare	DI	I13.4		Slave 4 Slot 6
Spare	DI	I13.5		Slave 4 Slot 6
Spare	DI	I13.6		Slave 4 Slot 6
Spare	DI	I13.7		Slave 4 Slot 6
~~Motorized Influent Screen No. 1 Start~~	~~DO~~	~~Q0.0~~	~~ST-04A-201-HSC~~	~~Slave 3 Slot 8~~
~~Motorized Influent Screen No. 1 Solenoid Valve Open~~	~~DO~~	~~Q0.1~~	~~ST-04A-201-SV~~	~~Slave 3 Slot 8~~
Spare	DO	Q0.2		Slave 3 Slot 8
Spare	DO	Q0.3		Slave 3 Slot 8
Spare	DO	Q0.4		Slave 3 Slot 8
Spare	DO	Q0.5		Slave 3 Slot 8
Spare	DO	Q0.6		Slave 3 Slot 8
Spare	DO	Q0.7		Slave 3 Slot 8
~~Influent Pump No. 1 (variable speed) Start~~	~~DO~~	~~Q1.0~~	~~ST-04A-241-HSC~~	~~Slave 3 Slot 9~~
~~Influent Pump No. 3 (constant speed) Start~~	~~DO~~	~~Q1.1~~	~~ST-04A-243-HSC~~	~~Slave 3 Slot 9~~
Spare	DO	Q1.2		Slave 3 Slot 9
Spare	DO	Q1.3		Slave 3 Slot

Description	Type	Address	Tag	Rack/Slot
				9
Spare	DO	Q1.4		Slave 3 Slot 9
Spare	DO	Q1.5		Slave 3 Slot 9
Spare	DO	Q1.6		Slave 3 Slot 9
Spare	DO	Q1.7		Slave 3 Slot 9
~~Motorized Influent Screen No. 2 Start~~	~~DO~~	~~Q2.0~~	~~ST-04A-202-HSC~~	~~Slave 4 Slot 7~~
~~Motorized Influent Screen No. 2 Solenoid Valve Open~~	~~DO~~	~~Q2.1~~	~~ST-04A-202-SV~~	~~Slave 4 Slot 7~~
Spare	DO	Q2.2		Slave 4 Slot 7
Spare	DO	Q2.3		Slave 4 Slot 7
Spare	DO	Q2.4		Slave 4 Slot 7
~~Influent Pump No. 4 (constant speed) Start~~	~~DO~~	~~Q2.5~~	~~ST-04A-244-HSC~~	~~Slave 4 Slot 7~~
~~Influent Pump No. 6 (variable speed) Start~~	~~DO~~	~~Q2.6~~	~~ST-04A-246-HSC~~	~~Slave 4 Slot 7~~
Spare	DO	Q2.7		Slave 4 Slot 7
Electrical Room Temperature Sensor (term addr unknown)	AI	PIW300		Slave 3 Slot 10
Spare	AI	PIW258		Slave 3 Slot 10
Influent Wetwell No. 1 Level	AI	PIW260	ST-04A-231-LIT	Slave 3 Slot 10
Spare	AI	PIW262		Slave 3 Slot 10
~~Influent Pump No. 1 Speed~~	~~AI~~	~~PIW264~~	~~ST-04A-241-ST~~	~~Slave 3 Slot 10~~
Spare	AI	PIW266		Slave 3 Slot 10
Influent Wetwell No. 2 Level	AI	PIW268	ST-04A-232-LIT	Slave 3 Slot 10
Spare	AI	PIW270		Slave 3 Slot 10
Spare	AI	PIW272		Slave 4 Slot 8
Spare	AI	PIW274		Slave 4 Slot 8
Spare	AI	PIW276		Slave 4 Slot 8
Spare	AI	PIW278		Slave 4 Slot 8
Spare	AI	PIW280		Slave 4 Slot

Description	Type	Address	Tag	Rack/Slot
				8
~~Influent Pump No. 6 Speed~~	~~AI~~	~~PIW282~~	~~ST-04A-246-ST~~	~~Slave 4 Slot 8~~
Spare	AI	PIW284		Slave 4 Slot 8
Spare	AI	PIW286		Slave 4 Slot 8
Odor Control Panel No. 1 pH Analyzer	AI	PIW288	ST-04A-261-AITA	Slave 5 Slot 4
Odor Control Panel No. 1 pH Analyzer	AI	PIW290	ST-04A-261-AITB	Slave 5 Slot 4
Odor Control Panel No. 1 ORP Analyzer	AI	PIW292	ST-04A-261-AITC	Slave 5 Slot 4
Odor Control Panel No. 1 ORP Analyzer	AI	PIW294	ST-04A-261-AITD	Slave 5 Slot 4
Spare	AI	PIW296		Slave 5 Slot 4
Spare	AI	PIW298		Slave 5 Slot 4
Spare	AI	PIW300		Slave 5 Slot 4
Spare	AI	PIW302		Slave 5 Slot 4
Odor Control Panel No. 2 pH Analyzer	AI	PIW304	ST-04A-262-AITA	Slave 5 Slot 5
Odor Control Panel No. 2 pH Analyzer	AI	PIW306	ST-04A-262-AITB	Slave 5 Slot 5
Odor Control Panel No. 2 ORP Analyzer	AI	PIW308	ST-04A-262-AITC	Slave 5 Slot 5
Odor Control Panel No. 2 ORP Analyzer	AI	PIW310	ST-04A-262-AITD	Slave 5 Slot 5
Spare	AI	PIW312		Slave 5 Slot 5
Spare	AI	PIW314		Slave 5 Slot 5
Spare	AI	PIW316		Slave 5 Slot 5
Spare	AI	PIW318		Slave 5 Slot 5
~~Influent Pump No. 1 Speed Control~~	~~AO~~	~~PQW256~~	~~ST-04A-241-SK~~	~~Slave 3 Slot 11~~
Spare	AO	PQW258		Slave 3 Slot 11
Spare	AO	PQW260		Slave 3 Slot 11
Spare	AO	PQW262		Slave 3 Slot 11
Spare	AO	PQW264		Slave 4 Slot 9

Description	Type	Address	Tag	Rack/Slot
~~Influent Pump No. 6 Speed Control~~	~~AO~~	~~PQW266~~	~~ST-04A-246-SK~~	~~Slave 4 Slot 9~~
Influent Flow Sampler Flow Pacing	AO	PQW268	ST-04A-290-FY	Slave 4 Slot 9
Spare	AO	PQW270		Slave 4 Slot 9

Exhibit B: New PLC 04A I/O List

Description	Type	Address	Tag	Rack/Slot
Influent Wetwell A High Level	DI	I0.0	121LAHH	
Influent Wetwell A Low Level	DI	I0.1	121LALL	
Influent Pump No. 1 Check Valve Status	DI	I0.2	151ZSH	
Influent Pump No. 5 Check Valve Status	DI	I0.3	155ZSH	
Influent Pump No. 4 Check Valve Status (Future)	DI	I0.4	154ZSH	
Influent Wetwell A Discharge Pressure High	DI	I0.5	121PSH	
Influent Wetwell A Inlet Gate Opened	DI	I0.6	117ZSH	
Influent Wetwell A Inlet Gate Closed	DI	I0.7	117ZSL	
Influent Wetwell B High Level	DI	I1.0	120LAHH	
Influent Wetwell B Low Level	DI	I1.1	120LALL	
Influent Pump No. 2 Check Valve Status	DI	I1.2	152ZSH	
Influent Pump No. 6 Check Valve Status	DI	I1.3	156ZSH	
Influent Pump No. 8 Check Valve Status (Future)	DI	I1.4	158ZSH	
Influent Wetwell B Discharge Pressure High	DI	I1.5	120PSH	
Influent Wetwell B Inlet Gate Opened	DI	I1.6	118ZSH	
Influent Wetwell B Inlet Gate Closed	DI	I1.7	118ZSL	
Spare	DI	I2.0		
Spare	DI	I2.1		
Influent Pump No. 3 Check Valve Status	DI	I2.2	153ZSH	
Influent Pump No. 7 Check Valve Status	DI	I2.3	157ZSH	
Spare	DI	I2.4		
Spare	DI	I2.5		
Electrical Building Smoke Alarm	DI	I2.6	191XA	
Electrical Building High Temperature	DI	I2.7	192TH	
Spare	DI	I5.0		
Spare	DI	I5.1		
Spare	DI	I5.2		
UPS Bypass	DI	I5.3		
UPS Common Alarm	DI	I5.4		
UPS on Inverter	DI	I5.5		
Panel Intrusion	DI	I5.6		
Spare	DI	I5.7		
Backup Pump Control Panel Disable	DO	Q0.0	HS150	
Spare	DO	Q0.1		

Description	Type	Address	Tag	Rack/Slot
Spare	DO	Q0.2		
Spare	DO	Q0.3		
Spare	DO	Q0.4		
Spare	DO	Q0.5		
Spare	DO	Q0.6		
Spare	DO	Q0.7		
Influent Inlet Chamber Level	AI	PIW256	LI122	
Spare	AI	PIW258		
Influent Wetwell Side A Level	AI	PIW260	LI121	
Spare	AI	PIW262		
Influent Flow Manhole B	AI	PIW264	FI190	
Spare	AI	PIW266		
Influent Wetwell Side B Level	AI	PIW268	LI120	
Spare	AI	PIW270		
Wetwell Level Control	AO	PQW264	LIC125	
Spare	AO	PQW266		
Spare	AO	PQW268		
Spare	AO	PQW270		

END OF SECTION

SECTION 13850
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide fire detection and alarm as indicated and in compliance with Contract Documents.

B. Provide, test, and place into operating condition an electrically operated, microprocessor based, UL listed, four-wire, analog/addressable, electrically supervised fire detection and evacuation system as indicated and specified.

C. The System shall include, but not be limited to: Fire Alarm Control Panel (FACP), power supplies and fire alarm initiating and notification devices including addressable monitor and control modules.

D. The fire alarm system shall include conduit, wire, fittings, and accessories required to provide a complete operating system.

E. All charges and fees required by the local Authority having jurisdiction (AHJ) to inspect the installation and implement fire alarm notification are to be included by the Contractor under this section at no additional cost to the Owner.

1.02 REFERENCES:

A. Factory Mutual (FM):

1. P7825: Approved Guide

B. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits.

2. C62.41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

2. 72: National Fire Alarm Code

3. 90A: Standard for the Installation of Air Conditioning and Ventilating Systems

4. 101: Life Safety Code.

D. Underwriters' Laboratories (UL)

1. Fire Protection Equipment Directory
2. 268: Standard for Smoke Detectors for Fire Alarm Signaling Systems
3. 464: Standard for Audible Signal Appliances
4. 864: Control Units for Fire Protective Signaling Systems
5. 1971: Signaling Devices for the Hearing Impaired

E. State and Local Building Codes.

1.03 SYSTEM DESCRIPTION:

A. Type of System:

1. Fire Alarm System: The fire alarm system shall operate as a low voltage analog/addressable type system and shall automatically initiate fire alarm signals whenever any manual or automatic fire detecting devices are placed into an alarm mode. The system shall indicate areas of alarm and sound local alarms. Initiating loops and notification loops shall be wired as four-wire class A loops. Initiating loops and notification loops shall be complete with necessary switches, meters, relays, pilot lights, surge arresters and addressable modules as required. A minimum of one thermal cut-out or fuse and surge arrestor for every notification circuit shall be provided.
2. The system shall be capable of operating with a single break or ground fault condition in the initiating or alarm sounding circuits.
3. Evacuation Alarms: Coded evacuation alarm: A fire alarm signal shall be employed for notifying the occupants to evacuate.
4. Trouble Signals: During abnormal conditions such as an open wire or a ground fault, or where both conditions occur at one point, the system shall automatically transmit trouble signals.
5. Power Supply for the System: A dedicated branch-circuit for supplying power to the alarm system shall be provided for the Fire Alarm Control Panel (FACP). The branch circuits shall be automatically energized from an auxiliary electrical power system during failures of the normal power supply. Provide battery backup power consisting of rechargeable, sealed type storage batteries and battery charger.
6. The system shall interface to HVAC system and other building systems as shown on the Contract Drawings and required by applicable codes to provide all required monitoring and control functions.

B. Sequence of Operation:

1. When a fire-alarm condition is detected by one of the system initiating devices, the following functions shall immediately occur:

    a. Automatic programs assigned to the alarm point shall be executed and the associated indicating devices and relays activated.
    b. Fire-alarm notification devices in the building shall operate.
    c. The system alarm on the Fire Alarm Control Panel will indicate condition.
    d. The alarm shall be signaled automatically to the facility SCADA system.
    e. Shutdown of HVAC equipment and associated exhaust and pressurization operations to be initiated.

2. When a trouble condition is detected by one of the system initiating or indicating circuits, the following functions shall immediately occur:

    a. System Trouble will be indicted on FACP.
    b. A local trouble-sounding device in the FACP shall be activated. This sound shall be distinct from the alarm sound.
    c. The appropriate message will appear on the LCD display at the FACP.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Copy of this specification section with addenda and all referenced specification sections with addenda check-mark each paragraph to indicate specification compliance or indicate deviation and reason for deviation.

    a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal with no further review and consideration.

2. Installer and system supplier qualifications and list of three similar projects with name and phone number of contact person.

3. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts. Shop drawings shall contain complete conduit riser diagrams, wiring diagrams, and schematic diagrams for the equipment furnished. Riser diagrams shall identify cable sizes and quantities, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

4. Manufacturer’s printed installation instructions.

5. Battery capacity calculations to demonstrate that the battery size selected is a minimum of 125 percent of the calculated requirement. Calculation to include supervisory power requirements for all equipment, and alarm power requirements for all equipment.

6. Wiring diagrams from the fire alarm system integrator or supplier differentiating clearly between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Identify all diagrams to be specific to this project and distinguish between field and factory wiring.

B. Spare Parts Data:

1. After approval of the list of shop drawings, and not later than six months prior to the date of substantial completion, furnish copies of spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies with current unit prices and source of supply, a list of supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified to be furnished in accordance with paragraph Special Tools and Spare Parts and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days.

C. Operating and Maintenance Instruction Manuals:

1. At end of project, submit operating instruction manuals as specified in Section 01730, outlining the step-by-step procedures required for system startup and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual parts list and brief description of all equipment and their basic operating features.

2. Maintenance instructions manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdown and repairs and a simplified connection wiring diagram for the system as installed. Provide the names, addresses, and telephone numbers of service organizations that provide technical assistance and carry stock of repair parts for the system to be furnished.

3. Performance Test Reports: Upon completion of the installed system, submit in booklet form field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

D. Submit Certificate of Compliance, signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

E. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

1.05 SPARE PARTS:

A. Comply with the requirements specified in Section 01600.

B. Provide one spare FACP mother board and 2 spare devices of each type provided for this Contract as listed below.

1. Manual Pull Stations
2. Photoelectric Smoke Detectors.
3. Alarm Audible Devices.
4. Alarm Strobes.

C. Three sets of special tools necessary for the maintenance of the equipment shall be furnished. Two spare sets of fuses of each type and size required and five spare lamps for each type shall be furnished. Spare parts shall be listed on submittal list.

1.06 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Standard Products: Material and equipment shall be the latest standard products of a single manufacturer regularly engaged in the manufacture of the product for the 5 years as a minimum.

C. Qualifications of the installer before commencing work: Submit information demonstrating that the supplier has successfully installed fire alarm systems of the same scope, type and design as specified.

1. Submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
2. Employ on staff a minimum of one full time NICET level 2 Technician or a professional engineer.
3. Certify that the completed system conforms with UL standards upon completion of the installation.
4. Ongoing maintenance and testing shall be provided to the Owner under a maintenance contract to maintain the UL listing.

D. Nameplates: The components of equipment shall have the manufacturer's name, address, type or style, and catalog number on a plate securely attached to the equipment.

E. Tags: Tags with stamped identification number shall be furnished for keys and locks. Tags shall be furnished to identify cable and conduit runs, wiring circuits, and all spare parts furnished for Authority's stock to maintain the system.

F. Keys and Locks: All locks shall be keyed alike.

G. Verification of Dimensions: Become familiar with details of the work and verify dimensions in the field.

H. Compliance: The fire detection and internal alarm system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

I. Accessibility: Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units, and allow ample gutter space for interconnections of panels and field wires.

J. Verify conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier.

K. Review selected arrangement with local fire authority for conformance with local and state requirements.

L. Onsite Technician Services:

1. Provide the services of a representative or technician certified by the manufacturer of the system, experienced in the installation and operation of the type of system provided.
2. The representative shall be licensed in the State if required by law.
3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system, and Underwriters Laboratories listing certification requirements.
4. The technician shall provide the required instruction to the Owner’s personnel in the system operation, maintenance and programming.
5. Provide services of the manufacturer's service representative during installation, startup and testing, for a period of two working days plus travel where a working day is equivalent to 8 hours.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Equipment placed into storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Notifier

B. Honeywell

C. Simplex - Grinnell

2.02 MATERIAL AND EQUIPMENT:

A. General Product Description:

1. Fire-Alarm Control Panel (FACP) shall be capable of fire detection, equipment supervision and control, alarm management, and historical data collection and archiving.

B. Communications:

1. The FACP shall have sufficient memory to support its operating system and databases including:

a. Fire management
b. Alarm management
c. Historical/Trend Data
d. Maintenance Support Applications
e. Custom Processes
f. Operator I/O

2. Communication Ports: Provide data communication ports for simultaneous operation of devices such as industry standard printers, programming terminal, PC, transponder and annunciator.

3. Integrated On-Line Diagnostics: The FACP shall continuously perform self-diagnostics, communication diagnostics and diagnostics on all subsidiary equipment.

4. Surge and Transient Protection: Isolation shall be provided at all field point terminations to suppress induced voltage transients where required. Surge arrestors shall provide protection from all non-signal electrical surges that could cause damage to the equipment. Line surge arrestors shall be isolated from the electrical circuitry that they are protecting.

C. System Software Features:

1. Provide software to form a complete operating system as described in this specification shall be provided.

2. The software programs specified in this section shall be provided as an integral part of the panel and shall not be dependent upon any higher level computer for execution.

3. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. The control unit shall have capability of performing alarm analysis and signaling. At no time shall the panel's ability to report alarms be affected by operator activity.

4. Status Change Report: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

5. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided.

6. Report Routing: Alarm reports shall be archived for future recall.

7. Alarm Messages: In addition to the point's description and the time and date, the user shall be able to print, display or store a custom alarm message to more fully describe the alarm condition or direct operator response.

8. The FACP shall be capable of storing a library of at least 900 events.

9. History Mode:

   a. The system shall be able to store and display at least 900 system events that have occurred in a non-volatile buffer memory. Display of these events shall be accomplished on-site through the use of the front control panel indicators and switches.

10. Field Configurable:

    a. The system shall be fully configurable and expandable without the need for EPROM programmers. All configurations shall be accomplished through downloading of programs from a computer. Reconfiguration shall not require knowledge of any programming languages or require any special training. All programs shall be stored in non-volatile memory. Entry into program mode shall require a special key and a special password entered into the front panel.

D. Analog Device Interface:

1. The Analog Device Interface will be capable of supporting devices as indicated on drawings with 25 percent spare slots for future devices.

2. The analog addressable device interface shall contain its own microprocessor control.

3. The analog addressable device interface shall communicate and provide power to all devices on its loop over a single pair of wires. The fire-alarm system shall function as a Class A system.

4. The analog interface board shall receive analog information from intelligent detectors and shall process this information to determine normal, alarm, or trouble conditions. The analog information may also be used for automatic test and determination of maintenance requirements.

5. Communication with connected devices shall be performed every 5 seconds or less. Average time to detect an alarm shall be less than 10 seconds (longer for alarm verification detectors).

E. Notification Appliance Circuit:

1. The FACP shall provide supervised Class A notification circuits as indicated on drawings with 50 percent spare capacity for future devices. The circuit capacity shall be 2.0 amperes maximum per circuit, maximum of 8.0 amperes from the FACP's power supply. If a short-circuit trouble occurs on one of the circuits it will not affect the operation of the remaining circuits.

F. Function Relays:

1. The FACP shall provide of Form "C" relay contacts, quantity as required, rated at 2 A at 120 VAC. These relays may be programmed to activate on alarm from any initiating zone or any combination of initiating zones, analog devices or addressable modules.

G. Central Processing Unit (CPU):

1. The CPU shall communicate with the operator interface, LCD display, LED display and control other modules in the panel. Removal, disconnection or failure of any control panel shall be detected and reported by the Central Processing Unit.

2. The CPU shall contain and execute all control-by-event programs for specific action to be taken if a fire situation is detected in the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs. The CPU shall also provide a real time clock for time annotation on the display.

H. Operator Display:

1. The operator display shall provide controls and indicators used by the system operator. The display shall contain, and display as needed, custom alphanumeric message for all intelligent detectors and addressable modules. Such message information shall be stored in programmable non-volatile memory.

2. The display board shall provide an 80-character alphanumeric Liquid Crystal Display (LCD). It shall also 24 LEDs for system indication such as AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; ACKNOWLEDGE; SIGNAL SILENCE, etc.

3. Factory programmable system indications and keys shall be available for unique functions. Keys shall be referred to as "Hot Keys".

4. The Display Interface shall provide a 15-key touch keypad with control capability to command all system functions, and entry of any numeric information. The keypad shall include means to enter a minimum of two different passwords to prevent unauthorized manual control.

5. Ground fault indication shall be displayed on a system and initiating zone basis.

I. Communications Ports:

1. The system shall provide the following interfaces:

a. One port for central station communication.
b. One port for service and field programming.

J. Mechanical Design:

1. The Fire Alarm Control Panel (FACP) shall be housed in a cabinet designed for mounting directly to a wall. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include an opening for viewing.

2. The FACP shall be modular in structure for ease of installation and maintenance.

K. One Person Test Feature: The control unit shall include a special one person test feature, which will allow a single person to test all initiating devices and indicating appliance in a system without returning to the panel to reset the system. A special password shall be required to enter the test mode. The service-technician shall be able to re-select the initiating and indicating circuits that are to be included in the one person test mode. The Walk-Test shall include a special audible indication that a trouble has been detected on an analog device, for the service-technician to check proper system wiring.

L. Provide addressable monitor modules to interface manual FACP to stations and other non-addressable detection components as required. The modules shall be capable of being mounted in a 4 x 4 x 2-1/8 inch junction box.

M. Provide addressable control modules to interface FACP to audible and visual devices and other control components as required. The modules shall be capable of being mounted in a 4 x 4 x 2-1/8 inch junction box.

N. Fire-Alarm Initiating Devices:

1. Addressable Devices: All addressable detectors shall:

a. Provide a test means whereby they will simulate an alarm condition and report that condition to the FACP. Such a test may initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

b. Provide address-setting means on the detector head using switches. The detectors shall also store an internal identifying code which the FACP shall use to identify the type of detector.

c. Provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

2. Addressable pull stations shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. Operated stations shall have a positive, visual indication of operation and utilize a key type reset. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inch or larger. Mount stations inside a red, weatherproof enclosure with a clear polycarbonate hinged front cover where station is indicated on the drawings as NEMA 4, NEMA 4X and hazardous areas including Class I, Division 1 and 2.

3. Analog/Addressable Area Photoelectric Smoke Detectors: Photoelectric Smoke Detectors shall use the photoelectric principle to measure smoke density and shall, on command from the control panel send data to the panel representing the analog level of smoke density. These addressable detectors shall connect with two wires to one of the control addressable input circuits.

4. Each detector shall be provided with a steel mounting plate, and the entire unit shall mount on a double gang electrical box.

5. Analog/Addressable Duct Smoke Detectors: Provided under Division 15.

   a. The detectors shall, on command from the control panel, send data to the panel representing the analog level of smoke intensity.

6. Provide devices suitable for the area classifications as indicated on the Contract Drawings (i.e., NEMA 1, NEMA 3R, NEMA 4X, and NEMA 7 (Class I, Division 1 or 2) etc).

O. Fire Alarm Indicating Devices:

1. Visual appliances shall be installed as shown on the drawings in accordance with the requirements of the UL 1971 standard and NFPA 72. Where multiple visual signals are visible from any location, circuitry shall be incorporated for the synchronization of the flash rate.

   a. Strobes shall meet UL 1971 flash rate.

b. Visual signals shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry.
c. The strobe intensity shall be rated per UL 1971.
d. The strobes shall be available for surface mounting and in conjunction with audible signals as required.

2. Audible Devices: Audible evacuation signals shall be provided meeting the following requirements:

a. Audible Notification appliance shall be electronic and use solid state components.
b. Each electronic signal shall provide four field selectable alarm tones. The tones shall consist of: slow hoop, continuous, temporal or interrupted.
c. The device shall provide UL dBA measurement at 10 feet shall be a minimum of 85 dBA for separately mounted audible signals.
d. The device shall have provisions for standard reverse polarity type supervision and in/out field wiring using terminals that accept 14 AWG wiring.
e. Combination audiovisual alarm horns shall have a high intensity flashing light and alarm horn as an integral unit. Both audio and visual components shall operate from the 24 volt dc polarized indicating circuits. The horn assembly shall be housed in a rugged, die-cast enclosure, and the electronic light source shall be sealed in silicone and protected by a Lexan lens. The word FIRE shall appear on the lens. Audiovisual alarm devices shall meet the requirements of visual appliances and alarm horns above. Single and/or dual projectors shall be supplied as shown on the plans.

P. Power Supply:

1. The power supply for the FACP and fire alarm peripherals shall be integral to the FACP. The power supply shall provide FACP and peripheral power needs.

2. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs.

3. Input power shall be 120 VAC, 60 Hertz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be sized as required to meet system requirements.

4. The main power supply shall provide a battery charging circuit consisting of a fully automatic standby battery charger, rate compensated, capable of maintaining battery in fully charged state and be capable of recharging batteries to 70 percent of alarm capacity within 12 hours. Provide for normal operation of entire system for 24 hours with power remaining to sound alarms for 5 minutes. For remote stations, provide battery capacity to operate for 60 hours followed by 5 minutes of alarm in accordance with NFPA 72B.

5. Provide charger with the following supervised functions: circuit protection for shorts, open, disconnected or reversed polarity battery connection, supervision or protection of high or low voltage, overcharging and charger failure. Automatic load shedding or battery disconnect on deep discharge to prevent battery damage.

6. Batteries shall be 24 volt, rechargeable, gelled electrolyte, totally sealed, fully charged with al interconnections ready for service, maintenance free, long-life.

Q. Wiring within Cabinets, Enclosures, Boxes, Junction Boxes, and Fittings:

1. Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet.

2. Conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks.

3. Mark each terminal in accordance with the wiring diagrams of the system.

4. Make connections with approved pressure type terminal blocks, which are securely mounted.

5. The use of wire nuts or similar devices shall be prohibited.

R. Terminal Cabinets:

1. Provide a terminal cabinet at the base of any circuit riser, and where indicated on the drawings.

2. Terminal size shall be appropriate for the size of the wiring to be connected.

3. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet.

4. Minimum size is 8 inch high by 8 inch.

S. Alarm Wiring:

1. Signaling line circuits and initiating device circuit field wiring shall be copper, 18 AWG size conductors at a minimum.

2. Notification appliance circuit conductors, that contain audible alarm devices, shall be solid copper 14 AWG size conductors at a minimum.

3. Wire size shall be sufficient to prevent voltage drop problems.

4. Power wiring, operating at 120 VAC minimum shall be 12 AWG solid copper having similar insulation.

5. Provide all wiring in rigid metal conduit

T. Conductor Terminations:

1. Labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection.

2. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation.

3. Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit, and terminal.

4. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install fire alarm system as indicated on the drawings, in accordance with the manufacturer's diagrams and printed instructions, except where otherwise indicated.

1. Wiring: Wiring for systems shall be installed in conduit. Provide conduit as specified in Section 16110.

2. Station loops shall be arranged to permit disconnecting and bypassing the system at the base of each riser. External wiring between the control panel and the stations and horns/lights shall connect to terminal strips in accessible locked cabinets. Connections to the terminal strips shall be made with terminal spade lugs or with approved type terminal blocks. Terminal cabinets shall be installed at each point where a station circuit riser originates or any point along a circuit where a tap is made. The conductors for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of the conduit. Gutter space to accommodate all necessary wiring shall be provided.

3. Panels: Panel enclosures shall comply with the requirements of UL 864. Enclosures having doors over 48 inch in height shall be provided with a three-point catch and lock; all other doors shall contain a cabinet type cylinder lock. Inserts shall be blind fastened so that no screws show on the panel front.

4. Detectors: Detectors shall be installed in accordance with manufacturer's printed instructions.

5. Provide complete wiring and conduit between all equipment. Devices shall be mounted upon UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted.

6. Junction boxes shall be painted red and labeled as “Fire Alarm System” with decal or approved markings.

7. Firm Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled “FIRE ALARM.”

8. Review the design drawings and perform a walk-through of all areas with the AHJ.

3.02 PERMITS AND CERTIFICATIONS:

A. Obtain required local permits.

1. Provide UL certification of the installation.

3.03 FIELD TESTING:

A. Notify the AHJ and the Owner 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Owner or his authorized representative. Furnish instruments and personnel required for the tests. Tests shall be conducted for the following:

1. Verify that the system is free of grounds or open circuits. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. The FACP shall indicate when a ground or open circuit exists.

2. Alarm initiating devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.

3. Verify that all strobes, audible devices, pull stations, transmitters, automatic detectors and supervisory devices are functioning as specified.

a. Strobes shall deliver the correct foot-candle. Audible devices shall delivery the correct sound pressure levels decibels of the specified device.
b. Stations shall close the circuits specified and deliver specified alarm codes. Verify central station receives alarm.
c. Automatic detectors shall actuate the specified zones when the appropriate fire or smoke conditions are generated. The detectors shall be exposed to actual smoke used to simulate this test on each and every smoke detector as located in the building; no other test will be accepted.
d. Panels and supervisory devices shall display and control functions as specified. Loss of AC system power shall also be tested.

B. System tests to be performed under the supervision of a qualified representative and the AHJ.

C. Perform all tests to verify the correction of defects found in the initial testing. If testing identifies system modifications are required to accomplish the required operation, perform work at no additional cost to the Owner and retest the system.

D. Furnish training as follows:

1. Training in the receipt, handling and acknowledgment of alarms.
2. Training in the system operation including manual control of output functions from the system control panel.
3. Training in the testing of the system.

3.04 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 15000
GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish all labor, materials, services, supplies, tools, equipment, transportation and facilities necessary to install complete and operable all mechanical equipment as shown on the Drawings and specified in this Division.

B. Drawings and Specifications: The Drawings and Specifications shall be considered as complementary, one to the other, so that materials and work indicated, called for, or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. The Drawings are to be considered diagrammatic, not necessarily shown in the detail or to scale all of the equipment or minor items. In the event of discrepancies between the Drawings and the Specifications, or between either of these and any regulations or ordinances governing work of this Division, the Bidder shall notify the Engineer in ample time to permit revisions.

C. Safety Requirements: In addition to the components specified and shown on the Drawings and necessary for the specified performance, the Contractor shall incorporate in the design and show on the shop drawings all the safety features required by the current codes and regulations, including, but not limiting to, those of the Occupational Safety and Health Act of 1970, and Amendments thereto.

1.02 QUALITY ASSURANCE

A. All equipment and materials used in this installation shall be new, of the best quality and unless otherwise noted, shall be standard catalog items of the various manufacturers.

B. Equipment and appurtenances shall be designed in conformity with ANSI (formerly ASA), ASME, IEEE, NEMA, OSHA, AGMA, and other generally acceptable applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions or operations. All bearings and moving parts shall be adequately protected against wear by bushings or other approved means. Provisions shall be made for adequate lubrication with readily accessible devices.

C. Machinery parts shall conform to the dimensions shown on the working drawings within allowable tolerances. The corresponding parts of identical machines shall be made interchangeable. Protruding members such as joints, corners and gear covers

shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

D. Clearances and Access: Ample clearance shall be provided for inspection and adjustment. All equipment shall fit the allotted space and shall leave reasonable access room for servicing and repairs. Greater space and room required by substituted equipment shall be provided by the Contractor and at his expense. Provide access panels at walls or ceilings for access to valves, dampers, equipment or any part requiring maintenance or service. Provide minimum sizes of 12 inches by 12 inches for hand access or 24 inches by 24 inches for personnel access.

E. Safety Requirements:

1. All machinery and equipment shall be safeguarded in accordance with the current safety codes of the ANSI, OSHA, and local industrial codes.

2. The Contractor shall provide for each V-belt drive or rotating shaft a protective guard which shall be securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys and be constructed to comply with all safety requirements.

3. For fans, the belt guard shall be arranged so as not to restrict the air flow into the fan inlet. Guards shall not interfere with lubrication of equipment.

F. Acceptance of Materials:

1. Only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by the Contractor shall be subject to the inspection and acceptance of the Owner. No material shall be deivered to the Work without prior submittal approval of the Engineer.

2. The Contractor shall submit to the Engineer data relating to materials and equipment he proposes to furnish for the Work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the Specifications.

3. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the Work, the Contractor shall submit samples of materials for such special test as may be necessary to demonstrate that they conform to the Specifications. Such sample shall be furnished, stored, packed, and shipped as directed at the Contractor's expense. Except as otherwise noted, the Owner will make arrangements for and pay for tests.

4. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporation in the Work.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaging: All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.

B. Protection: All machined surfaces and shafting shall be cleaned and protected from corrosion by the proper type and amount of coating necessary to assure protection during shipment and prior to installation. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage as specified in Sections 09900: Painting and 09905: Paint and Equipment Identification System. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

C. Lubrication: Grease and lubricating oil shall be applied to all bearings and similar items as necessary to prevent damage during shipment and storage.

D. Marking: Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

E. Fabricated sub-assemblies, if any, shall be shipped in convenient sections as permitted by carrier regulations and shall be properly match-marked for ease of field erection.

F. Responsibility:

1. The Contractor shall be responsible for all material, equipment, and supplies sold and delivered to the site under this Contract until final inspection of the Work and acceptance thereof by the Owner. In the event any such material, equipment, and supplies are lost, stolen, damaged, or destroyed prior to final inspection and acceptance, the Contractor shall replace same without additional cost to the Owner.

2. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

G. Delivery: The Contractor shall arrange deliveries of products in accordance with construction schedules and coordinate to avoid conflict with work and conditions at the site.

1. The Contractor shall deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Immediately on delivery, the Contractor shall inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged.

3. Under no circumstances shall the Contractor deliver equipment to the site more than one month prior to installation without written authorization from the Engineer. Operation and maintenance data shall be submitted to the Engineer for review prior to shipment of equipment as described in Section 01730: Operating and Maintenance Data.

H. Storage and Protection of Products:

1. The Contractor shall furnish a covered, weather-protected storage structure providing a clean, dry noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this project. Storage of equipment shall be in strict accordance with the "Instructions for Storage" of each equipment supplier and manufacturer including connection of space heaters, and placing of storage lubricants in equipment. Corroded, damaged, or deteriorated equipment and parts shall be replaced before acceptance of the project. Equipment and materials not properly stored will not be included in a payment estimate.

   a. The Contractor shall store products subject to damage by the elements in weathertight enclosures.
   b. The Contractor shall maintain temperature and humidity within the ranges required by manufacturer's instructions.
   c. The Contractor shall store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. The Contractor shall cover products which are subject to deterioration with impervious sheet coverings and provide adequate ventilation to avoid condensation.
   d. The Contractor shall store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

2. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during, and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind whatsoever to the material or equipment.

3. Cement, sand, and lime shall be stored under a roof and off the ground, and shall be kept completely dry at all times. All structural and miscellaneous steel and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water, staining, chipping, or cracking. Brick,

block, and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking, and spalling to a minimum.

4. All materials which, in the opinion of the Engineer, have become damaged and are unfit for the use intended or specified shall be promptly removed from the site of the Work and the Contractor shall receive no compensation for the damaged material or its removal.

5. The Contractor shall arrange storage in a manner to provide easy access for inspection. The Contractor shall make periodic inspections of stored products to assure products are maintained under specified conditions, and free from damage or deterioration.

6. Protection After Installation: The Contractor shall provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. The Contractor shall remove covering when no longer needed.

I. Extended Storage Requirements For Equipment: Because of the long period allowed for construction, special attention shall be given to extended storage and handling of equipment onsite. As a minimum, the procedure specified herein shall be followed:

1. If equipment will be stored onsite for more than one month prior to incorporation into the Work, the Contractor shall submit a written request to the Engineer outlining any special provision to be made to protect and maintain the equipment while it is being stored. All such provisions shall be acceptable to the Owner. No equipment shall be stored onsite for more than one month without prior written authorization from the Engineer.

2. All equipment having moving parts including gears, electric motors, and/or instruments shall be stored in a temperature and humidity controlled building accepted by the Engineer, until such time as the equipment is to be installed.

3. All equipment shall be stored fully lubricated with oil and grease unless otherwise instructed by the manufacturer.

4. Manufacturer's storage instructions shall be carefully studied by the Contractor and reviewed by him with the Engineer. These instructions shall be carefully followed and a written record of this review kept by the Contractor.

5. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment the Contractor shall start the equipment and operate, loaded when possible, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

6. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. Mechanical equipment to be used in the Work, if stored for longer than ninety

days, shall have the bearings cleaned, flushed, and lubricated prior to testing and startup, at no extra cost to the Owner.

7. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective, and it shall be removed and replaced at the Contractor's expense.

8. A maintenance log shall be maintained by the Contractor outlining the schedule of maintenance required for each piece of equipment as well as the date on which the maintenance was actually performed and the initials of the individual performing the work. Submit a copy of the maintenance log monthly with the progress pay application.

1.04 PROTECTIVE COATINGS

A. All machined surfaces and shafting shall be cleaned and protected form corrosion by the proper type and amount of coating necessary to assure protection during shipment and prior to installation.

B. Oil lubricated gearing, bearings, etc. are to be shipped with an oil soluble protective coating as recommended by the equipment manufacturer.

C. Motors, reducers and electric controls shall have the standard factory finish prior to delivery.

D. Refer to Section 09900 for painting.

1.05 PREPARATION FOR SHIPMENT

A. Fabricated sub-assemblies, if any, shall be shipped in convenient sections as permitted by carrier regulations and shall be properly match-marked for ease of field erection.

1.06 INSTALLATION OF EQUIPMENT

A. The Contractor shall have on site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled when practical.

B. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Engineer during installation.

C. The equipment shall be brought to proper level by shims (1/4-inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grout shall be as specified in Division 3.

D. The grout shall be tamped into position with a board, steel bar or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.

E. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.

F. Installed equipment shall be inspected by manufacturer or its representative and certificates of approval submitted as specified in Section 01820. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the equipment manufacturer's qualified mechanic, millwright, machinist, or authorized representative, to laser align the pump and motor prior to making piping connections or anchoring the pump base.

G. All rotating equipment shall be statically and dynamically balanced. Perform vibration analyzer testing on all rotating equipment. Unless otherwise specified, the vibration allowance in the units shall not exceed the upper limits as established by the manufacturer.

H. Equipment of a portable nature which requires no installation shall be delivered to a location designated by the Owner.

I. Tolerances: Precision gauges and levels shall be used in setting all equipment. All piping and equipment shall be perfectly aligned, horizontally and vertically. Tolerances for piping and equipment installation shall be 1/2 inch to 30 ft horizontal and vertically. All valves and operators shall be installed in the position shown on the Contract Drawings or as directed by the Engineer, if not shown.

J. Alignment and Level: The equipment shall be brought to proper level by shims (1/4 inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grouting shall be as specified in Section 03600: Grout.

K. Grouting: The grout shall be tamped into position with a board, steel bar, or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.

L. All cutting and patching necessary for the work shall be performed by the Contractor. Where interferences occur, and departures from indicated arrangements are required, the Contractor shall coordinate the mechanical work with the other trades involved

and make a determination as to changed locations and elevations of ductwork and/or piping and shall obtain approval from the Engineer for the proposed changes.

M. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall beseparated using not less than one coat of zinc chromate primer and one heavy coat of aluminum pigmented asphalt paint on each surface.

N. Operation: All equipment installed under this Contract, including that furnished by Owner or others under separate contract, shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

1.07 EQUIPMENT FOUNDATION AND SUPPORTS

A. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by the Contractor.

B. All floor mounted equipment shall be mounted on a reinforced concrete pad of four inches in height as a minimum or as required by the Drawings.

C. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.

D. Anchor bolts required or indicated by the Drawings shall be furnished and built into the concrete foundations. Anchor bolts shall be Type 316 stainless steel.

E. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed by Contractor.

F. All foundations, anchor pads, piers, pipe supports, and structural steel supports shall be built to template and reinforced as required for loads imposed on them.

G. The Contractor shall assume all responsibility for sizes, locations and design of all foundations, anchor pads, piers, pipe supports, curbs and structural steel supports.

1.08 VIBRATION ISOLATION

A. All rotating or reciprocating equipment unless otherwise directed shall be mounted on vibration isolators and provided with flexible connections to isolate the equipment from the structure and/or installation.

B. Isolators shall produce uniform loading and deflections, regardless of equipment weight distribution, and shall be the product of a manufacturer regularly engaged in the production of such items and who publishes engineering and selection data.

1.09 LUBRICATION

A. The Contractor shall thoroughly lubricate all equipment in accordance with the equipment manufacturer's instructions. Lubricating oils and greases shall be of type and viscosity as recommended by the equipment manufacturer.

B. All lubricants shall be furnished by the Contractor.

C. All systems requiring oil lubrication for gearing, bearings, etc., are to be flushed with flushing oils as recommended by the equipment manufacturer. This includes all gearings, bearings, etc., regardless of whether they have been shipped with or without oil soluble protective coatings.

D. Following flushing, oil lubricated systems shall be filled with "run-in" oil as recommended by the equipment manufacturer. The equipment will be "run-in" at the no-load condition for a minimum period of 2 hours. Following "run-in" and inspection, the equipment is to be drained and flushed again with flushing oil as recommended by the equipment manufacturer.

E. The schedule for the above procedures is to be submitted for review by the Engineer at least two (2) weeks prior to the selected procedure starting date. At this time inspection details can be worked out.

F. The Contractor shall provide a one-year supply of all types of lubricants required for the various types of equipment furnished and installed under this Contract. Lubricants shall be in metal containers suitably labeled.

1.10 TEST OPERATION

A. When equipment is required to be factory tested, the results of the tests shall be submitted to the Engineer and approval of the test results shall be obtained before shipment of the equipment.

B. When an item of equipment, including controls and instrumentation, has been completely erected, the Contractor shall notify the Engineer, who will designate a time to make such tests as required, and operate the item to the satisfaction of the Engineer. All testing shall be done in the presence of the Engineer. "Completely erected" shall mean that the installation is erected, all necessary adjustments have been made, all required utility connections have been made, required lubricants and hydraulic fluid have been added and the unit has been cleaned up.

C. Contractor shall furnish labor, lubricants, and all other materials, equipment and instruments necessary for all tests.

1.11 FAILURE OF TESTS

A. Any defects in the equipment, or deviations from the guarantees or requirements of the Specifications, shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to correct any defects or deviations, or if the replaced equipment when tested shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for such equipment, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.

B. In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay the Owner all sums of money paid to him and the Owner agrees to deliver to the Contractor a bill of sale of all his rights, title, and interest in and to the rejected equipment provided, however, that the equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected. The bill of sale shall not abrogate the Owner's right to recover damages for delays, losses or other conditions arising out of the basic Contract. The Owner hereby agrees to obtain the alternate equipment within a reasonable time and the Contractor agrees that the Owner may use the original equipment furnished by him without rental or other charge until the other equipment is obtained.

1.12 RESPONSIBILITY DURING TESTS

A. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

1.13 EQUIPMENT MANUFACTURER'S SERVICE REPRESENTATIVE

A. Equipment which will require any manufacturer's service representative for the purpose of assisting and directing and installation and adjustment of equipment is noted in the applicable sections of this Division. An experienced, competent, and authorized representative of the manufacturer of each item of equipment shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer. All costs relative to services by equipment manufacturer's service representatives shall be borne by the Contractor.

B. Each manufacturer's representative shall furnish to Owner and Engineer a letter of certification stating that the equipment has been properly installed and lubricated; is

in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; has been operated under full load conditions and that it operated satisfactorily, and that the project personnel have been instructed in the proper use of the equipment.

1.14 NAMEPLATES

A. Provide identification nameplates for all equipment, controls, and apparatus where nameplates and/or data plates are not specified elsewhere.

1. Equipment and apparatus nameplates shall be fabricated from 1 1/2-inch high black laminated plastic with 1 inch high cut-in white letters, permanently secured with stainless steel screws.
2. Controls and switches shall be labeled with 1 inch high black laminated plastic with 1/2-inch white letters to designate functions.
3. Nameplates schedule and sample shall be submitted to the Engineer for approval.

B. Each piece of equipment shall be provided with stainless steel data plate securely fastened in a conspicuous place and clearly inscribed with the equipment manufacturer's name, year of manufacture, serial number and principal rating data. These data plates shall not be painted.

1.15 PIPE AND VALVE IDENTIFICATION

A. Refer to specification Section 15075

1.16 EQUIPMENT CLEANING

A. All equipment, piping, duct work, insulation and other work provided under this Division and to receive finish painting by the General Contractor shall be thoroughly cleaned and ready for finish painting.

B. Thoroughly inspect all items of equipment and any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and approval.

C. Each system of piping shall be blown through, washed out and/or flushed after completion to remove grit, dirt, sand, etc., from coils and piping for as long a time as required to thoroughly clean the apparatus.

D. All pipe systems 16 inch and larger shall be video inspected after clearing to confirm installation and clearing of the pipe.

E. All elements within the system that may be damaged by the cleaning operation shall be removed or otherwise protected during the operation.

F. Repair or replace any control valves or other system components which do not function properly due to damage during the cleaning operation or because of imperfect cleaning of any piping system.

G. All strainers shall be inspected and cleaned as often as required and left in a clean condition at project completion.

1.17 PRESSURE TESTS

A. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Sections 02660, 02661, 02662, and 15144.

B. All tests shall be made in the presence of and to the satisfaction of the Owner's representative and also, to the satisfaction of any local or state inspector having jurisdiction.

1. Provide not less than five (5) days notice to the Engineer and the authority having jurisdiction when it is proposed to make the tests.

2. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed by the Engineer.

3. The piping systems may be tested in sections as the work progresses but no joint or portion of the system shall be left untested.

C. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.

D. All defects and leaks observed during the tests shall be corrected and made tight in an approved manner and the tests repeated until the system is proven tight.

E. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.

F. Provide test pumps, gauges, and other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, and additional restraint which may be required for test pressures above normal working pressures.

G. All tests shall be maintained for as long a time as required to detect all defects and leaks but not less than the duration specified for each type of pipe or piping system in this Division.

1.18 PROTECTION OF PIPING, DUCT WORK AND APPURTENANCES

A. All duct work, piping, appurtenances, and openings furnished and installed under this Division shall be protected from dirt, foreign objects, and damage during the construction period. Damaged piping, duct work or other appurtenances shall be replaced without additional cost to the Owner, should the damage occur prior to final acceptance of the work by the Owner. As soon as installed, all metal plated or polished fixture trimmings shall be thoroughly covered with noncorrosive grease which shall be maintained until all construction work is completed.

B. Suitable precautions against freezing shall be taken during cold weather.

C. All open ends of piping shall be closed by suitable cap or plug fitting to prevent obstruction and damage.

D. The Contractor shall also be responsible for the work of other trades that may be damaged or disturbed in the course of this work and he shall restore it to the condition existing prior to damage without additional cost to the Owner.

1.19 FIRE HAZARD RATING

A. All piping, duct work, and equipment insulation, fastener, and jacketing materials shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed, and 50 for smoke developed. Rating shall be determined by ASTM Designation E84, "Surface Burning Characteristics of Building Materials". Corresponding ratings determined by Underwriters' Laboratories, Inc., UL-723, "Test Method for Fire Hazard Classification of Building Materials", will also be acceptable.

B. Fire hazard ratings for materials proposed for use shall be substantiated by test results from the National Bureau of Standards, a certified report from an approved testing laboratory, or a UL label or listing.

C. Flameproofing treatments will not be accepted.

1.20 WARRANTY

A. For mechanical equipment and piping warranties, refer to Section 01740 – Warranties and Bonds.

PART 2 - PRODUCTS

2.01 FABRICATION AND MANUFACTURE

A. Workmanship and Materials:

1. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage or other failure. Materials shall be suitable for service conditions.

2. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

3. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

B. Lubrication:

1. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

2. Lubricants of the type recommended by the equipment manufacturer shall be furnished by the Contractor in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.

3. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

C. Drive Units: Unless otherwise specified, drive units furnished with equipment shall meet the following requirements. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

1. Gear Reducers:

a. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated antifriction, rolling element bearings throughout.

b. Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class 11. Helical gear

reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall bear an AGMA nameplate.

c. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100 degrees Fahrenheit (°F) above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.

d. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

e. Gear reducers which require the removal of parts or periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

f. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

D. Safety Guards: All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated form 16 USS gage or heavier galvanized aluminum-clad sheet steel or 1/2 inch mesh galvanized expanded metal or 316 stainless steel mesh. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

E. Equipment Foundation Supports:

1. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by the Contractor.

2. Unless otherwise indicated or specified, all equipment shall be installed on reinforced concrete bases at least 6 inches high and shall conform to Section 03300: Cast-In-Place Concrete. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base

with suitable anchor bolts and the space beneath filled with grout as specified in Section 03600: Grout. All open equipment bases shall be filled with nonshrinking grout sloped to drain to the perimeter of the base.

3. The Contractor shall furnish, install and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.

4. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with, unless otherwise specified, shall have a minimum diameter of 3/4 inch. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1 1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

5. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed by Contractor.

6. All foundations, anchor pads, piers, thrust blocks, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.

7. The Contractor shall assume all responsibility for sizes, locations and design of all foundations, anchor pads, pier, thrust blocks, inertia blocks, curbs and structural steel supports.

F. Shop Painting:

1. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade oil-resistant enamel suitable for coating in the field with an alkyd enamel. Coatings shall be suitable for the environment where the equipment is installed.

2. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer. Unless otherwise specified, the shop primer for steel and iron surfaces shall be Cook "391-N-167 Barrier Coat", Koppers "No. 10 Inhibitive Primer", or equal.

3. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344", Rust-Oleum "R-9", or equal.

G. Nameplates: Contractor shall provide equipment identification nameplates for each item of equipment. Nameplates shall be 1/8 inch Type 304 stainless steel and shall be permanently fastened. Plates shall be fastened using round head metallic drive screws, or where metallic drive screws are impractical, with stainless steel pop rivets. Metallic drive screws shall be brass or stainless steel, Type V and No. 8 by 3/8 inch long. Names and/or equipment designations shall be engraved on the plates and the engraving painted with a primer and black paint system compatible with stainless steel. Contractor shall submit a list of proposed names and designations for review prior to fabrication of nameplates. At a minimum, each nameplate shall include equipment manufacturers name, year of manufacture, serial number and principal rating data.

H. Noise Attenuation and Control:

1. Unless otherwise specified, the maximum permissible noise level for a complete installed piece of equipment located within or outside a structure shall not exceed 85 dB at 3 feet. A complete piece of equipment includes the driver and driven equipment, plus any intermediate couplings, gears, and auxiliaries. All equipment provided herein that is specified to be factory and field tested shall be tested as specified herein for noise generation at the equipment manufacturer's expense.

2. Maximum permissible noise (sound pressure) levels shall be in decibels as read on the "A" weighting scale of a standard sound level meter (dB); all measurements shall be made in relation to a reference pressure of 0.0002 microbar. Measurements of emitted noise levels shall be made on a sound level meter meeting at least the Type 2 requirements set forth in ANSI S1.4, Specification for Sound Level Meters. The sound level meter shall be set on the "A" scale and to slow response. Unless otherwise specified for a particular piece of equipment, the point of measurement of sound level shall be made at the specified distance from any major surface along the entire perimeter and at midheight of the piece of equipment, or at the specified distance from an outer major surface encompassing the sound source including inlets or outlets.

I. Fire Hazard Rating:

1. All piping, duct work, and equipment insulation, fastener, and jacketing materials shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed, and 50 for smoke developed. Rating shall be determined by ASTM Designation E84, "Surface Burning Characteristics of Building Materials". Corresponding ratings determined by Underwriters' Laboratories, Inc., UL-723, "Test Method for Fire Hazard Classification of Building Materials", will also be acceptable.

2. Flameproofing treatments will not be acceptable.

2.02 ACCESSORIES

A. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

B. Fasteners: All nuts, bolts, anchors and other fastening devices shall be a minimum of 304 stainless steel unless otherwise specified.

2.03 PIPE MATERIALS SCHEDULE: Unless identified differently on the drawings, all piping material shall comply with the following schedule.

SERVICE	ABBREVIATION	ALLOWABLE MATERIALS
Potable Water, Pressure and Buried and Aboveground, ≥4"	PW	DIP
Potable Water, Pressure <4"	PW	PVC, Sch. 80 underground, Brass above Grade
Potable water, Pressure Buried 4" to 12":	PW	PVC, C900 DR 18
Reclaimed Water <4"	RW	PVC, Sch. 80 underground, Brass above Grade
Reclaimed water 4" to 12"	RW	PVC, C900 DR 18
Force main	FM	DIP/HDPE/ PVC, C900 DR 18
Vent Pipe	VENT	PVC
Drain/Sewer	DR	PVC/HDPE

2.04 PIPE MATERIAL ABBREVIATIONS

ABBREVIATION	DESCRIPTION	SPEC. SECTION
DIP	Ductile Iron Pipe	15062
HDPE	High Density Polyethylene	15066
PVC	Polyvinyl Chloride, SCH 80, C900, DR 18, unless otherwise noted	15070

PART 3 - EXECUTION

3.01 INSTALLATION AND OPERATION

A. Installation: Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of Contractor or his subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.

1. The Contractor shall have on site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled when practical.
2. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Engineer during installation.
3. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.
4. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the equipment manufacturer's qualified mechanic, millwright, machinist, or authorized representative, to align the pump and motor prior to making piping connections or anchoring the pump base.
5. Equipment of a portable nature which requires no installation shall be delivered to a location designated by the Owner.

B. Tolerances: Precision gauges and levels shall be used in setting all equipment. All piping and equipment shall be perfectly aligned, horizontally and vertically.

Tolerances for piping and equipment installation shall be 1/2 inch to 30 ft horizontal and vertically. All valves and operators shall be installed in the position shown on the Contract Drawings or as directed by the Engineer, if not shown.

C. Alignment and Level: The equipment shall be brought to proper level by shims (1/4 inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grouting shall be as specified in Section 03600: Grout.

D. Grouting: The grout shall be tamped into position with a board, steel bar, or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.

E. Contact of Dissimilar Metals: Where the contact of dissimilar metal may cause electrolysis and where aluminum will contact concrete, mortar, or plaster, the contact surface of the metals shall be separated using not less than one coat of zinc chromate primer and one heavy coat of aluminum pigmented asphalt paint on each surface.

F. Cutting and Patching: All cutting and patching necessary for the work shall be performed by the Contractor.

G. Operation: All equipment installed under this Contract, including that furnished by Owner or others under separate contract, shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

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SECTION 15053
MISCELLANEOUS MECHANICAL PIPING MATERIALS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals
3. Sleeves
4. Miscellaneous Piping and Accessories

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

A. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals section. Items requiring submittals shall include, but not be limited to, the following:

1. Welder Certification. Prior to the start of the work, Contractor shall submit a list of the welders he proposes using and the type of welding for which each has been qualified. Copy of AWS certification and identification stamp shall be submitted for each welder. Qualification tests may be waived if evidence of prior qualification is deemed suitable by Engineer.

2. Spool Drawings. Spool drawings indicating the complete line, showing all welded and assembly items, except for insulation shoes or nonstress-relieved lines, shall be developed and submitted for the following services:

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Submit certificate demonstrating that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Tolerances. These tolerances apply to in-line items and connections for other lines.

1. The general dimension, such as face-to-face, face or end-to-end, face- or end-to center, and center-to-center shall be 1/8 inch.

2. The inclination of flange face from true in any direction shall not exceed 3/64 inch per foot.

3. Rotation of flange bolt holes shall not exceed 1/16 inch.

1.05 DELIVERY, STORAGE, AND HANDLING.

A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

B. Coated Pipe. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide, padded skids. Plastic-coated pipe shall be covered or otherwise protected from exposure to sunlight.

1.06 WARRANTY

A. For miscellaneous piping and accessories installation warranties refer to Section 01740 – Warranties and Bonds

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Threaded Fittings

1. Anti Seize Thread Lubricant: Jet Lube "Nikal", John Crane "Thred Gard Nickel", Never Seez "Pure Nickel Special", or Permatex "Nickel Anti Seize".
2. Teflon Thread Sealer: Paste type; Hercules "Real-tuff", John Crane "JC-30", or Permatex "Thread Sealant with Teflon".
3. Teflon Thread Tape: Hercules "Tape Dope" or John Crane "Thread-Tape".

B. Insulating Fittings

1. Threaded: Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. "Clearflow Fittings".
2. Flanged: Epco "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".

C. Watertight/Dust-tight Pipe Sleeves

1. O-Z Electrical Manufacturing "Thruwall" and "Floor Seals", or Thunderline "Link-Seals"; with modular rubber sealing elements, nonmetallic pressure plates, and galvanized bolts.
2. Pipe Sleeve Sealant: Polysulfide or urethane, as specified in the Joint Sealant section or as indicated on the Drawings.

D. Protective Coatings

1. Tape Wrap: ANSI/AWWA C209, except single ply tape thickness shall not be less than 30 mils; Protecto Wrap "200" or Tapecoat "CT".
2. Primer: As recommended by the tape manufacturer.
3. Coal Tar Epoxy: High build coal tar epoxy, 20 to 24 mils DFT; PPG "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H 413 Hi Build Tneme Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".

E. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12.

E. Solvent Cements for Joining Plastic Piping:

1. Solvent Cement for PVC Piping Systems: ASTM D 2564.
2. Solvent Cement for CPVC Piping Systems: ASTM F 493.
3. Sodium Hypochlorite, Sodium Hydroxide, and Sodium Bisulfite Service: IPS Corporation: "Weld-On 724"
4. Primer for PVC Systems: ASTM F656.

2.03 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Type 316 Stainless Steel Include two for each sealing element.

D. Connecting Bolts and Nuts: Type 316 Stainless Steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.04 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, hot dip galvanized after fabrication.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, hot dip galvanized after fabrication, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, and hot dip galvanized after fabrication unless otherwise indicated.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 80.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

PART 3 - EXECUTION

3.01 INSPECTION.

A. All piping components shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3.02 FIELD MEASUREMENT.

A. Pipe shall be cut to measurements taken at the site, not from the Drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3.03 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Pipe Installation:

1. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

    a. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

2. All instruments and specialty items shall be installed according to the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance.

3. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

6. Install piping to permit valve servicing.

7. Install piping at indicated slopes.

8. Install piping free of sags and bends.

9. Install fittings for changes in direction and branch connections.

10. Install piping to allow application of insulation.

11. Select system components with pressure rating equal to or greater than system operating pressure.

12. Install escutcheons for penetrations of walls, ceilings, and floors.

13. Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe, valves, or connecting equipment.

14. Piping shall be supported in conformance with the Pipe Hangers and Supports section.

15. Piping shall be connected to equipment by flanges or unions as specified in the various piping sections. Piping connecting to equipment shall be supported by a pipe support and not by the equipment.

16. Water supply piping shall be provided with a shutoff valve and union at each fixture or unit of equipment, whether or not indicated on the Drawings, to permit isolation and disconnection of each item without disturbing the remainder of the system.

17. A union shall be provided within 2 feet of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the Drawings or the Specifications.

18. Taps for pressure gauge connections on the suction and discharge of pumping units shall be provided with a nipple and a ball type shutoff valve.

19. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.

20. In all piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of stainless steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of with stainless steel pipe, tubing, fittings, valves, or appurtenances.

21. Piping adjacent to flow sensors shall be installed in accordance with the requirements of the manufacturer of the flow sensor and commonly accepted design practices of the appropriate straight pipe runs both upstream and downstream.

22. Drains required for operation are shown on the Drawings. However, vents at all high points and drains at all low points in the piping that are required for complete draining for pressure test may not be shown on these Drawings. Contractor shall add such items as found to be necessary during detail piping design and/or piping installation.

B. Pipe Sleeve Installation:

1. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

2. Piping passing through concrete or masonry shall be installed through sleeves that have been installed before the concrete is placed or when masonry is laid.

3. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates.

4. Unless otherwise indicated on the Drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 1 inch nor more than 2 inches above the floor surface, with the projections uniform within each area.

5. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the Drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

6. Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

7. Unless otherwise indicated on the Drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

8. Piping shall be made dustight and gastight with special rubber-gasketed sleeve and joint assemblies; with sleeves sealed with modular rubber sealing elements; or by caulking with oakum and polysulfide or urethane sealant, when passing through the following locations:

9. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

    a. Install steel pipe for sleeves smaller than 6 inches in diameter.
    b. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
    c. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

10. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

a. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

C. Reducers. Eccentric reducers shall be installed flat on the bottom for the odor control system.

D. Valves. Isolation valves provided with equipment and instruments shall be located in a manner which will allow ease of access and removal of the items to be isolated. .

3.04 PIPING ASSEMBLY.

A. General. Contractor shall only use labor that has been qualified by training and experience to capably perform the specified activities required to accomplish the work in a satisfactory manner. Any deviations from the Specifications or piping locations shown on the Drawings require prior review and approval by Engineer.

3.05 PRESSURE AND LEAKAGE TESTING.

A. The Contractor shall coordinate this section with Section 15144- Pressure Testing of Piping.

3.06 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints.

1. Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads.

2. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation Ream threaded pipe ends to remove burrs and restore full ID. Unless otherwise indicated, threaded joints shall be made up with teflon thread tape, thread sealer, or a suitable joint compound. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints.

1. Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

2. Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.

3. Weld cross-sections shall be equal to or greater than the pipe wall thickness. Welds shall be smooth and continuous and shall have interior projections no greater than 1/16 inch. Backing strips or rings shall not be used except with specific prior review by Engineer as to use, material, and design. Root gap inserts that are completely melted and consumed in the weld bead are acceptable only when reviewed in advance by Engineer.

4. Stainless steel welding shall be inert gas tungsten arc (TIG) or the direct current, straight polarity, inert gas metal arc process (MIG).

5. For socket weld joints, fully engage the two pipe ends, then separate them by 1/16 inch prior to welding to all space for shrinkage.

F. Flanged Joints.

1. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

2. Tighten the nuts and bolts or studs finger tight then progressively tighten diametrically opposite nuts uniformly around the flange until the proper torque is achieved. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but shall not be torqued less than the minimum value required by the gasket manufacturer. Flange bolts shall not be so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

3. Flange bolt holes shall be oriented as follows, unless otherwise indicated on the spool drawings:

a. Vertical flange face: Bolt holes to straddle the vertical centerlines.
b. Horizontal flange face: Bolt holes shall be aligned with connecting pipe.

4. Pipe sealants, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by Engineer.

5. Welds at orifice flanges shall have internal surfaces ground smooth to the pipe wall.

6. Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1/16 to 1/8 inch between the edge of the fillet weld and the face of the flange. The seal weld shall be applied so that the flange face shall be free of weld spatter and does not require refacing.

7. Flat-faced flanges shall be used when mating to Class 125 flanges. Full-face gaskets shall be used with flat-faced flanges and ring gaskets shall be used with raised faced flanges.

8. Weld neck flanges shall be used with butt-weld fittings. The bore of weld neck flanges shall match the pipe wall thickness.

9. Insulating joints connecting submerged (buried) piping to exposed piping shall be installed above the maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged (buried) metallic piping shall be isolated from the concrete reinforcement. Insulating flanges shall be tested for electrical isolation after installation and bolt-up but prior to introduction of conducting fluid.

G. Compression:

1. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past finger-tight, or as recommended by the fitting manufacturer, to produce a leak-tight, torque-free connection.

H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.

3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

5. PVC non-pressure piping: Join according to ASTM D 2855.

6. PVC to ABS non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

J. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

K. Grooved Couplings. Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions, as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

L. Push-on. Gasket installation and other jointing procedures shall be in accordance with the recommendations of the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with a heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

M. Rubber-Gasketed. Rubber-gasketed joints for bell and spigot type ductile iron pipe shall have plain spigot ends, without beads. Cut ends of all pipe shall be cut square, beveled, and all burrs shall be removed. Spigot ends shall be coated with a lubricant recommended by the gasket manufacturer and fully seated in the gasket.

N. PE Piping Heat-Fusion Joints.

1. Heat fusion bonded joints shall be used for polyethylene pipe with socket and butt fusion fittings. All joint preparation, cutting, jointing equipment, and jointing procedures shall comply with the pipe manufacturer's recommendations. The heating time, temperature, pressure applied to the joint during bonding, and cooling time shall consistently produce leaktight joints as strong as the pipe being joined.
2. Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
3. Plain-End Pipe and Fittings: Use butt fusion.
4. Plain-End Pipe and Socket Fittings: Use socket fusion.

O. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.07 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.08 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.09 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install Type 316 Stainless Steel anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement (refer to Division 3, Section “Cast-In-Place Concrete”).

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.11 PRESSURE AND LEAKAGE TESTING

A. All pressure piping shall be pressure and leakage tested in accordance with Section 15144 – Pressure Testing of Piping.

3.12 CLEANING

A. The interior of all pipe, fittings and valves shall be smooth, clean and free of blisters, loose mill scale, sand, dirt and other foreign matter when installed. Before being placed into service, the interior of all pipelines shall be thoroughly cleaned to the satisfaction of the Engineer and the Owner.

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SECTION 15063
DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish all labor, materials, equipment and incidentals required and install, Diameter Ductile Iron Piping, Ductile Iron Fittings, and Appurtenances for Raw Sewage Service as shown on the Drawings and as specified herein.

B. General Design: The equipment and materials specified herein are intended to be standard types of ductile iron pipe and cast or ductile iron fittings for use in transporting raw influent wastewater, potable water, and reclaimed water.

1.02 QUALITY ASSURANCE

A. Qualifications: All of the ductile iron pipe and ductile or cast iron fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

B. Standards:

1. ANSI A 21.50/AWWA C150
2. ANSI A-21.51/AWWA C151
3. ANSI A-21.41/AWWA C104

C. Factory Tests: The manufacturer shall perform the factory tests described in ANSI A-21.51/AWWA C151.

1. Quality Control
2. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards. All pipe on this Project shall be supplied by a single manufacturer unless otherwise accepted in writing by the County.
3. In addition to the manufacturer's quality control procedures, the County may select an independent testing laboratory to inspect the material at the foundry for compliance with these specifications. The cost of foundry inspection requested by the County will be paid for by the County.

1.03 SUBMITTALS

A. Materials and Shop Drawings

1. Submit Shop Drawings and piping layouts, including areas within and under buildings and structures. Shop Drawings shall include dimensioning, methods and locations of supports and all other pertinent technical specifications.

Show locations of all field cuts. Shop Drawings shall be prepared by the pipe manufacturer. Shop Drawings for piping within and under buildings and structures shall be submitted within 30-days of Execution of Contract.

B. Submit Installation Instructions Manufacturer's Certification

1. Submit manufacturer's sworn certification of factory tests and test results.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for all materials furnished and stored until the date of project completion. The Contractor shall replace, at his expense, all materials found to be defective or damaged in handling or storage. The Contractor shall, if requested by the County, furnish certificates, affidavits of compliance, test reports, samples or check analysis for any of the materials specified herein. All pipe delivered to project site for installation is subject to random testing for compliance with the designated specifications.

B. Delivery and Storage: Delivery and storage of the materials shall be in accordance with the manufacturer's recommendations. Stored pipe shall be covered for protection against contamination and UV light. Joint gaskets shall be stored in clean, dark and dry location until immediately before use.

C. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe and fittings and their respective coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Pipe shall be unloaded by lifting with a forklift or crane. All pipe or fittings shall be examined before installation and no piece shall be installed which is found to be defective. Pipe shall be handled to prevent damage to the pipe or coating. Accidental damage to pipe or coating shall be repaired to the satisfaction of the County or be removed from the job. When not being handled, the pipe shall be supported on timber cradles or on level ground, graded to eliminate all rock points and to provide uniform support along the full pipe length. When being transported, the pipe shall be supported at all times in a manner which will not permit distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the County, is damaged beyond repair by the Contractor shall be removed from the site.

1.05 WARRANTY

A. For ductile iron pipe installation warranties, refer to Section 01740 – Warranties and Bonds.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ductile Iron Pipe

1. Standards: ANSI A-21.50, AWWA C150 and ANSI A-21.51, AWWA C151

2. Thickness/Pressure Class:

a. Below ground piping: Class 350 (4-inch to12-inch), Class 250 (16-inch to 24-inch), and Class 250 (30-inch to 64-inch).

3. Above ground piping: Flanged, Thickness Class 53 (minimum) unless otherwise noted or specified.

B. Joints

1. Push-on or Mechanical Joints (below ground piping)

a. Standards: ANSI A21.11, AWWA C111
b. Class: 350-psi working pressure rating
c. Pipe Length (below ground installation): 20-feet maximum nominal length.
d. Gaskets

i. Potable and Reclaimed Water Service: Ethylene Propylene Diene Monomer (EPDM) ring type.
ii. Wastewater Service: Neoprene rubber ring type.

2. Flanged (above ground or inside below ground vaults)

a. Standards: ANSI A21.15, ANSI B16.1
b. Class: 125-pound factory applied screwed long hub flanges, plain faced without projection.
c. Gaskets

i. Spans less than 10-feet: full-face 1/8-inch thick nylon fabric reinforced neoprene rubber
ii. Spans greater than 10-feet: Toruseal gaskets as manufactured by American Cast Iron Pipe or acceptable equal.
iii. Gaskets shall be EPDM for potable and reclaimed water service and neoprene for wastewater service.

3. Restrained Joints

a. Manufacturers:

i. For joints greater than 16-inch, Lok-Ring system as manufactured by American Ductile Iron Pipe; or HP-Lok as manufactured by US Pipe; or acceptable equal.
ii. For 16-inch diameter and smaller, locking type gasket systems as manufactured by American Ductile Iron Pipe; MEGALUG System as manufactured by EBBA Iron; or acceptable equal.

b. Class: 250-psi minimum design pressure rating.
c. Standard mechanical joint retainer glands shall not be acceptable.

4. Joint Accessories

a. Mechanical joint bolts, washers and nuts: Type 304 stainless steel.
b. Flanged joint bolts, washers and nuts: 316 stainless steel with bolts and nuts conforming to ASTM A193 Grade B8M.

5. Pipe Length (below ground installation): 20-feet maximum nominal length.

6. Pipe Identification

a. Each length of pipe shall bear the name or trademark of the manufacturer, the location of the manufacturing plant, and the class or strength classification of the pipe. The markings shall be plainly visible on the pipe barrel. Pipe which is not clearly marked is subject to rejection. The Contractor shall remove all rejected pipe from the project site within five NORMAL WORKING DAYS.

C. Fittings

1. Ductile iron fittings, 4-inch through 24-inch shall be pressure rated at 350-psi minimum, except flanged joint type fittings which shall be rated at 250-psi minimum; 30-inch and larger ductile iron fittings, shall be pressure rated to 250-psi minimum. All fittings shall conform to either ANSI/AWWA C110/A21.10 and/or C153/A21.53, latest revision, and shall be ductile iron only. All fittings shall be cast and machined allowing the bolt holes to straddle the vertical centerline. All fittings shall be designed to be capable to withstand, without bursting, hydrostatic tests of three times the rated water working pressure. All fittings shall have a date code cast (not printed or labeled) with identification of date, factory, and the factory unit from which it was cast and machined. Fittings shall have the pressure rating, nominal diameter of openings, manufacturer's name, and the country where cast and number of degrees or fraction of the circle distinctly cast on them. Ductile iron fittings shall have the letter "DI" or "Ductile" cast on them.

2. Joints shall be as described for ductile iron pipe for above ground/exposed and buried service.

3. All potable water main fittings shall have NSF 61 certification, and ISO 9001 certification for both the foundry and manufacturer. The NSF 61 certification shall be issued on all coatings and linings, from the said manufacturers that are used for potable water applications.

2.02 COATINGS, LININGS AND IDENTIFICATION MARKINGS

A. Exterior Coatings

1. Below ground/buried or in a casing pipe:

a. Basecoat: Arc-sprayed Zinc per ISO 8179. The mass of zinc shall be 200 g/m2 of pipe surface area.
b. Topcoat: Asphaltic coating, 1.0-mil DFT in accordance with ANSI/AWWA A21.51/C151.
c. Combination basecoat and topcoat shall be in compliance with ISO 8179-1 “Ductile Iron Pipes – External zinc-based coating – Part 1 Metallic zinc with finishing layer”.
d. Markings: (continuous 3-inch wide strip within top 90 degrees of pipe - min. drying time 30-minutes before backfill).
e. Color:

i. Raw Wastewater: Safety Green

2. Above ground/Exposed/In vaults

   a. Coatings and coating testing for ductile iron pipe and fittings for above ground/exposed applications shall be accordance with Division 9. Primer, intermediate and final coats whether shop or field applied shall be compatible and applied in accordance with the coating system manufacturer's recommendations. Refer to Appendix D "List of Approved Products" for approved coating system suppliers. Asphaltic seal coat applied to the exterior of above ground piping and fittings shall be blasted and completely removed prior to coating per NACE-3/SSPC-SP6 commercial blast cleaning minimum angular anchor profile of 1.5-mils.

   b. Color

      i. Raw Wastewater: Safety Green

3. Inside Wetwell

   a. All piping inside of wastewater wetwells shall be Type 316 stainless steel.

B. Interior Lining for Wastewater (Applied by pipe manufacturer)

1. Paint all steel sleeves, tapping sleeves, rods, nuts and washers, and couplings with Roster Laboratories, Inc., -Roskote Mastic No. A-939, or Carboline Company, Inc. Bitumastic No.300-M Black coal tar epoxy, or approved equivalent.

2. All ductile iron pipe and fitting for wastewater service including pressure and gravity mains shall have a ceramic epoxy lining on the interior and bituminous coating on the outside except for 6 inches back for the spigot end.

3. Interior Lining Material – The material used for the lining shall be a two component amine cured epoxy of at least 87% solids. Protecto 401, Permit 9043, Type II Glass Filled Epoxy are the standards for quality. The permeability rating of zero permeance when a film of at least 40 mils is tested according to ASTM D1653 or a permeability rating of 0.0 perms when measured using Method A of ASTM E66 procedure A with a test duration of 42 days.

   a. The material shall contain at least 20% by volume of ceramic quartz pigment in the dried film.

   b. The following test must be run on ductile iron panels with the results certified by the lining material supplier of the material being submitted.

Test	Rating/Method
1. Direct Impact	ASTM D-2794
2. 3% Sulfuric Acid Immersion @ 120°F	ASTM D-714

3.	25% Sodium Hydroxide Immersion @ 140°F	ASTM D-714
4.	Deionized Water Immersion @ 160°F	ASTM D-714
5.	Moisture and Ultraviolet Light Cycle 8 hours light/ 4 hours 100% humidity	ASTM G-5377

4. Application of Lining – The lining shall be applied by a competent firm with at least a five-year history of applying linings to the interior of ductile pipe and fittings.

   a. Surface Preparation: Prior to abrasive blasting in the entire area which will receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil, grease or any substance which can be removed by solvent is present shall be solvent cleaned using the guidelines outlined in SSPC-SP-1 Solvent Cleaning. After the surface has been made free of grease, oil, or other substances, all areas which are to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The blast media shall strike 100 percent of the surface area to sufficient force to remove rust and oxides. The entire surface area to be lined shall be struck with blast media so that all rust, loose, oxides, etc., are removed from the surface. Only slight stains and specks of tightly adhering oxides may be left on the surface. Any area where rust appears before coating must be reblasted to remove all rust.

   b. Lining: After surface preparation and within 8 hours of surface preparation of the barrel of the pipe from the inside should of the gasket groove to the end of the interior spigot shall receive a minimum coating of 40 mils dry film thickness of the protective lining. If flange fittings or pipe are included in the project the linings must not be used on the face of the flange; however, full face gaskets must be used to protect the ends of the pipe. All fittings shall be lined with a minimum of 40 mils of the protective lining. Push-on type fittings shall be lined from the gasket groove to the gasket groove. The 40 mils system shall not be applied in the gasket grooves.

   c. Coating of Gasket Groove and Spigot Ends: Due to the tolerances involved, the gasket groove and exterior pipe spigot end up to 6 inches back from the end of the spigot end must be coated with a minimum of 10 mils dry of Protecto Joint Compound. This coating shall be applied by brush to ensure coverage. Care should be taken that the coating is smooth without excess buildup in the gasket groove or on the spigot end. All materials for the gasket groove and spigot end shall be applied after the application of the lining.

d. Number of Coats: The number of coats of lining material applied shall be as recommended by the lining Manufacturer. However, in no case shall the material be applied above the dry thickness per coat recommended by the lining Manufacturer in printed literature. The time between coats shall never exceed that time recommended by the lining material Manufacturer. If at any time the lining must be recoated beyond the lining material Manufacturer's recommended recoat time, the surface of the existing lining shall be roughened sufficiently to prevent delamination between coats.

5. Inspection:

a. All pipe shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 film thickness testing.

b. The barrel of all pipe fittings shall be pinhole detected with a nondestructive 2,500-volt pinhole test.

c. Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date.

6. Certification: The pipe or fitting Manufacturer must supply a certificate attesting to the fact that the Applicator met the requirements of this specification, that the material used was as specified, and that the material was applied as required by the specification.

7. Repair: All pinholes and damaged lined areas shall be repaired in accordance with written repair procedure furnished by the Manufacturer of the lining material so that the repaired area is equal in performance to the undamaged lined areas.

C. Potable Water and Reclaimed Water: Interior coating shall be fusion-bonded epoxy (FBE) or Cement Mortar lined with asphaltic seal coat.

1. FBE for Fittings: Fittings shall be supplied with a FBE coating, both inside and outside for total protection including flanged and buried fittings. The exterior of flanged fittings for above ground assemblies shall adhere to final exterior coating requirements per 3119 2.04 A. The FBE coating system shall meet or exceed ANSI/AWWA C-550 and C116/A21.116 requirements and shall have NSF 61 certification. FBE coating thickness shall be 6 to 8-mils dry film thickness, shall be applied for secure adhesion, shall have a smooth surface and shall be holiday free.

2. Cement mortar lining with a seal coat of asphaltic material shall be in accordance with ANSI/AWWA A21.4/C104.

D. Interior Lining for Reclaimed Water: Interior lining for ductile iron pipe for reclaimed water service shall be cement mortar lining with a seal coat of asphaltic material in accordance with ANSI/AWWA A21.4/C104. Cement lining and asphaltic seal coat shall be NSF 61 approved.

E. Enhanced Polyethylene Encasement is required for all ductile iron piping. Polyethylene encasement shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE) film fused into one layer. The installing Contractor shall comply and certify that installation is in accordance with the following standards:

1. AWWA C150/ANSI A21.50
2. AWWA C 151/ANSI A21.51
3. AWWA C 105/ANSI A21.5
4. AWWA C600 and M41

2.03 LOCATION MARKERS AND LOCATION WIRE

A. Electronic Markers and Locator System (For reclaimed water and wastewater ONLY)

1. Markers: Markers shall consist of a passive device capable of reflecting a specifically designated repulse frequency tuned to the utility (service) being installed. Markers shall be color coded in accordance with American Public Works Association's "Utility Locating and Coordinating Council Standards." Color shall be: Wastewater and Reclaimed Water - #1404 Green. Markers shall be full range. Markers shall be installed directly above the centerline of the respective pipeline at intervals not to exceed 100-feet, at each fitting (tees, wyes, crosses, reducers, plugs, caps and bends) or change in horizontal direction and at each valve along the pipeline. Markers shall be hand backfilled to 1-foot above the pad and have a finished depth of burial of not less than 2-feet or more than 6-feet. No separate payment shall be made for furnishing and installing the respective frequency and color-coded electronic pad type marker.
2. Locator System: Marker locator set shall be the 3M Dynatel 2250M-iD Electronic Marker System Marker Locator, or acceptable equal. The Contractor shall furnish 1-locator set for each type of service piping installed on the project (i.e.: reclaimed water, wastewater) to the County. Each unit shall incorporate the following features and accessories:
    a. Unit(s) shall be tuned to the proper frequency for each type (service) of piping.
    b. Field strength meter that provides visual indication of the return signal.
    c. Function switch for selection of operation mode.
    d. Sensitivity control to adjust the receiver gain.
    e. Audio speaker for signal response.
    f. Battery access panel containing condensed operating instructions.
    g. Auxiliary headset and heads set jack.
    h. Permanently attached shoulder straps.
    i. Rugged shockproof and weatherproof storage/carrying case.
3. Manufacturer: System shall be 3M Dynatel Locating and Marking System, or acceptable equal.

B. Location Detection Wire

1. Materials: Continuous, insulated 10-gauge copper wire (color to match pipe identification).

2. Installation: Directly above (1-inch maximum) centerline of pipe terminating at top of each valve box collar and be capable of extending 18-inches above top of box (stored inside the 2-inch brass pipe through the valve box collar) in a manner so as not to interfere with valve operation. For direction drilling installations, a minimum of 2 (two) 10-gauge wires shall be pulled along with the pipe.

3. If no valve boxes are included in the pipe run, install valve boxes at a minimum spacing of 1,000 feet and terminate the location wire in the box.

4. Continuity: Continuity of wire to be tested using Metrotech 810/9860 or acceptable equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ductile iron pipes shall be installed in accordance with AWWA C600 and AWWA Manual M-42. When a restraining type gasket is used, the bell shall be painted red.

B. Underground Ductile Iron Pipe and Fittings.

1. Bedding firm, dry and even bearing of suitable material. Blocking under the pipe will not be permitted.

2. Placement

a. Alignment: In accordance with lines and grades shown on the Drawings. Deflection of joints shall not exceed 75% of the values recommended by the pipe manufacturer.

b. The Contractor shall provide line and grade stakes at a 100-foot maximum spacing and at all line and/or grade change locations. The Contractor shall provide temporary benchmarks at a maximum of 1,000-foot intervals. The minimum pipe cover shall be 36-inches below the finished grade surface or 36-inches below the elevation of the edge of pavement of the road surface whichever is greater.

c. All pipe and fittings shall be inspected prior to lowering into trench to insure no cracked, broken or otherwise defective materials are being used. All homing marks shall be checked for the proper length so as to not allow a separation or over homing of connected pipe. Homing marks incorrectly marked greater than 1-inch shall result in rejection of pipe and removal from site. The Contractor shall clean ends of pipe thoroughly and remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

d. Proper implements, tools and facilities shall be used for the safe and proper protection of the Work. Pipe shall be lowered into the trench in

such a manner as to avoid any physical damage to the pipe. Pipe shall not be dropped or dumped into trenches under any circumstances.

e. Trench Dewatering and Drainage Control: Contractor shall prevent water from entering trench during excavation and pipe-laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water.

f. Pipe Laying in Trench: Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and re-laid. Pigging of pipe may be used to remove foreign materials in lieu of flushing. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the County to ensure absolute cleanliness inside the pipe. The pipe shall be installed with the color stripe and pipe text on the top of pipe.

3. Cutting: When required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of the pipe to be used with a push-on bell shall be beveled. Bare metal exposed at ends of the pipe shall be field coated in accordance with pipe manufacturer's recommendations. Cut pipe for wastewater service shall have exposed bare metal ends repaired with Protecto 401 using the coating system manufacturer's field repair kit.

4. Joints

a. Joint Placement

i. Push on joints: Pipe shall be laid with the bell facing upstream. The gasket shall be inserted and the joint surfaces cleaned and lubricated prior to placement of the pipe. After joining the pipe, a metal feeler shall be used to verify that the gasket is correctly located.

ii. Mechanical Joints: Pipe and fittings shall be installed in accordance with the "Notes on Method of Installation" under ANSI A21.11/AWWA C111. The gasket shall be inserted and the joint surfaces cleaned and lubricated with soapy water before tightening the bolts to the specified torque.

C. Thrust Restraint

1. General: Thrust restraint shall be accomplished by the use of mechanical restraining devices unless specifically identified otherwise on the Drawings or herein.

2. Length of Restrained Joints: In accordance with the lengths listed in the table as shown on the Drawings.

D. Installation of Pipes on Curves

1. Maximum deflections at pipe joints, fittings and laying radius for the various pipe lengths shall not exceed 75% (percent) of the pipe manufacturer's recommendation.

3.02 CLEANING AND FIELD TESTING

A. General: At the conclusion of the Work, the Contractor shall provide all associated cleaning and field testing as specified in other related sections of these specifications.

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SECTION 15064
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish all labor, materials, equipment and incidentals required and install and test all polyvinyl chloride (PVC) piping, fittings and appurtenances as shown on the Drawings and specified herein.

B. General Design: The equipment and materials specified herein are intended to be standard types of PVC pipe and ductile iron fittings for use in transporting wastewater, reclaimed water, and water.

1.02 RELATED WORK

A. Valves and Appurtenances are included in Section 15100.

B. Pipe Hangers and Supports are included in Section 15126.

C. Pressure Testing of Piping is included in Section 15144.

1.03 QUALITY ASSURANCE

A. Qualifications: All of the PVC pipe and ductile iron fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

B. Standards:

1. AWWA C900/C905
2. ASTM D1784 / D1785 / D2241 / D2466 / D2564 / D2729 / D2774 / D3034 / D3139 / D3212
3. NSF 14
4. UNI-B-1 through 5

C. Factory Tests: The manufacturer shall perform the factory tests described in Section 3 - AWWA C900.

D. Quality Control:

1. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards.
2. In addition to the manufacturer's quality control procedures, the County may select an independent testing laboratory to inspect the material at the production facility for compliance with these specifications. The County will pay for the cost of facility inspection requested by the County.

1.04 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

B. Materials and Shop Drawings

C. Manufacturer's Certification

1. Submit sworn certification of factory tests and their results.

2. The Contractor shall furnish an Affidavit of Compliance certified by the pipe manufacturer that the pipe, fittings, and specials furnished under this Contract comply with all applicable provisions of current AWWA and ASTM standards, NSF 61, and these Specifications. No pipe or fittings will be accepted for use in the Work on this project until the Affidavit has been submitted and approved by the Engineer.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with the manufacturer's recommendations. PVC pipe shall be covered with black plastic with a minimum thickness of 15-mil. Joint gaskets shall be stored in a clean, dark and dry location until use.

B. PVC pipe shall be delivered to the Site in unbroken bundles packaged in such manner as to provide protection against damage. When possible, pipe shall be stored at the Site in the unit packages until ready for use. Packaged units shall be handled using a fork lift or a spreader bar with fabric straps. Packaged units shall not be stacked at the Site higher than two units high.

C. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or fittings and their respective coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Pipe shall be unloaded by lifting with a forklift or crane. All pipe or fittings shall be examined before installation and no piece shall be installed which is found to be defective. Pipe shall be handled to prevent damage to the pipe or coating. Accidental damage to pipe or coating shall be repaired to the satisfaction of County or it shall be removed from the job. When not being handled, the pipe shall be supported on timber cradles or on level ground, graded to eliminate all rock points and to provide uniform support along the full pipe length. When being transported, the pipe shall be supported at all times in a manner to prevent distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the County, is damaged beyond repair by the Contractor shall be removed from the site.

D. When it is necessary to store PVC pipe for more than 30 days, exposure to direct sunlight shall be prevented by covering the pipe with an opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. PVC pipe shall not be stored close to heat sources or hot objects such as heaters, fires, boilers or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The

interior and all sealing surfaces of pipe, fittings and other appurtenances shall be kept clean and free of dirt and foreign matter.

E. Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged or defective pipe and fittings, or any length of pipe having a gouge, scratch or other permanent indentation of more than 10 percent of the wall thickness in depth, shall be rejected and removed at once from the Work and replaced with new acceptable pipe at no additional cost to the Owner.

F. The Contractor shall be responsible for all materials furnished and stored until the date of project completion. The Contractor shall replace, at his expense, all materials found to be defective or damaged in handling or storage. The Contractor shall, if requested by the County, furnish certificates, affidavits of compliance, test reports, samples or check analysis for any of the materials specified herein. All pipe delivered to project site for installation is subject to random testing for compliance with the designated specifications.

1.06 WARRANTY

A. For PVC pipe installation warranties refer to Section 01740 – Warranties and Bonds.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

B. All materials that come into contact with potable water or sodium hypochlorite shall be NSF 61 approved for use in contact with potable water. Manufacturers shall submit an affidavit with the shop drawings indicating approval by the EPA or NSF for the materials used in products that come into contact with the water, in accordance with Rule 62-555.320(3) Florida Administrative Code.

2.02 LARGE DIAMETER POLYVINYL CHLORIDE (PVC) PIPE

A. Polyvinyl Chloride (PVC) Pipe

1. Standards: AWWA C900 and ASTM D1784/D3034/F679 (Gravity Sewer)

2. Compounds: Cell Class 12454-A or Cell Class 12454-B

3. PVC Gravity Pipe and Fittings: PVC gravity pipe (6-inch to 15-inch), shall conform to ASTM D3034, maximum SDR 35. PVC gravity pipe (18-inch to 36-inch), shall conform to ASTM F679 and uniform minimum "pipe stiffness" at 5% (percent) deflection shall be 46-psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI Bell Plastic Pipe Association standard is UNI B.

4. PVC Pressure Pipe and Fittings: All PVC pipe of nominal diameter 4 to 60-inches shall be manufactured in accordance with AWWA Standard C900, latest revision. The PVC pipe shall have a minimum working pressure rating of 165-psi and shall have a maximum dimension ratio of 18. Pipe shall be the same outside diameter as ductile iron pipe.

5. Dimension Ratio/Thickness: (unless otherwise shown on the Drawings)

   a. Raw Wastewater:

      i. Pressure Systems: DR 18
      ii. Gravity Systems: DR 35 (ASTM D3034) or PS 46 (ASTM F679)

   b. Treated Wastewater: DR 18
   c. Reclaimed Water: DR 18
   d. Raw Water: DR 18
   e. Potable Water: DR 18
   f. Irrigation Piping: Schedule 40 or SDR 21

6. Joints:

   a. Push-on integral bell elastomeric gasket joints:

      i. Standards: ASTM D3212/D3139/F477 and UNI-B-1
      ii. Gaskets:

         I. Potable and Reclaimed Water Service: Ethylene Propylene Diene Monomer (EPDM) Rieber type.
         II. Wastewater Service: Neoprene Rieber type for C900 pipe. Neoprene ring type for gravity systems.

      iii. Pipe Markings: Pipes shall have a manufacturer's home-mark on the spigot. On field cut pipe, the Contractor shall provide home-mark on the spigot in accordance with manufacturer's recommendations.

   b. Solvent weld (nominal diameter less than 4-inches):

      i. Standards: ASTM D2466/D2564
      ii. Type: Slip Fitting Socket (tapered)
      iii. Exclusions: Plastic saddle and flange joints will not be used.

   c. Restrained Joints:

      i. Restrained joint devices shall be made specifically for PVC pipe and meet or exceed the requirements in ASTM F-1674.
      ii. Approved Manufacturers: Uni-flange mechanical joint restraints and bell restraints (for all sizes); Mega-Lug system as manufactured by EBBA Iron (sizes 12-inches or smaller), or acceptable equal.
      iii. Design pressure rating equal to or above test pressure as specified herein.

d. Pipe Length:

i. Pressure systems: 20-feet maximum nominal length
ii. Gravity systems: 13-feet minimum nominal length

B. Fittings - Pressure Systems (nominal diameter 4-inches and greater):

1. Materials: Ductile iron

2. Joints: Mechanical Joint, Minimum 350-psi pressure rating

3. Gaskets:

a. Water and Reclaimed Water Service: Ethylene Propylene Diene Monomer (EPDM) ring type.
b. Wastewater Service: Neoprene rubber ring type.

4. Exclusions: Standard double bell couplings will not be acceptable where the pipe will slip completely through the coupling.

5. All fittings shall conform to either ANSI/AWWA C110/A21.10 and/or C153/A21.53, latest revision, and shall be ductile iron.

6. All fittings shall have a date code cast (not printed or labeled), with identification of the date, factory and unit at which it was cast and machined. Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's name, the country where cast, and deflection angle. Ductile iron fittings shall have the letters "DI" or "Ductile" cast on them.

7. All potable water main fittings shall have NSF certification and ISO 9001 certification for both the foundry and manufacturer. The NSF 61 certification shall be issued on all coatings and linings, from the said manufacturers that are used for potable water applications.

8. All ductile iron fittings shall have exterior coatings, including markings and colors, and interior linings in conformance with Section 09900.

9. All wastewater ductile iron fittings shall have a Protecto 401 interior coating meeting the requirements as specified for ductile iron pipe.

10. All potable water and reclaimed water fittings shall have a cement mortar lining as specified for ductile iron pipe.

C. Fittings - Pressure Systems (nominal diameter less than 4-inches)

1. Material: Polyvinyl Chloride (PVC), Schedule 80.

2. Joints: Slip fitting tapered socket with solvent weld.

3. Solvent: Sure Guard 12 or acceptable equal.

4. Exclusions: Plastic saddle and flange joint fittings shall not be used.

2.03 SCHEDULE 80 PVC PIPE

A. Odor control piping indicated on the Drawings shall be made of polyvinyl chloride, Schedule 80 pipe, conforming to ASTM D1785. Schedule 80 pipe shall have solvent welded joints. PVC pressure pipe shall bear the approved seal of the National Sanitation Foundation (NSF). PVC pipe that is exposed to sunlight shall be manufactured with additives to provide resistance to ultraviolet deterioration.

B. All fittings shall be solvent welded. All flange gaskets, union seals, valve seals and piping seals shall be fully compatible for their intended use. The orientation of the piping connections, access openings, and other appurtenances shall be as indicated on the drawings. Piping shall be routed such that it does not impede mobility around the site or block access to any equipment, doors or hatches.

C. Fittings

1. Underground fittings shall be polyvinyl chloride Schedule 40 DWV.

2. Fittings shall be socket type and shall conform to ASTM D-246.

3. Threaded fittings shall only be used where approved by Engineer. Threaded fittings shall be pressure rated for at least one-half of the rating for socket fittings, and shall conform to ASTM D-2464.

D. Flanges

1. Slip-on flanges shall be provided to connect to flanged valves, fittings, or equipment. Flanges shall match the connecting flanges on the adjacent fitting, valve or piece of equipment.

2. Flanges for Schedule 80 PVC pipe shall be PVC rated for a 150 psi working pressure with ANSI B 16.1 dimensions and bolting pattern. Flanges shall be connected to PVC piping with solvent welded joints in accordance with ASTM D2467. Gaskets shall be Viton, full faced type with a minimum thickness of 1/8-inch. Nuts and bolts shall be hexagonal with machine threads, manufactured of Titanium. Titanium flat washers shall be used against PVC flanges.

E. Solvent Cement

1. PVC solvent cement shall be IPS Weld-On CPVC 724 Cement Gray in conjunction with Weld-On P-70 Purple Primer.

F. Threaded Lubricant

1. Threaded connections shall only be used where approved by Engineer.

2. Lubricant for Schedule 80 threaded connections shall be Teflon tape only, MIL Spec, P-27730A.

2.04 LOCATION MARKERS, LOCATION WIRE AND IDENTIFICATION MARKINGS

A. Electronic Markers and Locator System (for reclaimed water and wastewater ONLY)

1. Markers: Markers shall consist of a passive device capable of reflecting a specifically designated repulse frequency tuned to the utility (service) being installed. Markers shall be color coded in accordance with the American Public Works Association's "Utility Locating and Coordinating Council Standards." Colors shall be: Wastewater and Reclaimed Water - #1404 Green. Markers shall be full range. Markers shall be installed directly above the centerline of the respective pipeline at intervals not to exceed 100-feet, at each fitting (tees, wyes, crosses, reducers, plugs, caps and bends) or change in horizontal direction and at each valve along the pipeline. Markers shall be hand backfilled to 1-foot above the pad and have a finished depth of burial of not less than 2-feet or more than 6-feet. No separate payment shall be made for furnishing and installing the respective frequency and color-coded electronic pad type marker.

2. Locator System: Marker locator set shall be the 3M Dynatel 2250M-i0 Electronic Marker System Marker Locator, or acceptable equal. The Contractor shall furnish 1 locator set for each type of service piping installed on the Project (i.e.: reclaimed water, wastewater.) to the County. Each unit shall incorporate the following features and accessories:

    a. Unit(s) shall be tuned to the proper frequency for each type (service) of piping.
    b. Field strength meter that provides visual indication of the return signal
    c. Function switch for selection of operation mode
    d. Sensitivity control to adjust the receiver gain
    e. Audio speaker for signal response
    f. Battery access panel containing condensed operating instructions
    g. Auxiliary headset and heads set jack
    h. Permanently attached shoulder straps
    i. Rugged shockproof and weatherproof storage/carrying case

3. Manufacturer: System shall be 3M Dynatel Locating and Marking System, or acceptable equal.

B. Location Detection Wire

1. Materials: Continuous, insulated 10-gauge copper wire (color to match pipe identification).

2. Installation: Directly above (1-inch maximum) centerline of pipe terminating at top of each valve box collar and be capable of extending 18-inches above top of box (stored inside the 2-inch brass pipe through the valve box collar) in a manner so as not to interfere with valve operation. For directional drilling installations, a minimum of 2 (two) 10-gauge wires shall be pulled along with the pipe.

3. If no valve boxes are included in the pipe run; install valve boxes at a minimum spacing of 1000 feet and terminate the location wire in the box.

4. Continuity: Continuity of wire shall be tested using Metrotech 810/9860 or acceptable equal.

C. Identification Markings:

1. PVC pipe shall be extruded or fabricated in an integral solid color in the PVC material during manufacture. The integral color for PVC pipe shall be as follows:

a. Raw Wastewater: Safety Green
b. Reclaimed Water: Purple (Pantone 522C)
c. Potable Water: Safety Blue

PART 3 - EXECUTION

3.01 INSTALLATION OF LARGE DIAMETER PVC PIPE

A. Standards: AWWA C900/UNI-B 3 and 4

B. Underground Polyvinyl Chloride (PVC) Pipe and Fittings

1. Bedding: Firm, dry and even bearing of suitable material. Blocking under the pipe will not be permitted.

2. Placement/Alignment:

a. Installation shall be in accordance with lines and grades shown on the Drawings. No bending or joint deflection of PVC pipe shall be permitted at any time. Changes in horizontal or vertical alignment of PVC pipe shall be achieved by use of fittings only.
b. All pipe and fittings shall be inspected prior to lowering into trench to insure no cracked, broken or otherwise defective materials are being used. All homing marks shall be checked for the proper length so as to not allow a separation or over homing of connected pipe. Homing marks incorrectly marked on pipe shall result in rejection of pipe and removal from site. The Contractor shall clean ends of pipe thoroughly and remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
c. Proper implements, tools and facilities shall be used for the safe and proper protection of the Work. Pipe shall be lowered into the trench in such a manner as to avoid any physical damage to the pipe. Pipe shall not be dropped or dumped into trenches under any circumstances.
d. Trench Dewatering and Drainage Control: Contractor shall prevent water from entering trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water.
e. Pipe Laying in Trench: Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and re-laid. Pigging of pipe may be used to remove foreign materials in lieu of flushing. At times when pipe installation is not in progress, the open

ends of the pipe shall be closed by a watertight plug or by other means approved by the County to ensure absolute cleanliness inside the pipe. When installing PVC pipe, no additional joints will be installed until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

f. Locating Wire: Locating wire, for electronically locating pipe after it is buried, or installed by trenchless technology shall be attached along the length of and installed with the pipe. This is applicable to all sizes and types of pressure mains. At a minimum, the tracing wire is to be attached to the pipe with nylon wire ties. The wire itself shall be 10-gauge single strand solid core copper wire with non-metallic insulation. The insulation shall be color coded for the type of pipe being installed. Continuous continuity must be maintained in the wire along the entire length of the pipe run. Permanent splices must be made in the length of the wire using wire connectors approved for underground applications as listed in the uniform electric code handbook. The coiled wire shall extend to a minimum of 18-inches above the surface and be connected to a test station box at valve locations.

g. PVC Pressure Pipe Installation and Training: PVC pipe shall be installed in accordance with standards set forth in the UNI-BELL "Handbook of PVC Pipe", AWWA C605, and AWWA Manual M-23. The pipe shall be laid by inserting the spigot end into the bell flush with the insertion line or as recommended by the manufacturer. At no time shall the bell spigot end be allowed to go past the "insertion line" or "homing mark" for pressure pipe applications and homing mark shall be visible.

h. Field Cutting: PVC pipe can be cut with a handsaw or power driven abrasive disc making a square cut. The end shall be beveled with a beveling tool, wood rasp or power sander to the same angle as provided on the factory-finished pipe. The insertion line on the spigot shall be remarked to the same dimensions as the factory-marked spigot.

i. All Contractor pipe crews utilizing PVC pressure pipe shall be trained on an annual basis by Uni-Bell in coordination with the County and attended by the manufacturer's representative of the respective approved Manufacturers in Appendix D "List of Approved Products." The Uni-Bell PVC training session will consist of proper handling, storage, installation, backfill and compaction as well as County requirements regarding PVC pipe installation. Every person handling, installing or backfilling PVC pipe shall not be permitted to install County owned and / or maintained pipe without training.

j. Approved manufacturers representatives (Appendix D "List of Approved Products"), not present at the hosted Uni-Bell training session or individuals of pipe crews not in attendance shall be trained on every project site. On-site project training shall be for each

manufacturer of pipe utilized on-site, per crew and per project. Specifically each crewmember shall be trained on every project by every pipe manufactures representative regardless of previous on-site training. Every person handling, installing, backfilling or compacting the trench for PVC pipe shall not be permitted to install County owned and / or maintained pipe without training.

k. PVC Gravity Pipe Installation: Gravity sewer pipe shall be installed to the homing mark, no tolerance. Any noticeable separation shall be removed and reinstalled. The homing mark may be disregarded to meet the maximum of 1-inch separation between bell and spigot requirement. Joints:

l. Joint Placement:

i. Push on joints: Pipe shall be laid with the bell ends facing upstream. The gasket shall be inserted and the joint surfaces cleaned and lubricated prior to placement of the pipe. After joining the pipe, a metal feeler shall be used to verify that the gasket is correctly located.

ii. Mechanical Joints: Pipe and fittings shall be installed in accordance with the "Notes on Method of Installation" under ANSI A21.11/AWWA C111. The gasket shall be inserted and the joint surfaces cleaned and lubricated with soapy water before tightening the bolts to the specified torque.

C. Thrust Restraint

1. Thrust restraint shall be accomplished by the use of mechanical restraining devices unless specifically identified otherwise on the Drawings or herein.

2. Length of restrained joints shall be in accordance with the lengths listed in the table as shown on the Drawings.

D. Installation of Pipes on Curves:

1. No joint deflection or pipe bending is allowed in PVC pipe. The maximum allowable tolerance in the joint due to variances in installation is 0.75° (degrees) (3-inches per joint per 20-foot stick of pipe). No bending tolerance in the pipe barrel shall be acceptable. Alignment change shall be made only with sleeves and fittings.

3.02 INSTALLATION OF SCHEDULE 80 PVC PIPE

A. Install Schedule 80 PVC pipe where shown on the Drawings and in strict accordance with the manufacturer's technical data and printed instructions.

B. Joints for Schedule 80 PVC pipe and fittings shall be solvent welded. All joints shall be made watertight and airtight. All pipe cutting, threading and jointing procedures for solvent welded and threaded PVC pipe joints shall be in strict accordance with the pipe and fittings manufacturer's printed installation instructions. Thread lubricant for threaded connections shall be Teflon tape only. In making solvent welded

connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth, if necessary and apply solvent cement of proper grade.

C. Installation of valves and fittings shall be strictly in accordance with the manufacturer's instructions. Particular care shall be taken not to over-stress threaded connections at sleeves. In making solvent weld connections the solvent shall not be spilled on valves or allowed to run from joints.

D. All piping shall have sufficient number of unions to allow convenient removal and shall be approved by the Engineer.

E. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify their locations from the approved Drawings.

F. Piping Identification:

1. Prior to attaching labeling and identification, all surfaces shall be cleaned of all dirt, grease and other foreign matter.

2. Pipes shall be labeled and identified in accordance with Section 09905.

3.03 PRESSURE AND LEAKAGE TESTING

A. Refer to Section 15144 for pressure and leakage testing requirements for PVC pipe and fittings.

B. All piping joints shall be visibly inspected for leaks. All leaks found shall be repaired.

3.04 CLEANING AND FIELD TESTING

A. At the conclusion of the Work, the Contractor shall provide all associated cleaning and field testing as specified in associated sections of these specifications.

END OF SECTION

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SECTION 15065
STAINLESS STEEL PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: This section specifies stainless steel pipe and fittings.

B. Types of Service: Stainless steel piping specified in this Section shall be used for raw sewage discharge piping in the pump station wetwell.

1.02 QUALITY ASSURANCE

A. References: This Section contains references to the following documents. They are a part of this Section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this Section as if referenced directly. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, 250, and 800
ANSI B16.11.80	Forged Steel Fittings, Socket Welding and Threaded
ANSI B31.1	Power Piping
ANSI B36.19M	Stainless Steel Pipe
ASME Section IX (1989)	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A182	Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	Stainless Steel Bars and Shapes
ASTM A312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A403	Wrought Austenitic Stainless Steel Piping Fittings

ASTM A409	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service
ASTM A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip
ASTM A774	As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A778	Welded, Un-annealed Austenitic Stainless Steel Tubular Products

B. Qualifications: All shop fabricated stainless steel pipe and fittings shall be furnished by a single manufacturer who is experienced and qualified in the manufacture and fabrication of the items to be furnished. The pipe and fittings shall be shop-fabricated and field-installed in accordance with common industry wide practices and methods and shall comply with these specifications. Only weld procedures which have been qualified under ASME Section IX and only welders who have successfully completed performance qualification tests per ASME Section IX on these qualified procedures shall be utilized.

C. Testing: Factory testing shall conform to the requirements of ASTM A312, ASTM A409 HT-0, or ASTM A778, depending on the size and type of stainless steel pipe provided.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals" and shall include the following:

1. Shop fabrication drawings showing details of materials, piping, fittings, couplings, dielectric connections, joint locations and details, and types and locations of supports.

2. Certifications specified in the following documents:

   a. ASTM A403, paragraph 14.1
   b. ASTM A774, paragraph 14.1
   c. ASTM A778, paragraph 14.1
   d. ASTM A409, paragraph 17.1

3. Test results as specified in this Section.

4. Names and qualification certificates of proposed welders.

5. Other data necessary to show conformance of the piping system to these specifications.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 PIPE

A. Unless otherwise specified, stainless steel piping 3-inches and larger shall be manufactured from ASTM A240 annealed and pickled sheets and plates, Type 316L, in accordance with ASTM A778 or ASTM A409 HT-0. Only extra-low carbon (ELC) materials with 0.030% maximum carbon shall be used. Pipe shall be manufactured to nominal pipe sizes as listed in ANSI B36.19 and shall have nominal wall thickness corresponding to schedule 40S.

2.03 FITTINGS

A. Unless otherwise specified, stainless steel fittings 3-inch and larger shall be butt weld type manufactured in accordance with ASTM A774 of the same material and in the same thicknesses as the pipe. Long radius elbows less than 24-inches in diameter shall be smooth, curved bends. All short radius, special radius, reducing, and long radius elbows 24-inches and greater in diameter shall be of mitered construction. Reducers shall be straight tapered cone type. Tees, crosses, laterals, and wyes shall be shop-fabricated from pipe.

2.04 FLANGED CONNECTIONS

A. Connections shall be flanged as specified in Section 15063 "Ductile Iron Pipe and Fittings" and be capable of being mated to ductile iron pipe flanges or pump base elbow.

2.05 GASKETS

A. Gaskets shall be as specified in Section 15063 "Ductile Iron Pipe and Fittings."

2.06 BOLTS

A. Bolts, nuts, and washers for stainless steel flange assemblies shall be Type 316 stainless steel with bolts and nuts conforming to ASTM A193 Grade B8M.

2.07 PIPE SUPPORT SYSTEMS

A. Unless otherwise specified, all hangers, rods, structural attachments, and other components of support systems for stainless steel pipe shall be of the same materials as the pipe.

2.08 FINISH

A. After all shop operations have been completed, pipe and fittings shall be pickled and passivated in the manufacturer's plant, and scrubbed and washed until discoloration and possible iron picked up from manufacturing process are removed. The standard

finish for 16-gauge through 8-gauge material shall be No. 1 or 2B per ASTM A480; 3/16-inch and heavier plate material shall be No. 1-mil finish or better per ASTM A480.

PART 3 - EXECUTION

3.01 PIPE CUTTING, THREADING, AND JOINTING

A. Pipe cutting, threading, and jointing shall conform to the requirements of ANSI B31.1. All pipe threads shall be lubricated with Teflon tape.

3.02 WELDING

A. General: Piping with wall thickness up to 11-gauge (0.120-inch) shall be welded with the TIG (GTAW) process. Unless otherwise specified, heavier walls shall be properly beveled and have a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process. Filler wire of ELC grades only shall be added to all welds to provide a cross section at the weld equal to or greater than the parent metal. Weld deposit shall be smooth and evenly distributed and have a crown of no more than 1/16-inch on the I.D. and 3/32-inch on the O.D. of the piping. Concavity, undercut, cracks, or crevices shall not be allowed. Butt welds shall have full penetration to the interior surface, and inert gas shielding shall be provided to the interior and exterior of the joint. Excessive weld deposits, slag, spatter, and projections shall be removed by grinding. Welds on gasket surfaces shall be ground smooth.

B. Field Welding: Field welding shall be minimized to the greatest extent possible by prefabrication of pipe systems at the factory. Pipe butt welds may be performed at the job site providing the butt welds are performed only with an inert gas shielded process and that other applicable specified welding requirements are rigidly adhered to. All residue, oxide, and heat stain is to be removed from any type of field weld and the affected adjacent areas by the use of stainless steel wire brushes. The field weld shall then be cleaned with an agent followed by complete removal of the agent.

C. Preparation of Surfaces to Be Welded: Surfaces of joints to be welded shall be free from mill scale, slag, grease, oil, paint, rust, and other foreign material. Joints to be welded shall be wire-brushed with stainless steel wire brushes and precisely fitted before welding.

D. Weather Conditions: Welding shall be done only when the surfaces are completely free of any moisture. Welding of the pipe shall not be done during periods of high winds or rain unless the areas being welded are properly shielded.

E. Tack Welds, Clips, and Other Attachments: Nicks, gouges, notches, and depressions in the base metal in the area of the joint shall be repaired before the joint weld is made. Tack welds, clips, and other attachments shall be removed and defects repaired, except where the tack welds occur within the weld area and these tack welds do not exceed the size of the completed weld. Cracked tack welds shall be removed. Areas to be repaired shall be ground to clean metal and then repaired by building up

with weld metal. The repaired areas shall be ground smooth to form a plane surface with the base metal.

F. Defects and Repairs: Welds with cracks, slag inclusions, porosity, undercutting, incomplete penetration, or which are otherwise deficient in quality or made contrary to any provisions of these specifications shall be removed by chipping or grinding throughout their depth to clean base metal. Caulking or peening of welds to correct defects shall not be allowed. Welds found deficient in dimension but not in quality shall be enlarged by additional welding after thoroughly cleaning the surface of previously deposited metal and the adjoining plate. Weld deposits, slag, weld spatter, and projections into the interior of the pipe shall be removed by grinding.

3.03 MARKING, SHIPPING, AND STORAGE

A. Pipe, fittings, and fabrications shall be properly marked with type, gauge, and heat number. Fabricated piping shall have openings plugged and flanges secured for storage or transport after fabrication. Fabricated piping shall be piece-marked with identifying numbers or codes which correspond to the Contractor's layout and installation drawings. The marks shall be located on the spools at opposite ends and 180° (degrees) apart. Pipe spools shall be loaded, blocked, and lagged as necessary to ensure protection from damage during shipping. Stainless steel pipe and fittings shall be stored per manufacturer's recommendation. Dents, gouges, and scratches in stainless steel pipe and fittings are not acceptable and are reason for rejecting pipe and fittings.

3.04 FABRICATION/INSTALLATION REQUIREMENTS

A. The piping supplier and the Contractor shall use extreme care to avoid the contact of any ferrous materials with the stainless steel piping during manufacturing, fabricating, handling, and installation stages. All saws, drills, files, and wire brushes shall be used for stainless steel piping only. Pipe storage and fabrication racks shall be nonferrous, stainless steel, or rubber-lined. Nylon slings or straps shall be used for handling stainless steel piping. After installation, the Contractor shall wash and rinse all foreign matter from the piping surface. All welded joints shall be treated with a pickling solution, brushed with stainless steel wire brushes, and rinsed clean. If rusting of embedded iron occurs, the Contractor shall pickle the affected surface with Oakite Deoxidizer SS, or equal, scrub with stainless steel brushes, and rinse clean.

3.05 COATINGS

A. Painting of the stainless steel pipe is not required.

END OF SECTION

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SECTION 15066
HIGH-DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: Provide and install high-density polyethylene (HDPE) pipe and fittings of the sizes and in the locations shown on the Drawings and as specified for use in directional drilling.

B. Butt Fusion and Welding: The terms butt-fusion and welding, and derivatives thereof, are to be interpreted synonymously within this Specification.

1.02 STANDARDS

A. Pipe 1/2-inches through 3-inches shall conform to AWWA C901 and the Specifications.

B. Pipe and fittings 4-inches through 60-inches shall conform to AWWA C906 and the Specifications.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and Section 01300 "Submittals."

B. Submit manufacturers recommended method for butt-fusing joints.

C. The polyethylene pipe manufacturer shall provide certification that stress regression testing has been performed on the specific product. Certification shall include a stress life curve per ASTM D2837.

D. Provide certification that the material is listed by the Plastic Pipe Institute in PPI TR-3 with a hydrostatic design basis of 1,600-psi at 73°F. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D2837 and PPI TR-3 testing and validation of samples of the pipe manufacturer's production pipe.

E. The manufacturer's certification shall state that the pipe was manufactured from 1 specific resin in compliance with these Specifications. The certificate shall state the specific resin used, its source, and list its compliance to these specifications.

F. Submit certified lab data to verify specified physical properties. Certify that tests are representative of pipe supplied for this project.

G. Submit affidavit of compliance with referenced standards (e.g., AWWA C901, C906, etc.).

H. Submit schedule for placement of and removal of test bulkheads.

I. HDPE pipe shop drawings shall show complete dimensions including length, internal diameter, pressure rating and wall thickness; maximum allowable deflection of the pipe;

detailing; mechanical connections; and necessary accessories for manufacture, transportation, storage, handling, and installation.

J. Shop drawings showing all specials and fittings, joint restraint systems, adapters, and couplings.

K. Testing procedures and testing laboratory for factory testing as specified in these Specifications.

L. Names of employees and other assigned personnel with their experience in assembly, welding and installation of the pipe.

M. Copies of certifications from the pipe manufacturer for certified pipe fusion technicians performing HDPE butt fusion processes for the Project. Training records for qualified fusion technicians shall also be submitted.

N. Pipe Assembly Procedures

1. Descriptions of procedures, means and methods for storing, fabricating, handling, transporting, and protecting pipe segments.

2. Calculations of stresses and longitudinal strains developed in pipe during handling and installation.

3. Description of procedures for lifting pipe.

4. Calculations showing allowable lifting configurations so allowable stresses will not be exceeded.

5. Welding procedures for high density polyethylene pipe.

O. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards. Manufacturer shall submit the following:

1. Name of the pipe manufacturer and a list of the piping and quantities to be provided by manufacturer.

2. Product data and pipe supplier data indicating conformance with this Specification and applicable standards, including written documentation regarding any intended variance from this Specification and applicable standards. This will include experience of pipe supplier by years and number of projects; warranty information; and independent laboratory testing certification.

3. Fusion joint data and fusion technician data indicating conformance with this Specification and applicable standards. This will include fusion joint warranty information and recommended project specific fusion parameters, including criteria logged and recorded by data logger.

P. Certified copies of test reports of factory tests required by the applicable standards and this Specification. Report shall include at minimum include following information:

1. Dimensional Checks

2. Pipe Burst

3. Flattening

4. Extrusion Quality (Acetone Immersion)

Q. Description of procedures, methods and materials that will be used to repair pipe or pipe joints damaged during installation.

R. Description of methods and materials that will be used to correct leaks in pipe or pipe joints.

S. Six (6) copies of the fusion data logging and joint report prepared by the certified pipe fusion technician shall be submitted by the Contractor following completion of pipe fusion and testing procedures. The report shall be certified and dated by the pipe fusion technician performing the work.

1.04 INSPECTION

A. All materials and installation furnished under this specification are subject to inspection by the County.

1.05 QUALITY AND WORKMANSHIP

A. The pipe and fitting manufacturer's production facilities shall be open for inspection by the County or his designated agents. During inspection, the manufacturer shall demonstrate that the facilities are capable of manufacturing the pipe and fittings required by this specification, that a quality control program meeting the minimum requirements of ASTM D3035 and ASTM F714 is in use, and that facilities for performing the tests required by this specification are in use.

B. The Contractor shall use certified HDPE pipe welding and fusion operators. The certifications of these individuals shall be made available prior to construction. HDPE pipe welding and fusion operators shall be certified by the pipe manufacturer prior to commencement of pipe welding and fusing operations.

1.06 QUALIFICATION OF FUSION OPERATORS

A. Each operator performing fusion joining shall be qualified in the use of the manufacturer's recommended fusion procedure(s) by the following:

B. The certified fusion operator shall have previous experience of performing fusion work on 63-inch HDPE pipes.

C. Appropriate training or experience in the use of the fusion procedure.

1. Making a sample joint according to the procedure that passes the following inspections and tests:

a. The joint shall be visually examined during and after joining and found to have the same appearance as a photograph or sample of an acceptable joint that was joined in accordance with the procedure; and

b. The joint shall be tested or examined by 1 of the following methods:

i. Pressure and tensile test as described in 49 CFR 192.283

ii. Ultrasonic inspection and found to be free of flaws that would cause failure

iii. Cut into at least 3 longitudinal straps, each of which is:

I. Visually examined and found to be free of voids or unbonded areas on the cut surface of the joint, and

II. Deformed bending, torque, or impact and if failure occurs, it must not initiate in the joint area.

2. Each operator shall be re-qualified under the procedure if during any 12-month period:

a. Operator has not made any joints under the procedure; or

b. Operator has 3 joints or 3% of the joints made, whichever is greater, that are found unacceptable by testing according to 49 CFR 192.513.

1.07 DELIVERY, STORAGE, AND HANDLING

A. On site pipe storage shall meet all manufacturers' requirements.

B. Transport individual pipe lengths to the job site on padded bunks with nylon tie-down straps or padded bonding to protect the pipe. Coiled HDPE pipe shall be stored in a manner to ensure safety. Protect the pipe from sharp objects. Anchor pipe securely to prevent slippage.

C. Store individual pipe lengths on earth berms or timber cradles in the numerical order of installation. Stack the heaviest series of pipe at the bottom. Do not stack pipe in excess of 6 feet high.

D. Protect the pipe from stones and sharp objects.

E. Store fittings in their original cartons.

F. Lift pipes with handling beams or wide belt slings near the middle of joints as recommended by the pipe manufacturer. Do not use cable slings, chains, or hooks.

G. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting. Remove any pipe section containing defects by cutting out the damaged section in a complete cylinder.

H. The Contractor shall be responsible for the delivery, storage, and handling of products. No products shall be shipped to the job site without the approval of the Engineer and the Owner's representative.

I. All pipes shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Owner's representative or the Engineer.

J. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify the Owner's representative or the Engineer immediately if more than immaterial damage is found.

K. Each pipe shipment should be checked for quantity and proper pipe size, color and type.

L. Pipe should be loaded, off-loaded, and otherwise handled in accordance with manufacturer guidelines.

M. If left bundled in units, unloading can be done with a single forklift so long as it is of sufficient capacity to handle the load. If sag exceeds pipe manufacturer's recommendations, then each piece of pipe should be unloaded individually. When unloading individual pieces of pipe, the pipe should be supported at approximately the 1/3 point measured from each end of the pipe. Sag is the measurement of the pipe ends relative to the pipe center.

N. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

O. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the Owner's representative or the Engineer.

P. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the Owner's representative or the Engineer.

Q. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution shall be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

R. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Use of hooks, chains, wire rope or any other handling device which creates the opportunity to damage the surface of the pipe is strictly prohibited.

S. After delivery to the project site, pipe shall be stored at ambient temperature and protected from ultraviolet light degradation

1.08 WARRANTY

A. For HDPE pipe installations warranties refer to Section 01740-Warranties and Bonds.

B. In addition to the standard pipe warranty, the fusion contractor shall provide, in writing, a warranty for a period of two years for all the fusion joints, including formation, installation, and pressure testing.

C. Warranty periods shall begin on the date of installation and product acceptance by the Owner after all applicable testing.

PART 2 - PRODUCTS

2.01 PIPE

A. Pipe shall have an outside diameter as indicated on the drawings. Pipe shall be manufactured by Performance Pipe (Chevron), JM Eagle, or ISCO.

B. Pipe for water pressure service shall have a nominal ductile iron pipe size outside diameter (OD). The dimension ratio shall be verified by the Contractor based on the pipe pull strength and the pressure rating of the pipe supplied shall be (DR 9) pressure class 200 for water main and reclaimed water mains, and (DR 11) pressure class 160 for wastewater force mains, in accordance with Table 5 of AWWA C906. The pipe shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties throughout.

C. Pipe shall have a minimum hydrostatic design basis (HDB) of 1,600-psi, as determined in accordance with ASTM D2837.

D. Pipe Material For Water Pressure Service:

1. Pipes for water pressure service shall be marked in accordance with AWWA requirements (C901 Section 2.4 or C906 Section 3.1, as appropriate).

2. AWWA C901 pipe (1/2-inch through 3-inches) shall be PE 3408 DR 9, colored blue for water, purple (Pantone 522C lavender) for reclaimed water, and green for wastewater. AWWA C901 pipe shall be as manufactured by Endot Endopure or approved equal.

3. AWWA C906 pipe (4-inches through 60-inches) shall be color coded as above with 4 co-extruded equally spaced stripes of the same material as the pipe. Stripes printed on the pipe outside surface shall not be acceptable. Stripe colors shall be as described above for the intended utility service.

4. Materials used for the manufacture of polyethylene pipe and fittings shall be very high molecular weight, high-density ethylene/hexene copolymer PE 3408 polyethylene resin meeting the requirements of Table 15066-2.

5. The pipe shall be extruded from pre-compounded resin. In-plant blending of resin is unacceptable.

E. HDPE Pipe shall have been continuously marked by the manufacturer with permanent printing with the following information at a minimum:

1. Nominal Size (Inches);

2. Dimension Ratio (DR);

3. Pressure Rating (psi);

4. Trade Name;

5. Material Classification (PE3408);

6. Plant, Extruder and Operator Codes;

7. Resin Supplier Code;

8. Date Produced; and

9. HDPE pipe used for potable water mains shall bear the NSF Seal of Approval.

F. Pipe Material for Foul Air Duct: HDPE pipe for foul air duct shall have a nominal IPS (iron pipe size) size outside diameter (O.D.). The dimension ratio and the

pressure rating of the pipe supplied for foul air duct shall be DR 17, pressure class 100. The pipe shall be capable of operating under vacuum conditions up to 12-inches of water without collapsing. HDPE pipe with IPS pipe sizes for foul air duct shall have the minimum dimensions presented in Table 15066-1.

1. The foul air HDPE pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index and other physical properties throughout.

2. Materials used for the manufacture of polyethylene pipe and fittings for foul air duct shall be high density, very high molecular weight polyethylene pipe designated as HDPE PE3408 polyethylene resin meeting the requirements of Table 15066-2.

Table 15066-1
Foul Air Duct HDPE IPS Pipe Sizes - Minimum Dimensions

Pressure Rating	Nominal Size	16”	18”	20”	22”	24”
	Actual O.D.	16.00”	18.00”	20.00”	22.00”	24.00”
DR 17 (100 psi)	Min Wall Thickness	0.941”	1.059”	1.176”	1.294”	1.412”
	Average I.D.	14.005”	15.755”	17.506”	19.256”	21.007”
DR 19 (89 psi)	Min Wall Thickness	0.842”	0.947”	1.053”	1.158”	1.263”
	Average I.D.	14.215”	15.992”	17.768”	19.545”	21.322”
DR 21 (80 psi)	Min Wall Thickness	0.762”	0.857”	0.952”	1.048”	1.143”
	Average I.D.	14.385”	16.183”	17.981”	19.779”	21.577”
DR 26 (64 psi)	Min Wall Thickness	0.615”	0.692”	0.769”	0.846”	0.923”
	Average I.D.	14.695”	16.532”	18.369”	20.206”	22.043”

Table 15066-2
Physical Property and Pipe Performance Requirements

Property	Specification	Units	Minimum Values
Material Designation	PPI/ASTM	---	PE3408
Material Classification	ASTM D1248	---	III C 5 P34
Cell Classification	ASTM D3350	---	345434C
Hardness	ASTM D2240	Shore D	64
Density	ASTM D1505	gm/cm^3	0.941-0.943
Melt Index	ASTM D1238	gm/10 min	0.05-0.11
Flexural Modulus	ASTM D790	psi	110,000-140,000
Compressive Strength (Yield)	ASTM D695	psi	1,600
Tensile Strength @ Yield (Type IV Spec.)	ASTM D638 (2%/min)	psi	3,200
Elongation @ Yield	ASTM D638	%, min	8
Tensile Strength @ Break (Type IV Spec.)	ASTM D638	psi	3,500
Elongation @ Break	ASTM D638	%, min.	600
Modulus of Elasticity	ASTM D638	psi	110,000
ESCR:			
(Cond A, B, C: Mold. Slab)	ASTM D1693	Fo, Hrs	Fo>5,000
(Compressed Ring)	ASTM F1248	F50, Hrs	F50>1,000
PENT	ASTM F1473	Hrs	>100
Impact Strength (IZOD) (0.125-inch thick)	ASTM D256 (Method A)	in-lb/in Notch	42
Linear Thermal Expansion Coef	ASTM D696	in/in/°F	1.2 x 10-4
Thermal Conductivity	ASTM C177	BTU, in/	2.7
		Ft2/hrs/°F	
Brittleness Temp	ASTM D746	°F	<-180
Vicat Soft. Temp	ASTM D1525	°F	+257
NSF Listing	Standard 61	---	Listed

Note: * Standard deviation 0.01.

2.02 NIPPLES AND FLANGED STUB ENDS

A. Short nipples and stub ends shall be of the same material as the HDPE pipe.

2.03 FITTINGS

A. Fittings shall be made from material meeting the same requirements as the pipe. Fittings shall be fabricated by the manufacturer of the pipe.

B. Fittings shall meet the appropriate AWWA standard for the size involved (C901 or C906) and shall be Pressure Class 200 for water main and reclaimed water main, Pressure Class 160 for wastewater force main and Pressure Class 100 for odor control duct.

C. Molded fittings shall be manufactured in accordance with ASTM D3261 and shall be so marked.

D. Mechanical fittings, when used, shall be specifically designed for, or tested and found to be acceptable for use with HDPE pipe.

E. Fittings used to connect with dissimilar pipe materials shall be provided as per Section 15063 "Ductile Iron Pipe and Fittings."

2.04 JOINTS

A. Sections of polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations and procedures. The butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer.

B. Butt fusion joining shall result in joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used. Extrusion welding or hot gas welding of HDPE shall not be used. Flanges, unions, grooved-couplers, transition fittings, and some mechanical couplers may be used to connect HDPE pipe mechanically without butt-fusion only where shown in the Drawings.

C. Ductile Iron to HDPE Connections

1. Flanged connections between ductile iron pipe or fittings and HDPE pipe or fittings shall meet all requirements of Section 15063 "Ductile Iron Pipe and Fittings."

2. Mechanical joint connections between ductile iron pipe or fittings and HDPE pipe or fittings shall use ductile iron mechanical joint glands conforming to AWWA C111 and AWWA C153. Mechanical joints shall be fully thrust restrained. Gaskets, bolts, and hexagonal nuts shall be standard rubber gaskets conforming to AWWA C111. Follower gland shall match class 350 compact fittings.

3. HDPE pipe stiffeners shall be constructed of 316 stainless steel and shall be flanged on one end to prevent over-insertion into the receiving pipe.

D. FRP Odor Control Duct to HDPE Odor Control Duct Connections

1. Flanged connections between FRP duct and HDPE duct shall meet all requirements of Section 15891 “FRP Ductwork”. Flanges shall meet ANSI B16.1 drilling patterns to insure correct alignment and bolting.

E. Flange Bolting:

1. Bolting for flanged connections of HDPE pipe to ductile iron pipe or FRP pipe shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts. The nuts shall have a hardness that is lower than that of the bolts and washers by a difference of 50 Brinnell hardness to prevent galling during installation.

2.05 LOCATION MARKERS, LOCATION WIRE AND IDENTIFICATION MARKINGS

A. Electronic Markers and Locator System (for reclaimed water and wastewater ONLY)

1. Markers: Markers shall consist of a passive device capable of reflecting a specifically designated repulse frequency tuned to the utility (service) being installed. Markers shall be color coded in accordance with the American Public Works Association's "Utility Locating and Coordinating Council Standards." Colors shall be: Wastewater and Reclaimed Water - #1404 Green. Markers shall be full range. Markers shall be installed directly above the centerline of the respective pipeline at intervals not to exceed 100-feet, at each fitting (tees, wyes, crosses, reducers, plugs, caps and bends) or change in horizontal direction and at each valve along the pipeline. Markers shall be hand backfilled to 1-foot above the pad and have a finished depth of burial of not less than 2-feet or more than 6-feet. No separate payment shall be made for furnishing and installing the respective frequency and color-coded electronic pad type marker.

2. Locator System: Marker locator set shall be the 3M Dynatel 2250-iD Electronic Marker System Marker Locator, or acceptable equal. The Contractor shall furnish 1 locator set for each type of service piping installed on the Project (i.e.: reclaimed water, wastewater.) to the County. Each unit shall incorporate the following features and accessories:

a. Unit(s) shall be tuned to the proper frequency for each type (service) of piping.
b. Field strength meter that provides visual indication of the return signal
c. Function switch for selection of operation mode
d. Sensitivity control to adjust the receiver gain
e. Audio speaker for signal response
f. Battery access panel containing condensed operating instructions
g. Auxiliary headset and heads set jack
h. Permanently attached shoulder straps
i. Rugged shockproof and weatherproof storage/carrying case

3. Manufacturer: System shall be 3M Dynatel Locating and Marking System, or acceptable equal.

B. Location Detection Wire

1. Materials: Continuous, insulated 10-gauge copper wire (color to match pipe identification).

2. Installation: Directly above (1-inch maximum) centerline of pipe terminating at top of each valve box collar and be capable of extending 18-inches above top of box (stored inside the 2-inch brass pipe through the valve box collar) in a manner so as not to interfere with valve operation. For direction drilling installations, a minimum of 2 (two) 10-gauge wires shall be pulled along with the pipe.

C. Identification Markings:

1. Pipe shall have 4 co-extruded colored stripes spaced at 90º around the pipe. The colored stripes shall run the entire length of the pipe, and be no less than 3/4-inch wide. Stripes shall be colored and the same materials the pipe. Stripes printed on the outside of the pipe are not acceptable. The stripe colors shall be as follows:

    a. Raw Wastewater: Safety Green
    b. Reclaimed Water: Purple (Pantone 522C)
    c. Potable Water: Safety Blue
    d. Above ground odor control piping: White UV Veil Coating System on the pipe with black stripes
    e. Below ground odor control piping: Standard Black pipe with white stripes.

PART 3 - EXECUTION

3.01 HEAT FUSION

A. Use fusion equipment specially designed for heat fusion of HDPE. The equipment utilized shall be regulated for the different melt strength materials. Compatibility fusion techniques shall be used when polyethylene of different melt indexes are fused together.

B. Butt-fused HDPE pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this Specification and pipe supplier's written recommendations.

C. Pipe will be fused by qualified fusion technicians, certified by the pipe supplier/manufacturer. Training records for qualified fusion technicians shall be submitted to the Owner and the Engineer for review.

D. Each joint fusion shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine. Joint data shall be submitted as part of the As-Built record information, in accordance with this Specification.

E. The pipe will be installed in a manner so as not to exceed 70 percent of the recommended maximum bending radius of the pipe.

F. Only appropriately sized, and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following properties, including the following elements:

    1. Heat Plate: Heat plates shall be in good condition with no deep gouges or scratches within the pipe circle being fused. Plates shall be clean and free of any contamination. Heater controls shall properly function, and cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's recommendations.

    2. Carriage: Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

3. General Machine: Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.

4. Data Logger: The current version of the pipe supplier's recommended and compatible software shall be used. Protective case shall be utilized for the hand held wireless portion of the unit. Data Logger operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

G. Other equipment specifically required for the fusion process shall include the following:

1. Pipe rollers shall be used for support of pipe on either side of the machine.

2. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement and /or windy weather.

3. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

4. Facing blades specifically designed for cutting HDPE pipe.

H. Use the following procedure for butt fused HDPE pipe. If a procedure noted below contradicts manufacturer's recommendations, follow the manufacturer's recommendation.

1. Maintain the proper temperature of the heater plate as recommended by the pipe manufacturer. Check it with a tempilstik or pyrometer for correct surface temperature.

2. Clean pipe ends inside and outside with a clean cotton cloth to remove dirt, water, grease, and other foreign materials.

3. Square (face) the pipe ends using the facing tools on the fusion machine. Remove all burrs, chips, and fillings before joining pipe or fittings.

4. Check the line-up of pipe ends in the fusion machine to see that pipe ends meet squarely and completely over the entire surface to be fused. The clamps shall be tight so that the pipe does not slip during the fusion process.

5. Insert the clean heater plate between the aligned ends and bring the ends firmly in contact with the plate but do not apply pressure while achieving the melt pattern. Allow the pipe ends to heat and soften. Softening depths shall be per the manufacturer's recommendation.

6. Carefully move the pipe ends away from the heater plate and remove the plate (if the softened material sticks to the heater plate, discontinue the joint, clean heater plate, square pipe ends, and start over).

7. The melted ends shall be connected rapidly but not slammed together. Apply enough pressure to form a double rollback bead to the body of the pipe around the entire circumference of the pipe about 1/8-inch (3.175-mm) to 3/16-inch

(4.763-mm) wide. Pressure is necessary to cause the heated material to flow together.

8. Allow the joint to cool and solidify properly. Remove the pipe from the clamps and inspect the joint appearance.

I. Joint Recording: Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of thermoplastic pipe. The software shall register and/or record the parameters required by the manufacturer and these Specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

J. Joint Fusion Bead Removal: Contractor shall remove the beads from the inside and the outside of the HDPE pipe following joint fusing.

3.02 OPERATIONS INCIDENTAL TO JOINT COMPLETION

A. Plan joint completion to accommodate temporary test bulkheads for hydrostatic testing on the day of installation.

3.03 ASSEMBLING JOINTS

A. Flanged Joints

1. Flange adapters shall be pressure rated the same as the pipe. Flange adapters shall be heat fused to the pipe as outlined in the heat fusion section.

2. Gaskets shall be used between the polyethylene flange adapters when recommended by the HDPE pipe manufacturer. Sufficient torque shall be applied evenly to the bolts to prevent leaks. After initial installation and tightening of flanged connections, allow the connections to set for a few hours then conduct a final tightening of the bolts.

3. Lubricate nuts and bolts with oil or graphite prior to installation.

4. Check operation of valves connected to molded stub end flange adapters. Insert polyethylene spacer if recommended by pipe manufacturer for clearance.

B. Mechanical Joints

1. Wipe the socket and the plain end clean. Lubrication and additional cleaning should be provided by brushing both the gasket and plain end with an approved pipe lubricant just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.

2. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

3. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after assembly but before tightening bolts.

4. Tighten the bolts to the normal range of bolt torque as indicated in AWWA C-600 while maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.

5. When connection is being made to HDPE pipe or fittings use a welded flange to connect to fittings.

3.04 INSTALLATION

A. Installation of High-Density Polyethylene Pipe

1. All high-density polyethylene (HDPE) pipe shall be handled, stored, assembled, and installed in accordance with AWWA C906, manufacturer's recommendations, and these Specifications.

2. Where indicated on the Drawings HDPE pipe shall be installed using directional drilling method of construction in accordance with Section 02665 "Horizontal Directional Drilling of Pressure Mains."

B. Installation of HDPE Service Connections

1. HDPE AWWA C901 (1/2-inch through 3-inch) water and reclaimed water service connections crossing roads shall be installed in a PVC casing pipe. PVC casing pipe may be installed by push/pull (reaming) methods as approved by the County. PVC casing pipe shall be Schedule 40 and meet the requirements of ASTM D1785. PVC fittings shall be Schedule 40 and shall meet the requirements of ASTM D2466. Casing pipe/carrier pipe size shall be as follows:

Carrier Pipe (Nominal Dia.)	**Casing Pipe (Nominal Dia.)**			
	Size	**O.D**	**Wall**	**I.D**
1-inch	2-1/2-inches	2.875	0.203	2.469
1-1/4-inch	3-inches	3.50	0.216	3.068
1-1/2-inch	3-1/2-inches	4.00	0.226	3.548
2-inch	4-inches	4.5	0.237	4.026

2. Casing pipe shall be air pressure tested for leaks immediately upon completion of each crossing at a minimum test pressure of 20-psi.

3. Following installation of carrier pipe within casing, install a plug in each open end of casing. Plugs shall be suitable for restraining against external earth load.

3.05 FOUNDATION, BACKFILLING AND COMPACTION

A. The foundation, backfilling, and compaction of the 63-inch HDPE pipeline shall conform to Plastics Pipe Institute (PPI) Underground Installation of PE Piping, inclusive of but not limited to the following requirements.

B. Pipes shall be installed on a stable foundation. Unstable soil or muck shall be removed from the trench bottom. A 12" foundation or bedding of compacted Class 1 material shall be in the bottom of the trench. The minimum density of the bedding material shall be equal to 98 percent Standard Proctor Density.

C. The bedding material shall be installed on grade. Water shall be removed from the trench before bringing the bedding material and pipe to grade and backfilling. When a trench is cut through solid rock, it shall be excavated to 6" below the pipe bottom grade, and bedded with Class 1 bedding. All slabs of rock, boulders and large rocks shall be removed.

D. Backfilling shall follow pipe placement and assembly as closely as possible to prevent the pipe from being shifted out of line by cave-ins, protect the pipe from external damage, and eliminate pipe lifting due to flooding of open trench.

E. Class l and II backfill material shall be used for backfill to at least 12" above the crown of the pipe. The minimum density of the backfill material shall be equal to 98 percent Standard Proctor Density.

F. This material shall be compacted to at least 98% Standard Proctor Density in 6" lifts to at least 12" above the crown of the pipe.

G. Final backfill shall be placed in the trench and compacted to finished grade. Native soils without rots, limbs, large rocks, boulders, clumps, or frozen clods or any object that could damage the pipe can be used.

H. Excessive compaction with inappropriate equipment can result in temporary deformation, pipe lifting off the bedding and shall be prevented therefore. There should be at least one foot of cover over the pipe before compaction of the final backfill by the use of self-powered compactors. Construction vehicles should not be driven over the pipe until a three feet of cover of properly compacted material is placed over the pipe.

I. In case ground water is present in the trench, a geo-textile membrane is recommended to prevent migration of fines.

3.06 DISINFECTION OF PIPE

A. Flush and disinfect potable water pipe in accordance with Section 02660 "Potable Water System."

3.07 HYDROSTATIC TESTING

A. Perform hydrostatic testing for leakage prior to installation and following installation in accordance with manufacturer's written recommendations.

B. All pressure piping shall be hydrostatically tested at a pressure equivalent to 1-1/2 times the working pressure, but not less than 150-psi for potable water or reclaimed

water mains or 100-psi for wastewater force mains, unless otherwise noted. No high-density polyethylene pipe section under test will be accepted if the make-up water amount is greater than that specified in applicable specification Section 02660 "Potable Water System", Section 02661 "Wastewater Force Mains", and Section 02662 "Reclaimed Water System."

END OF SECTION

SECTION 15075
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Access panel and door markers.
4. Pipe markers.
5. Duct markers.
6. Stencils.
7. Valve tags.
8. Valve schedules.
9. Warning tags.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Valve numbering scheme.

C. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.05 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.

2. Data:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.02 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.

2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.03 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive. Self-adhesive duct markers/tape may be substituted.

2.04 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Metal or fiberboard.

2. Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

2.05 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Engineer. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch-thick aluminum.

2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.06 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.

2. Frame: Extruded aluminum.

3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.07 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

2. Pumps, compressors, chillers, condensers, and similar motor-driven units.

3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.

4. Fans, blowers, primary balancing dampers, and mixing boxes.

5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

   a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   b. Fire department hose valves and hose stations.
   c. Meters, gages, thermometers, and similar units.
   d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
   e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
   g. Fans, blowers, primary balancing dampers, and mixing boxes.
   h. Packaged HVAC central-station and zone-type units.
   i. Tanks and pressure vessels.
   j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install access panel markers with screws on equipment access panels.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.

2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.

3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.

4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2

inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.04 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on air ducts in the following color codes:

1. Underground Foul Air Duct: White lettering on black HDPE pipe.
2. Aboveground Foul Air Duct: Black lettering on white FRP pipe.
3. Letter Size: Minimum 1/2- inch for name of units if viewing distance is less than 24 inches, 1-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and

HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:
2. Cold Water: 1-1/2 inches, round.
3. Hot Water: 1-1/2 inches, round.
4. Fire Protection: 1-1/2 inches, round.
5. Gas: 1-1/2 inches, round.
6. Steam: 1-1/2 inches, round.
7. Valve-Tag Color:
8. Cold Water: Blue.
9. Hot Water: Black.
10. Fire Protection: Red.
11. Gas: Yellow.
12. Letter Color:
13. Cold Water: White.
14. Hot Water: White.
15. Fire Protection: White.
16. Gas: Black.

3.06 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.08 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.09 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

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SECTION 15076
HVAC IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Access panel and door markers.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

PART 2 - PRODUCTS

2.01 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
    a. Manufacturer, product name, model number, and serial number.
    b. Capacity, operating and power characteristics, and essential data.
    c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:
    a. Name.
3. Size: 2-1/2 by 4 inches for equipment.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Package Units.
2. Duct Smoke Detectors

3.03 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 15100
VALVES AND PIPING APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: The scope of work includes the furnishing of all labor, materials, equipment and appurtenances required for the complete installation of valves and associated appurtenances as shown on the Drawings and as specified herein.

B. Related Work Described Elsewhere.

1. Piping, Valve, and Equipment Identification System is included in Section 15075
2. Pipe Hangers and Supports are included in Section 15126
3. Pressure Testing of Piping is included in Section 02660 and 02661

C. General Design

1. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water, chemicals, etc., depending on the application.
2. The equipment includes, but is not limited to the following:
   a. Valve Actuators
   b. Valve Tagging and Identification
   c. Bolts and Nuts for Flanged Valves
   d. Gaskets for Flanges
   e. Limit Switches for Check Valves
   f. Painting and Coating
   g. Packing, O-Rings, and Gaskets
   h. Rubber Seats
   i. Pressure Gauges
   j. Valves (Plug Valves, Check Valves, and Air Release/Vacuum Relief Valves)

1.02 QUALITY ASSURANCE

A. All of the valves and appurtenances specified herein shall be products of well established reputable firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with standard practices and methods and shall comply with these specifications as applicable.

B. Reference Standards

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C517	Resilient Seated Cast-Iron Eccentric Plug Valves
AWWA C508	Swing Check Valves

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

B. Submit proof-of-design test reports specified in paragraph 1.04.

C. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

D. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

E. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

F. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."

1.04 PROOF OF DESIGN TEST FOR ECCENTRIC PLUG VALVES

A. Plug Valves 3-inch to 42-inch in size:

1. The Contractor shall require the valve manufacturer to furnish six certified copies of reports covering the design tests for the eccentric plug valves as described in AWWA C517 and the following. One prototype valve of each size and class of a manufacturer's design shall be tested for leakage at the

specified design pressure and hydrostatically tested with twice the specified design pressure. The hydrostatic test shall be performed with the plug in the open position. The leakage test shall be performed with the plug in the closed position. The duration of each test shall be 10 minutes minimum. During the leakage test, there shall be no indication of leakage past the valve plug. Valves specified to have bi-directional seats shall be leak tight in both directions. In the case of flanged valves, the valve body shall be bolted to a flanged test head.

2. No part of the valve or plug shall be permanently deformed by the hydrostatic test. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft seal.

3. It is the intent that the valve manufacturer provide evidence of the adequacy of each type offered to perform under design pressures within the applicable rating for a sufficient number of test cycles simulating a full service life. The adequacy is to be proven by tests, made on one or more similarly designed valves selected to represent each basic type of seat design of a size within each applicable group, in a pressure class or classes equal to or greater than that specified. The required number of test cycles appears in the following table:

Test Cycles Required		
Size Group (inches)	No. of Cycles	Minimum Differential Pressure (psig)
3 to 20	10,000	150
24 to 42	5,000	150

4. Every test cycle shall consist of applying the specified differential pressure to the plug in the closed position, then opening the plug (which will relieve the pressure) to the wide-open position and then closing the plug.

5. The valve shall be leak tight under the specified pressure differential upon completion of the cycle test without having to stop during the test to repair the valve, modify or reinforce the seat, or install shims or wedges around the seat.

6. The plug shall not be rotated past the center position to jam the plug onto the seat during the hydrostatic test, the leakage test, or the cycle test.

B. Plug Valves 48-inch and larger in size:

1. For valves 48” and larger plug valves, each valve shall be production tested (shell and seat, direct and reverse pressure) by the valve manufacture prior to shipment as described in AWWA C517. The contractor shall require the valve manufacture to furnish six (6) certified copies of reports covering the production testing for the eccentric plug valves.

2. The manufacturer shall provide six (6) certified copies of proof of design cycle testing for eccentric plug valves 48-inch in size and larger. The manufacturer shall provide evidence of the adequacy of each valve type and

size offered to perform under design pressures within the applicable rating for a sufficient number of test cycles simulating a full service life. The adequacy is to be proven by proof of design tests, made on one or more similarly designed valves selected to represent each basic type of seat design of a size within each applicable group, in a pressure class or classes equal to or greater than that specified. The required number of test cycles for 48-inch and larger plug valves shall be 2,000 cycles at 100 psi.

3. In lieu of production testing the valves at an independent testing laboratory, testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory, and all test reports must be certified by the laboratory representative. Failure to satisfactorily complete the production testing shall be deemed sufficient evidence to reject the valves.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment provided under this section shall be shipped, handled and stored in accordance with the Manufacturer's written instructions and in accordance with Section 01600: Material and Equipment.

1.06 WARRANTY AND GUARANTEES

A. Provide equipment warranties in accordance with Section 01740.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications except as noted in this specification.

B. Valves shall include the required accessories such as operators, operating handwheels, operating levers, valve boxes, handwheels, chain wheels, extension stems, floor stands, gear actuators, operating nuts, chains, wrenches etc. necessary for proper operation.

B. All valves and appurtenances shall have the name of the manufacturer, the working pressure for which they are rated, and be of the size shown on the drawings with size label of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate. All similar type valves shall be from the same manufacturer.

C. Valves are identified in the drawings by size and type number. For example, a callout in the drawings of "30" VBF, Type 200" refers to 30-inch Type 200 valve in these

specifications, which is a 30-inch rubber-seated butterfly valve. All bolts, washers and nuts shall be Type 316 stainless steel, unless specified otherwise.

D. In addition, valves are further described by a suffix letter on the type number:

Suffix Letter	Description
L	Limit switches at the fully open and/or fully closed positions
M	Motorized actuator

E. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

F. Factory Finishing:

1. Epoxy Lining and Coating:

   a. Linings and coatings shall be in accordance with AWWA C550, as applicable, unless otherwise specified.
   b. Linings and coatings shall be either two-part liquid material or heat-activated (fusion) material. Only heat-activated material is acceptable if specified as "fusion" or "fusion bonded" epoxy.
   c. Linings and coatings shall be a minimum of 7-mil dry film thickness except where limited by valve operating tolerances.

G. Materials

1. All wetted materials shall be NSF 61 approved. Manufacturer's shall submit an affidavit with the product literature indicating NSF 61 approval, in accordance with Rule 62-555.320(3) Florida Administrative Code.
2. Brass and bronze valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
3. Approved alloys are of the following ASTM designations:

   a. B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
   b. Stainless steel Alloy 18-8 may be substituted for bronze.

2.02 VALVE ACTUATORS

A. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

C. Provide 2-inch AWWA operating nuts for buried and submerged valves. Provide 2-inch AWWA operating nuts with the handwheels for manually actuated valves between 12 inches and 30 inches for use with a portable electric valve actuator.

D. Provide enclosed gear actuators on plug valves 6 inches and larger, unless electric valve actuators are shown in the drawings. Gear actuators for valves between 12 inches and 30 inches shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.

E. Design gear actuators assuming that the differential pressure across the plug or disc is equal to the test pressure of the connecting piping unless otherwise required in the detailed valve specifications.

F. Gear actuators for plug valve shall conform to the following:

1. Worm gears shall be constructed in accordance AWWA C517 and shall be IP68 rated. Actuators shall be enclosed in a ductile iron housing with outboard seals to protect the bearings and other internal components. The actuator shaft and the quadrant shall be supported on permanently angular contact bearings. Input shaft and fasteners shall be made of stainless steel. Gears shall be efficiency optimized 3 stage gear reduction type.

2. Gear actuators shall include:

    a. Stainless steel removable and repositionable drive sleeve.
    b. Amercoat 880 glass flake paint, suitable for corrosive or heavy wear environment.
    c. Angular contact bearings to support the worm shaft.
    d. 450 Ft pounds of input torque.
    e. Adjustable travel stops.
    f. Ductile iron gear case.
    g. 316 Stainless Steel position indicator.
    h. 431 Stainless Steel input shaft machined from one solid piece of metal.

3. Externally adjustable open and closed position stops shall be provided. The adjustable closed position stop shall be used to set closing torque and provide adjustment to compensate for change in pressure differential or flow direction.

4. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuators shall be 90% grease filled. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals.

5. Gears shall incorporate the use of a Rotorlok Device for backwinding protection to prevent undesired reverse rotation of the gear train at the extents (i.e. fully closed position) of travel when holding a residual applied torque.

6. Buried valves shall incorporate the use of an Aunspach Model D87 Torq master overtorq protector. Sheer force shall be 450ft lbs.

7. Gears shall have a two year warranty from date of shipment and shall have a metal tag containing a serial number, ratio; number of turns shall be riveted to the gear for future identification. Gears shall be Rotork Model IW-RL-OC-RAW.

8. Manual operators shall be provided with completely enclosed mounting brackets or adapters. The operators shall be equipped with adjustable stops to prevent over-travel in both the open and closed position with standard 2-inch square operating nuts with skirts as listed elsewhere herein, or with handwheel if for above ground service. All plug valves shall open by turning the operating nut or handwheel counterclockwise. Orient operators with horizontal plug shafts such that the plug rotates upward upon opening.

9. All operator components between the operating nut and the adjustable stops shall be designed to withstand, without damage, an input torque of 300 ft. lbs.

G. Manufacturer's design shall be tested for leakage at the specified design pressure and Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

H. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

I. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

J. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

K. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

L. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.03 VALVE TAGGING AND IDENTIFICATION

A. Provide identifying valve tags per Section 15075.

2.04 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors and above ground, shall be Type 316 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

B. Bolts and nuts for buried or submerged Class 150 flanges and Class 150 flanges located outdoors above ground or in vaults and structures shall be Type 316 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

C. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B7.

D. Fit shall be Classes 2A and 2B per ASME B1.1 when connecting to cast-iron valves having body bolt holes.

E. Bolts used in buried flanges and flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H). Buried flanges shall be wrapped in cold applied wax tape, Trenton Wax-Tape #1, Denso Densyl Tape, or Equal.

F. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.05 GASKETS FOR FLANGES

A. Gaskets shall be full face, 1/8-inch thick, Buna-N having a hardness of 55 to 65 durometer. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Provide Garlock Style 9122 or equal.

B. All gaskets for potable water use shall comply with NSF 61.

2.06 LIMIT SWITCHES FOR CHECK VALVES

A. For check valves denoted with the suffix “L”, provide oil tight position limit switches for indication of open position of check valves. Provide single-pole double-throw

contacts rated for 3 amperes break, minimum, at 120-volt a-c, 35% power factor. Provide an adjustable mounting bracket to permit the actuation point to be field adjustable at any point of the valve's travel. Switch to be Square D, Allen-Bradley, or equal.

2.07 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09900. Apply the specified prime and intermediate coat at the place of manufacture. Finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.

B. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09900. Apply lining at the place of manufacture.

C. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

D. Measure the thickness of the valve interior linings per Section 09900. Repair areas having insufficient film thickness per Section 09900.

2.08 PACKING, O-RINGS, AND GASKETS

A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following non-asbestos materials:

1. Teflon.
2. Kevlar aramid fiber.
3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard", Klinger "Klingersil C4400", or equal.
4. Buna-N (nitrile).

2.09 RUBBER SEATS

A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/l in the fluid conveyed.

2.10 PRESSURE GAUGES

A. Pressure gauges shall be installed on each pump station discharge pipe as indicated in the drawings. Each pressure gauge shall be direct mounted, diaphragm (type) gauge,

liquid filled, stainless steel case, stainless steel sensing element, liquid filled, with a 4-1/2-inch diameter dial and furnished with a clear glass crystal window, shut-off (isolation) valve, 1/2-inch NPT process connections. Pressure gauges shall be weatherproofed. The face dial shall be white finished aluminum with jet-black graduations and figures. The face dial shall indicate the units of pressure measured in psi, gauges shall be provided with pressure at normal operations at the mid-range of the gauge as acceptable to the County.

B. Approved pressure gauges:

1. Ashcroft

Gauge: 35 1009SWL 02L XCG 60psi
Diaphragm seal: 25 201SS 02T XYTSECG

2. Trerice

Gauge: 700LFSS4002LA100
Diaphragm Seal: M51101SSSS
Fill and Mount Charge: D99100

3. Winter Gauges

Gauge: PFQ770 (0-60 PSI)
Top: D70950
Bottom: D70954

2.11 PLUG VALVES:

A. Plug and Seating Design for Eccentric Plug Valves:

1. Eccentric plug valves shall comply with AWWA C517 and the following. Provide a rectangular or circular plug design, with an associated rectangular or round seat. Provide bidirectional seating design. The valve shall seat with the rated pressure both upstream and downstream of the closed plug. Provide geared actuators sized for bi-directional operation.

B. The metallic portion of the plug shall be one-piece design and shall be without external reinforcing ribs which result in there being a space between the rib and the main body of the plug through which water can pass. Valves shall be repackable without any disassembly of valve or actuator. The valve shall be capable of being repacked while under the design pressure in the open position. Nowhere in the valve or actuators shall the valve shaft be exposed to iron on iron contact. Sleeve bearings shall be bronze or stainless steel in valves. Provide enclosed worm-gear actuators for valves per paragraph 2.02 A, item 6.

C. Rubber compounds shall have less than 2% volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at a temperature of 73.4°F ±2°F for 70 hours.

D. Eccentric Plug Valves:

1. Eccentric plug valves shall be non-lubricated resilient plug type. Minimum pressure rating shall be 150 psi. Bodies shall be cast iron per ASTM A126, Class B. Ends shall be flanged, Class 125 per ASME B16.1 or mechanical joint per ANSI/AWWA C111/A21.11. Plugs shall be cast iron (ASTM A126, Class B), or ductile iron (ASTM A536, Grade 65-45-12) with neoprene facing. Design plugs to seat over a pressure range of 0 to 5 psi. Valve body seats shall be Type 316 stainless steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Plug shall be of the one-piece design. Body capscrews and bolts and nuts shall be Type 316 stainless steel. Packing shall be butadiene-filled Teflon. Alternatively, U-cup seals may be provided. Provide 100% port area. Valves shall be manufactured by DeZurik, Val-Matic, or Milliken.

E. Actuators: Valves shall have gear actuators and tee wrenches, extension stems, extension bonnets, and floor stands as indicated on the Drawings. Buried valves shall have a 2-inch square operating nut. All gearing shall be enclosed in a steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. Actuator shafts shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Exposed nuts, bolts and washers shall be 316 stainless steel.

F. All valves shall open counter-clockwise. All buried valves shall be fitted with valve boxes as specified herein. One 2-inch square tee-handled valve wrench, made by the valve manufacturer, of suitable length to operate all valves within valve boxes shall be furnished for every 5 valves installed.

G. Plug valves shall be installed complete with extension stems, buried gear actuators, and 2-inch operating nuts (buried) or operating hand wheels (exposed), as required for normal operation. All valve nuts shall be brought up to 1-foot below the proposed finish grade or as shown on the drawings.

H. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body. A permanent plate shall be attached to the valve or operator indicating serial number, order number, accessories, operator model and manufacturer.

I. Valve bodies shall be cast iron ASTM A126, Class B and fusion-bonded epoxy coated.

J. Valve Testing: Plug valves shall be tested in accordance with AWWA C504. Each valve shall meet the performance, leakage, and hydrostatic tests described in AWWA C504. The leakage test shall be applied to the face of the plug tending to unseat the valve. The manufacturer shall furnish certified copies of reports covering proof-of-design testing as described in AWWA C504.

K. Motorized Operator shall be as specified in Section 11205 – Electric Motor Actuators and shall be supplied by the valve manufacturer. Motorized Operator shall communicate with plant SCADA system via Profibus Actuator Control equipment and software.

2.12 VALVE BOXES

A. All valves installed underground shall have extension stems and bonnet to the surface valve operation vault structure, floor stand and motorized operator as shown on the drawings.

B. The extension stem shall be high strength, corrosion resistant steel construction and permanently attached to the operating nut. The operating nut extension insert shall be one complete assembled unit with a self-adjusting extension stem system that fits inside a standard valve box. All moving parts of the extension stem shall be enclosed in a housing to prevent contact with the soil. A valve box-centering device designed to eliminate the shifting of the valve box against the operating nut of the valve shall be used.

C. The stem assembly shall be of a telescoping design that allows for variable adjustment length. The material shall be galvanized square steel tubing. The stem assembly shall have a built-in device that prevents the stem assembly from disengaging at its fully extended length. The extension stem must be capable of surviving a torque test to 1,000 foot-pounds without failure.

D. Extension sections shall be cast or ductile iron only.

E. Valve Operation Vaults shall be installed with a bronze identification disc as shown on the Drawings.

2.13 AIR RELEASE AND/OR VACUUM RELIEF VALVES

A. Air release/vacuum relief valves for sanitary sewer force mains shall be installed as shown on the plans. Valves shall be located in an enclosure as detailed on the Standard Detail. The valves shall be constructed with a 316 stainless steel body, cover and baffle, stainless steel float, BUNA-N or Viton seat and stainless steel trim. All other internal parts shall be corrosion resistant 316 stainless steel or non-metallic plastic materials. The valve body shall be conical in shape with a funnel shape lower body to automatically drain sewage back into the system. On flanged connections, 316 stainless steel bolts, nuts and washers are to be used along with the proper sized gasket.

B. Combination Air Valves shall be H-Tec Model 986 (SST), A.R.I. Model D-020 (SST), or approved equal.

2.14 CHECK VALVES:

A. Swing Check With Controlled Closing Using Bottom-Mounted Hydraulic Buffer:

1. Controlled closing swing check valves shall be iron body with the following materials of construction:

Description	Material	Specification
Disc or clapper seat ring	Buna-N	
Valve body seat ring	Aluminum bronze	ASTM B148
Body and cap (bonnet)	Cast iron	ASTM A126, Class B
Disc and hinge or arm	Ductile iron	ASTM A536
Shaft and hinge pin	Stainless steel	Type 303, 304, or 410
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Buffer rod	Stainless steel	ASTM A582: Type 303, 304, or 410

2. Ends shall be flanged, Class 125, ASME B16.1. Minimum valve working pressure shall be 150 psi. Provide check valves with outside lever and weight.

3. The cushion swing check valve shall conform to AWWA C508. Provide integral flanges (not wafer). The body shall have a flush and drain hole. The seat shall be locked in place with stainless steel lock screws and be field replaced without the use of special tools. The shaft shall be one piece, extending through both sides of the body with a lever and weight mounted on each side. The disc shall utilize a double clevis hinge to prevent disc tipping and be connected to a disc arm. The disc arm assembly shall be suspended from the shaft. The valve shall have a bottom hydraulic buffer to permit free open but positive non-slam control closure of the disc. The hydraulic buffer shall make contact with the disc during the last 10% of closure to instantly control the valve disc until shutoff. The last 10% of closure shall be externally adjustable and variable. The line media to the buffer must be separated by a combination pressure sensing, oil/water separator device to protect the buffer cylinder against corrosion from the main line media. The hydraulic buffer assembly shall be removable from valve without need to remove the entire valve from the pipeline.

4. Cylinders shall be of tie-rod or bolted-flange construction and shall have a pressure rating of 150 psi minimum, as determined by National Fluid Power Association Specification T3.6.8. Cylinder mounting dimensions shall comply with National Fluid Power Association Specification T3.6.8 regarding mounting and physical dimensions with slight modifications where required to

adapt to the valve cylinder mounting. Construction materials shall incorporate a design factor of safety of 4:1 based on tensile strength.

5. Cylinder barrels, heads, and caps shall be AISI Type 316 stainless steel, or bronze. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

6. The shop drawing submittal shall include a detail showing how the hinge pin extends through the valve body. Show packing gland, hinge pin gland, cap, and other pieces utilized.

7. Valve shall be APCO Series 6000B or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Valves shall be installed in accordance with manufacturer's installation instructions and with the details shown on the Drawings. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

2. Valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain. Valves shall be installed such that their weight is not borne by pumps or equipment that are not designed to support the weight of the valve.

3. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat: Check and adjust all valves for smooth operation.

4. After installation, all valves and appurtenances shall be tested at least 2 hours at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the Engineer.

5. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the drawings that are in masonry

floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of these structures. In addition, install hangers or supports at all changes in direction at the spacing requirements stated in Section 15126 Pipe Hangers and Supports.

6. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections in Division 15.

7. Flanged joints shall be made with 316 stainless steel bolts, nuts and washers, unless otherwise noted. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts. All exposed bolts shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint, Tnemec Series 46 – 465, Carboline Bitumastic 50, or equal.

8. Clean iron flanges by wire brushing before installing flanged valves. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

9. Floor Box and Stem: Steel extension length shall locate operating nut in floor box.

10. Valves shall be tested hydrostatically, concurrently with the pipeline in which they are installed. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure test(s). If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.

11. Expansion and Contraction Provisions

    a. Rigidly support all piping with adequate provisions for expansion and contraction.
    b. Firmly anchor horizontal runs over 50 feet in length at the midpoint of the runs to force expansion equally toward the ends.

12. Support valves in accordance with Section 15126.

13. Pipe sleeves and wall castings shall be provided at the locations called for on the Drawings. These units shall be as detailed and of the material as noted on the Drawings. They shall be accurately set in the concrete or masonry to the elevations shown. All wall sleeves and castings required in the walls shall be in place when the wails are poured. Ends of all wall castings and wall sleeves shall be of a type consistent with the piping to be connected to them.

14. Link seals for wall sleeves shall be installed in strict accordance with the manufacturer's printed installation instructions. For watertight applications in

tanks or treatment units, the link seal installation shall be tested hydrostatically for leaks at the same time as the tank or treatment unit. Any leaks that occur during the test period shall be repaired by checking the link seals for proper installation and replacement of unit(s) found to be defective at no additional cost to the Owner.

15. Tie rods shall be installed in strict accordance with the manufacturer's written installation requirements. Unless otherwise indicated on the Drawings, the size and number of tie rods for a joint or installation shall be as recommended by the manufacturer's design chart for a working pressure of 150 psi.

16. Piping, fittings, and the air release valves shall be installed as shown on the Drawings. The air release valve assemblies shall be installed so that they are properly supported and such that they will function properly and freely and no parts shall be strained. Air release valve testing shall be performed during the testing of pipeline which air release is attached.

B. Joints

1. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

C. Installing Exposed Valves

1. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

2. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3. Following installation, all above-ground valves shall be painted in accordance with the painting system specified in Section 09900.

D. Installing Eccentric Plug Valves

1. Install such that the rotation of the plug is about a horizontal axis.

2. Install such that the plug stores in the top when the valve is open.

3. Orient the valve such that the seat is opposite the high-pressure side.

4. Valves shall be carefully inspected, opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Plug valves shall have the plug shaft installed vertically with the plug rotating upward to the side of the valve. Any valve that does not operate correctly shall be removed and replaced. Seats shall face in the direction as recommended by the manufacturer.

5. Valve actuator vaults shall centered or aligned with the operating nuts/extended bonnet of the valves. Extended bonnet shall extend into a concrete vault for direct connection to motorized operator/actuator as shown on the plans. The Contractor shall coordinate precast concrete actuator vault with supplier of plug valve and verify all dimensions as needed to insure proper fit and clearance in the vault.

E. Installing Extension Stem Guide Brackets

1. Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

F. Mounting Gear Actuators

1. The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

G. Field Installation of Gear Actuator

1. Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

H. Valve Leakage Testing

1. Test both sides of valves for leakage at the same time that the connecting pipelines are tested. See Section 02660 and 02661 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

I. Valve Field Testing

1. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding.

Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

2. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel- operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

SECTION 15126
PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals and install a complete system of pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting non-buried piping as shown on the Drawings and as specified herein.

B. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system.

1.02 SUBMITTALS

A. Submit, in accordance with the Contract Documents, complete sets of shop drawings of all items to be furnished under this Section. Submittals shall include complete layouts, schedules, location plans and complete total bill of materials for all pipe support systems.

B. Submittals shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support. Provide detailed information on anti-seize compound.

C. Submittals shall include complete piping drawings as submitted for each piping submittal indicating type of hanger and/or support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.

D. Types and locations of pipe hangers and/or supports shall also be shown on the piping layouts for each piping submittal as specified in the respective Contract Document pipe sections. Service conditions for each piping system, including service temperatures, and operating and test pressures, are tabulated in the piping sections.

E. Submit complete design data for pipe support systems to show conformance with this Section.

F. Support System Design

1. Engage the services of an independent registered professional engineer in the state of Florida ordinarily engaged in the business of pipe support systems analysis, to analyze system piping and service conditions and to develop a detailed support system, specific to the piping material, pipe joints, valves and piping appurtenances proposed for use.

2. The proposed support system engineer shall have at least five years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe support and in the use of commercial pipe stress software programs. Provide a detailed resume, including references from projects within the past five years. The use of a support systems engineer shall be subject to the approval of the Engineer.

G. The proposed systems engineer shall attend a conference with the Engineer, scheduled prior to any support systems design.

1. The support system design shall include:

   a. Criteria by piping system.
   b. Summary of Contractor-selected related components including joints, class, valves appurtenances, etc, and commercial supports and especially including pipe materials.
   c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to AutoPIPE.

      i. Each system shall be presented in an isometric graphic and shall show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints and expansion/flexible joints.

   d. Submit a draft report to the Engineer for approval.
   e. After the work is installed, but before it is filled for start-up and testing, the support system design engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
   f. Submit a report, including all field modifications and including all certificates.
   g. The report shall bear the stamp of a registered professional engineer in the state of Florida and shall be subject to the approval of the Engineer.

2. All aspects of the analysis and design shall comply with the provisions of ANSI B31.1 and the referenced standards.

3. Support arrangements shall be coordinated to eliminate interference with similar systems to be installed under HVAC, Plumbing and Electrical; to

account for structural expansion joints and to maintain access for both personnel and for the removal of equipment. Support systems shall not include the use of monorail or bridge crane support. Nor shall they rely on the horizontal structural struts.

4. Commercial hardware and custom supports shall comply with the requirements of this Section.

5. Expansion joints shall comply with the provisions of Division 15.

6. Prepare for and attend a post-analysis review and presentation, after the Engineer's review of the report. Revise per the comments and issue as FINAL REPORT.

1.03 REFERENCE STANDARDS

A. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

B. American Society for Testing and Materials (ASTM)

1. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

2. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

3. ASTM A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.

4. ASTM A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

C. American National Standards Institute (ANSI)

1. ANSI B31.1 - Power Piping.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. All hangers, supports and appurtenances shall conform to the latest applicable requirements of ANSI B31.1, except as supplemented or modified by the requirements of this Section.

B. All hangers, supports and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting

equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-ft of waterfilled pipe being supported.

C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

1.05 DELIVERY, STORAGE AND HANDLING

A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.

B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All of the equipment specified herein is intended to support the various types of pipe and piping systems shown on the Drawings. It shall be the responsibility of the Contractor to develop final details and any details associated with special conditions not already covered to meet the system conditions (in particular system temperatures and pressures) specified in the Division 15 Pipe Sections.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces and all probable external forces such as equipment, pipe and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Division 5 and shall be furnished and installed under this Section.

C. The Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

D. Where flexible couplings are required at equipment, tanks, etc, the end opposite to the piece of equipment, tank, etc, shall be rigidly supported, to prevent transfer of force systems to the equipment. No fixed or restraining supports shall be installed between a flexible coupling and the piece of equipment.

E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

F. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be Type 316 stainless steel. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper plated or shall have a 1/16-in plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be of Type 316 stainless steel.

G. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.

H. All uninsulated non-metallic piping such as PVC, CPVC, etc, shall be protected from local stress concentrations at each support point. Protection shall be provided by Type 316 stainless steel protection shields or other method as approved by the Engineer. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360 degree arc support is required, such as U bolts, protection shields shall be provided for the entire pipe circumference. Protection shields shall have an 18 gauge minimum thickness, not be less than 12-in in length and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2-in wide.

I. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location as specified under respective pipe insulation. Provide protection shields as specified in at each support location.

J. Where pipe hangers and supports come in contact with copper piping provide protection from galvanic corrosion by; wrapping pipe with 1/16-in thick neoprene sheet material and Type 316 stainless steel protection shield, or copper plated or PVC coated hangers and supports. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields, similar to above methods.

K. Pipe supports shall be provided as follows:

1. Cast iron and ductile iron, steel and stainless steel piping shall be supported at a maximum support spacing of 10-ft with a minimum of one support per pipe section at the joints.

2. Insofar as is possible, floor supports shall be given preference. Typical concrete supports are shown on the structural drawings. Base elbow and base tees shall be used where possible.

3. Support spacing for stainless steel piping 2-in and smaller diameter and copper tubing shall not exceed 5-ft.

4. For all stainless steel piping, provide neoprene isolators between the pipe and support components.

5. Maximum spacing of hangers and supports shall be as follows.

	Support Spacing, Feet			
Nominal Pipe Diameter, (inches)	Copper	Ductile Iron	Plastic	Steel
1/2	4.0	N/A	3.5	4.5
3/4	4.0	N/A	4.0	5.0
1	4.0	N/A	4.5	5.5
1-1/4	6.0	N/A	5.0	6.5
1-1/2	6.0	N/A	5.0	7.5
2	6.0	N/A	5.5	8.0
2-1/2	6.0	N/A	5.5	8.0
3	6.0	N/A	6.0	8.0
4	N/A	8.0	7.0	8.0
Larger than 4	N/A	See Note	N/A	See Note

6. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC piping shall be supported as recommended by the piping manufacturer or as listed in the table above.

7. All vertical pipes shall be supported at each floor or at intervals of not more than 12-ft by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

8. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.

9. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from other piping or from metal stairs, ladders and walkways, unless specifically directed or authorized by the Engineer.

10. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

11. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

L. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued Type 316 stainless steel components, conforming to the requirements of MSS-SP-58 and -69; and shall be as manufactured by Anvil International, Bergen

Pipe Supports, Inc. and Unistrut or an approved equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.

M. Any required pipe supports for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural Type 316 stainless steel shapes, concrete and anchor hardware similar to items previously specified herein and shall be subject to the approval of the Engineer.

N. All anchor bolts, assembly bolts, hanger rods, washers, nuts, clips, and other hardware items for equipment installation shall be Type 316 stainless steel. All bolt diameters and lengths shall be as required by the equipment manufacturer. All anchor bolts shall be epoxy adhesive type anchor bolts. All threads for nuts and bolts shall be in accordance with ANSI B1.1, Class 2A fit, coarse thread series. All nuts, bolts, and washers used for anchors, equipment assembly, hanger rods, etc., shall be Type 316 stainless steel, Alloy Group 2, Condition "A" in accordance with ASTM F593 for bolts and studs and ASTM F594 for nuts. All washers, clips, and other hardware shall be Type 316 stainless steel. Brinnell hardness separation between all bolts and nuts shall be sufficient to prevent galling during installation.

O. Hanger rods shall be Type 316 stainless steel. The strength of the rod shall be based on its root diameter. Hanger rods shall be attached to concrete structures using concrete inserts or continuous concrete inserts. Inserts shall be stainless steel. Where necessary and approved by the Engineer, epoxy-type anchors shall be used for attaching to concrete structures.

2.02 SINGLE PIPE HANGERS

A. Single pipes shall be supported by hangers suspended by hanger rods from structural Type 316 stainless steel members, concrete ceilings, bottom of trapeze hangers and wall mounted Type 316 stainless steel angle brackets.

B. Except as otherwise specified herein, pipe hangers shall be Type 316 stainless steel, of the adjustable clevis type similar to Anvil, Figure No. 26055 and 59055 as required.

C. Where pipes are near walls, beams, columns, etc, and located an excessive distance from ceilings or underside of beams, welded Type 316 stainless steel wall brackets shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.03 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets.

Trapeze hangers shall consist of structural Type 316 stainless steel channel supported from threaded rod or attached to concrete walls, columns or structural steel support members as required to meet the intent of this Section. Channel shall be similar to rods, concrete inserts, "C" clamps, beam clamps, welded beam attachments and expansion shields shall be as specified in Paragraph 2.02 above.

B. Except as otherwise specified herein pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs as required. Material of construction shall be Type 316 stainless steel. Chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.04 SINGLE AND MULTIPLE PIPE SUPPORTS

A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods as shown on the Drawings and as specified herein.

B. Pipes 3-in in diameter and larger shall be supported by adjustable stanchions. Stanchions shall provide at least 4-in adjustment and be flange mounted to floor.

C. Pipes less than 3-in in diameter shall be held in position by supports fabricated from steel "C" channel, welded post base. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe. Wherever possible, supports shall be fastened to nearby walls or other structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support.

D. Where shown on the Drawings, pipe shall be supported using concrete anchor posts. Pipe shall be securely fastened to the posts using suitable metal straps as required and as approved.

2.05 WALL SUPPORTED PIPES

A. Single or multiple pipes located adjacent to walls, columns or other structural members, whenever deemed necessary, shall be supported using welded Type 316 stainless steel wall brackets "C" channel with Type 316 stainless steel brackets similar to Unistrut pipe clamps. All members shall be securely fastened to wall, column, etc, using double expansion shields or other method as approved by the Engineer. Additional wall bearing plates shall be provided where required.

B. Pipe shall be attached to supports using methods specified herein to meet the intent of this Section.

2.06 BASE ANCHOR SUPPORT

A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base bend support shall be installed at the bend to carry the load. The base bend shall be fastened to the floor, pipe stanchion, or concrete pedestal using epoxy-type Type 316 stainless steel anchor bolts or other method as approved by the Engineer.

B. Where shown on the Drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to the concrete supports with suitable Type 316 stainless steel bands as required and approved by the Engineer. A felt insert shall be used to isolate the piping from the poured concrete.

2.07 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut system as specified in Paragraph 2.08 below, they shall be supported in one of the following methods.

1. For pipes 1/4-in to 2-in in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported. The hanger ring shall be steel or PVC clad depending on the supported pipe.
2. For pipes equal to or greater than 2-in in diameter extended pipe clamps may be used. The hanger shall be attached to concrete structures using double expansion shields, or to steel support members using welding lugs.
3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be Type 316 stainless steel. Copper clad or PVC coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.
4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12-ft shall be supported by base elbows/tees, clamps, brackets, wall rests and pipe collars, all located as required to ensure a rigid installation.

B. SPECIAL SUPPORTS

1. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 10-ft. The support system shall consist of a framework suitably anchored to floors, ceilings or roofs.
2. Vertical and horizontal supporting members shall be U shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. All components shall be of Type 316 stainless steel.

3. For piping 3-in and smaller, the framework shall be as manufactured by the Unistrut Corporation or equal. For piping larger than 3-in, the support frame shall be fabricated from structural Type 316 stainless steel shapes and secured through the use of Type 316 stainless steel epoxy-type anchors.

4. The assemblies shall be furnished complete with all nuts, bolts and fittings required for a complete assembly including end caps for all unistrut type members.

5. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.

6. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural Type 316 stainless steel shapes in accordance with applicable provisions of Section 05500, or unistrut-type frame; have anchor hardware similar to items previously specified herein, shall meet the minimum requirements listed below and be subject to the approval of the Engineer.

7. Pipe support systems shall meet all requirements of this Section and all related Sections.

C. Complete design details of the pipe support system and system components shall be submitted for review and approval as specified in PART 1. No hanger or support shall be installed without the written approval of the Engineer.

1. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.08 SURFACE PREPARATION AND SHOP PRIME PAINTING

A. All surfaces shall be prepared and shop painted as part of the work of this Section. Surface preparation and shop painting shall be as specified in Section 09901.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Proceed with the installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.

B. The installation of pipe support systems shall in no way interfere with the operation of the overhead bridge cranes, monorails, access hatches, etc.

C. The installed systems shall not interfere with maintenance and operational access to any equipment installed under this Section, or any other related Section.

D. All pipes horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the Engineer.

E. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.

F. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings (within four pipe diameters) and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

G. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

H. Continuous metal inserts shall be embedded flush with the concrete surface.

I. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no additional cost to the Owner.

J. Contractor shall coordinate the installation of all pipe supports to existing facility areas with details shown in the Drawings, or submit alternatives for review and approval by the Engineer prior to fabrication or installation.

3.02 TESTING

A. All pipe support systems shall be tested for compliance with this Section. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under this Section to the satisfaction of the Engineer.

END OF SECTION

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SECTION 15140
HVAC AND PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe, duct, and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.02 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish hanger and support inserts sleeves to Section for placement into formwork

1.03 SUBMITTALS

A. Submit shop drawings and product data for all items listed under this section.

B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 2 to 4 inches: Stainless steel, adjustable, clevis.

B. Multiple or Trapeze Hangers: Stainless steel channels with welded spacers and hanger rods; Stainless steel roll and stand for hot pipe sizes 6 inches and over.

C. Wall Support for Pipe Sizes to 3 Inches: Stainless steel hook.

D. Wall Support for Pipe Sizes 4 Inches and Over: Welded stainless steel bracket and clamp; adjustable stainless steel yoke and roll for hot pipe sizes 6 inches and over.

E. Vertical Support: Stainless steel riser clamp.

F. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe

G. Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

I. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long per pipe support.

J. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.

K. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90 degree segments, 12 inch minimum length, block thickness same as insulation thickness.

L. Shields for Vertical Copper Pipe Risers: Sheet lead.

2.02 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 FLASHING

A. Metal Flashing: galvanized steel.

B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.

C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.04 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel; plastic inserts or Schedule 40 steel.

B. Sleeves for Pipes Through Non-fire Rated Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gage galvanized steel.

C. Sleeves through beams shall be Schedule 40 steel; only in locations approved by the Structural Engineer.

D. Sleeves for Round Ductwork: Form with galvanized steel.

E. Flanges shall be 20 gage galvanized steel.

2.05 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

2.06 FINISH

A. Prime coat steel hangers and supports.

PART 3 - EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
1/2 to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inch	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"
PVC (All Sizes)	6'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at joints	5/8"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. All hangers, hanger rods, supports, etc. shall be double nutted.

3.02 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete type.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.03 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor, and mop sink drains watertight to adjacent materials.

E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.04 SLEEVES

A. Extend sleeves through floors one inch above finished floor level. Calk sleeves full depth and provide floor plate.

B. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

SECTION 15141
DISINFECTION OF POTABLE WATER PIPELINES

PART 1 - GENERAL

1.01 GENERAL

A. Description: This section includes materials and procedures for disinfection of water mains by the continuous feed method. Disinfect piping in accordance with AWWA C651, the Orange County Utilities Standards and Construction Specifications Manual and this specification.

B. Job Conditions

1. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility and shall be done in a legal manner.

2. Only potable water shall be used for potable water main disinfection procedures.

3. A request for use of potable water from existing water mains for flushing or disinfection shall be submitted to the Owner 72 hours in advance of the proposed procedures.

4. Chemicals for use in disinfection of potable water mains shall be certified as conforming to NSF 60.

PART 2 - MATERIALS

2.01 DISINFECTION MATERIALS

A. Dry Calcium Hypochlorite: High test granular calcium hypochlorite (HTH) used as the chlorinating agent shall contain between 65 to 70 percent of available chlorine by weight. The dry calcium hypochlorite shall be stored in a cool, dry, and dark environment, prior to its use, to minimize deterioration.

B. Sodium Hypochlorite Solution: Sodium hypochlorite solution used as the chlorinating agent shall be obtained fresh and shall have a minimum concentration of 10 percent by weight available chlorine. To minimize degradation, sodium hypochlorite solution shall be stored in opaque, closed polypropylene containers, isolated from contact with any metals and out of direct sunlight. The solution shall be stored in covered (as dark as possible) areas and as cool as possible, prior to use on the jobsite. Sodium hypochlorite solution is highly corrosive. Therefore the Contractor shall use this chlorinating agent with caution and per the recommendations of the sodium hypochlorite solution manufacturer.

C. Chlorine Residual Test Kit: To measure chlorine concentration, provide and use a mid-range total chlorine test kit with a digital titrator, using sodium thiosulfate as the titrant. Maintain fresh reagents for the test kit and maintain all components of the kit

in good working order available for immediate testing of chlorine residuals at the point of sampling.

PART 3 - EXECUTION

3.01 PIPELINE CLEANING AND FLUSHING

A. Prior to pressure testing and disinfection, all pipelines shall be hydraulically cleaned utilizing multiple pass operations with a polypropylene swabbing device, also referred to as “pigging” operations, of the piping system, followed by full bore flushing. Cleaning and flushing prior to pressure testing and disinfection shall be in accordance with Section 15144 – Pressure Testing of Piping.

3.02 FINAL DISINFECTION OF POTABLE WATER PIPELINES

A. Before any portion of a new potable water piping system is to be placed into service, it shall be disinfected; and its disinfection shall be demonstrated by bacteriological testing conducted in accordance with "Standard Methods for Examination of Water and Sewage" for the coli-aerogenes group, by a commercial laboratory approved by the FDEP, and acceptable to the Engineer and the Owner, or may be completed by the Orange County Health Department.

B. All pipe, fittings, valves, and all other appurtenances installed for potable water pipelines shall be disinfected prior to being placed in service. Disinfection procedures shall be approved by the Engineer and the Owner and shall be in conformance with ANSI/AWWA C651, latest revision. Contractor shall comply with all General Notes on the Drawings and special requirements that are included with the FDEP permit related to disinfection and clearance of new potable water mains.

C. Pipe subjected to contaminating materials shall be treated in a manner approved by the Engineer and the Owner. Should such treatment fail to remove contaminants from the pipe, contaminated sections of pipe shall be replaced with new uncontaminated pipe.

D. Disinfection of a completed potable water pipeline shall be accomplished using the following procedure:

1. All water piping, fittings, valves, and appurtenances shall be disinfected with a chlorine solution with a sufficient concentration such that the initial chlorine concentration in the water line shall be a minimum of 50 mg/l available chlorine, at any point in the line, and that a chlorine residual of not less than 25 mg/l remains in the water, at any point in the line, after standing 24 hours in the pipeline.

2. Chlorine may be applied as a liquid 10% sodium hypochlorite solution, or as a mixture of water and high-test calcium hypochlorite. The Contractor shall assume responsibility for safe handling of chlorinating agents and shall meet requirements of OSHA and other regulatory agencies for safe handling of chlorinating agents.

3. The dry high test calcium hypochlorite (HTH) may be used to make up a high concentration chlorine solution which will be used for disinfection. The hypochlorite solution to be used for disinfection should be mixed based on the HTH manufacturer's recommendations. Under no circumstances will undiluted, dry calcium hypochlorite be placed in the pipeline to be disinfected.

4. The chlorine solution, either 10% sodium hypochlorite or a calcium hypochlorite mixed solution, shall be metered into the pipeline with a small metering pump.

5. Disinfection of Valves, Blind Flanges and Appurtenances: Swab exposed faces of valves and blind flanges with a 2% sodium hypochlorite solution prior to bolting flanges in place.

6. Disinfection of Tapping Sleeves, Tapping Valves and Line Stops: Flush exterior of pipe with potable water after removal of existing coating. Swab exterior of pipe and interior of tapping, sleeve, tapping valve and line stop valve with a 2% sodium hypochlorite solution. Disinfect per AWWA C651, Section 4.8. After completion of tapping and line stopping, swab interior of pipe, valves, and faces of flanges to be connected to bypass piping with a 2% sodium hypochlorite solution.

7. Disinfection of Connections to Existing Pipelines: Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 2% sodium hypochlorite solution. Following disinfection procedures, flush with potable water again until water is free of chlorine odor

8. Water from the existing, in-service water line shall be made to flow at a constant, slow rate into the water line to be disinfected. A jumper connection from the existing potable water main to the new water main, utilizing a reduced pressure principle backflow preventer approved by the Owner, shall be used to obtain water for disinfection. Chlorine solution shall be injected or pumped at a regulated rate into the new main, at a point not more than 10 feet downstream from the beginning of the new water main. The method of tapping the water main for the chlorine injection point and the location of the tap shall be approved by the Engineer and the Owner.

9. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

10. Chlorine solution shall be circulated in the water main by opening the water control valve and systematically manipulating valves. Fire hydrants and blowoffs.

11. Water service lines, if applicable, shall be disinfected in a similar manner as that for water mains, including corrective measures, by methods acceptable to the Engineer and the Owner.

12. Chlorine solution shall remain in the water lines for no less than 24 hours, but longer than 24 hours, if directed by the Engineer or the Owner.

13. Extreme care shall be exercised at all times to prevent concentrated chlorine solution from entering existing water mains.

E. After 24 hours, the free residual chlorine concentration in the water line at the pipe extremity sample points shall be checked to make sure the concentration is at least 25 mg/l; if not, the water lines shall be re-disinfected as described above.

F. Final flushing of lines with potable water may proceed after 24 hours, provided the free residual chlorine analysis is satisfactory. Flushing shall be continued until a chlorine residual test shows that the pipelines contain only the normal chlorine residual in the feed potable water. Prior to flushing water with high chlorine concentrations, obtain approvals from the Engineer and the Owner as to the methods and locations of discharge.

G. Following disinfection and thorough flushing of the water lines, as specified herein, the Contractor shall furnish all labor and materials required to obtain samples of water from established points of the water line in suitable sterilized containers obtained from the County Health Department or an analytical laboratory approved by the Owner. Two (2) series of successive samples shall be obtained at each established sampling point in accordance with AWWA C651, Section 5.1, to obtain a bacteriological quality test result to demonstrate the absence of coliform bacteria in each separate section of the pipeline being tested after chlorination and refilling. Each test series will require two samples at each sampling point. The period between each series of samples shall be a minimum of 24 hours. Samples shall be delivered by the Contractor to the County Health Department or the approved analytical laboratory for bacteriological examination within 6 hours of obtaining the samples. Samples shall be collected in conformance with the County Health Department standards and lab testing schedule. Prior to collecting samples, the Contractor shall notify the Engineer and the Owner, who will have representatives present during bacteriological sample collection.

H. Collect at least one set of samples from every 1,000 feet of the new water main and line stopping insertion point, plus one set from the end of the line and at least one set from each branch. At each connection to an existing pipeline, take two additional samples.

I. Bacteriological test results will be available approximately 48 to 72 hours after samples are submitted. If tests results are unsatisfactory, the Contractor shall immediately re-chlorinate and retest the water lines as described above and proceed with such corrective measures as are necessary to secure disinfected lines. All services shall be re-chlorinated if the lines are re-chlorinated. The water lines shall be re-disinfected and re-tested, at the Contractor's expense, until approved by the Engineer, the Owner, and the County Health Department or FDEP as applicable.

J. At satisfactory completion of the bacteriological test requirements, potable water pipelines shall be placed into service in a manner approved by the Engineer and the Owner. Complete the pipeline where temporary disinfection or test facilities were

installed. Potable water mains shall not be placed into service until all requirements of the State and County Public Health Departments are met, and the Letter of Clearance is obtained from the Florida Department of Environmental Protection (FDEP). Contractor shall notify the Engineer and the Owner at least 72 hours prior to placing potable water pipelines into service.

3.03 OBTAINING WATER FOR FLUSHING, TESTING AND DISINFECTION

A. The potable water supply shall be protected with an air gap or a reduced pressure principle backflow preventer approved by the Owner, to obtain potable water used for testing and flushing. Only potable water shall be use for flushing and pressure testing of potable water pipelines.

B. To obtain potable water service during construction, the Contractor shall be required to install a temporary water meter. The piping, fittings, backflow preventer, and appurtenances required for the temporary construction water service shall be supplied by the Contractor.

C. The Contractor shall coordinate with the Owner for temporary construction water service connection, usage, and flushing.

END OF SECTION

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SECTION 15144
PRESSURE TESTING OF PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: This section specifies the leakage testing requirements for plant piping.

B. Test Pressures: Test pressures for the various services and types of piping are shown in Table 15144-1, at the end of this Section.

C. Testing Records:

1. Provide a record of each piping installation during the testing on the Pressure Test Form provided in Table 15144-2, at the end of this Section. These records shall include:

   a. Date of test.
   b. Identification of pipeline tested or retested.
   c. Identification of pipeline material.
   d. Identification of pipe specification.
   e. Test fluid.
   f. Test pressure.
   g. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
   h. Certification by Contractor that the leakage rate measured conformed to the Specifications.
   i. Signature of Owner's representative witnessing pipe test.

2. Submit five (5) copies of the test records to the Engineer's representative upon completion of the testing.

PART 2 - PRODUCTS

2.01 GENERAL

A. Testing fluid shall be potable water for all hydrostatic tests unless pneumatic test is indicated.

2.02 MATERIALS AND EQUIPMENT

A. Provide pressure gauges, pipes, bulkheads, pumps, and meters to perform the hydrostatic and pneumatic testing.

PART 3 - EXECUTION

3.01 PIPELINE CLEANING AND FLUSHING

A. Before conducting hydrostatic testing, flush pipes with water to remove dirt and debris. For pneumatic tests, blow dry air or nitrogen gas through the pipes. Flushing of potable water, process water, reclaimed water, wastewater and chemical feed pipelines shall be in accordance with the following.

B. Prior to pressure testing and disinfection, all pipelines shall be hydraulically cleaned utilizing multiple pass operations with a polypropylene swabbing device, also referred to as "pigging" operations, of the piping system. Between successive operations, the pig diameter shall increase and the pig material shall stiffen. Poly pigs shall be blown elastomer polyurethane with open cell-type construction having a material density suitable for use within the system to be cleaned. Pipe cleaning poly pigs shall have a parabolic nose, crisscross coated with a resilient peripheral surface that engages the inner cylindrical wall of the pipe to maintain a sliding seal. Pipe cleaning poly pigs shall be able to pass through a reduction of a minimum of sixty-five percent (65%) of the original cross-sectional area of the pipe and shall be bi-directional. Cleaning procedures shall conform to the Poly Pig manufacturer's recommendations.

C. The Contractor shall provide pig launching and retrieval points for the pipeline cleaning, as required. The poly pig cleaning operation shall be completed prior to connection of the new potable water main or reclaimed water main to an existing potable water main or reclaimed water main

D. Passage of cleaning poly pigs through the system shall be constantly monitored, controlled, and all poly pigs entered into the system shall be individually marked and identified so that the exiting of the poly pigs from the system can be confirmed.

E. Cleaning of the system shall be done in conjunction with the initial filling of the system for its hydrostatic test.

F. The line to be cleaned shall only be connected to an existing potable water distribution system at a single connection point. Only the Owner's operating personnel shall operate the supply valve from the existing potable water distribution system.

G. The Contractor shall locate and open all new in-line valves beyond the point of connection on the pipeline to be cleaned during the swabbing operation.

H. At the receiving or exit point for the poly pig, the Contractor is responsible for creating a safe environment for collection of debris, water, and the swab. The Contractor shall provide for the protection of surrounding personnel and property and the safe retrieval of the poly pig.

I. Temporary blowoffs may be required for the purpose of flushing mains. Temporary blowoffs shall be installed as close as possible to the ends of the main being flushed. Blowoffs installed on the main shall be the same diameter as the main. Temporary blowoffs shall be removed and plugged after the main is flushed.

J. The Owner shall be notified at least 72 hours prior to pigging and flushing mains.

K. Cleaning and flushing shall be accomplished by propelling the poly pig down the pipeline to the exit point with potable water. Flushing shall continue until the water is completely clear and poly pig is retrieved.

1. Re-apply a series of individual poly pigs in varying diameters and/or densities as required, to attain proper cleanliness of pipeline.

2. Pigging speed shall range between two and five feet per second.

L. Following the pigging process for cleaning the pipeline, the length of new water main shall be final flushed with a full bore clean water flush with a flushing velocity of at least 2.5 fps. The time required for the final full bore flush shall be based on the time needed to provide two complete turnovers of the quantity of water in the pipeline based on the length and diameter of water main being flushed.

M. Blowoffs and temporary drainage piping used for flushing shall not be discharged into any gravity sewer or pumping station wetwell. The Contractor shall obtain prior approvals from the Engineer and the Owner as to the methods and locations of flushing water discharge.

N. Following the pigging and flushing process, pressure testing of the pipeline shall be completed as specified below.

3.02 HYDROSTATIC TESTING PREPARATION

A. Pipes shall be in place and anchored before commencing pressure testing. Concrete for thrust collars, if used, shall have cured at least 28 days prior to pressure testing.

B. Conduct hydrostatic and pneumatic tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.

C. Following the hydrostatic pressure testing procedure, chemical feed pipelines shall be drained of water and dried out using clean, dry air or dry nitrogen gas before introducing any chemicals to the pipelines.

D. Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, test bulkheads, special flanges, or blind flanges. After the new line has been successfully tested, remove test caps, bulheads and flanges and connect to the existing piping.

E. Conduct hydrostatic pressure tests on buried pipe after the trench has been completely backfilled. The pipe may be partially backfilled and the joints left exposed for inspection for an initial leakage test. Perform the final test, however, after completely backfilling and compacting the trench.

F. Hydrostatic Pressure Test:

1. All tests shall be made in the presence of and to the satisfaction of the Owner or Engineer and also, to the satisfaction of any local or state inspector having jurisdiction.

    a. Provide not less than three (3) days notice to the Owner, Engineer, and the authority having jurisdiction when it is proposed to make the tests.
    b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed by the Engineer.
    c. The piping systems may be tested in sections as the work progresses, but no joint or portion of the system shall be left untested.

2. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.

3. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.

3.03 INSPECTION AND TESTING

A. Hydrostatic tests shall consist of a pressure test and a leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints and valves including all service lines to the curb stops. Air testing of pressure pipes will not be permitted under any circumstance unless specifically allowed by this specification. Tests shall be made on sections not exceeding 1,000 feet or between all valves. The Contractor shall furnish all closure pieces in the pipe as required.

B. All equipment required for the hydrostatic test shall be furnished by the Contractor and shall include, but not be limited to, graduated containers, pressure gauges, testing taps and valves, hydraulic force pumps, and suitable hoses and piping. The Engineer and the Owner will monitor and approve a satisfactory test. The Contractor shall dispose of all flushing and testing water.

C. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes

only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified.

D. The maximum rate of filling the pipeline with water shall not cause the water velocity in the pipeline to exceed 1.0 fps. Filling may be facilitated by removing automatic air release valves and releasing air manually. Open all vents at high points of the piping system to purge all air while the pipeline is being filled with water. Venting during filling may also be provided by temporarily loosening flange bolts.

E. All pipe sections to be tested shall be subjected to a hydrostatic test. Pipelines shall be subjected to a test pressure as specified in Table 15144-1. Apply and maintain the test pressure by means of a hydraulic force pump. The minimum duration of pressure and leakage tests shall be for a test period of four (4) hours each. If during the tests, the integrity of the tested line is in question, the Owner may require 6-hour tests. The basic provisions of AWWA C-600 shall be applicable.

F. Hydrostatic Testing of Aboveground or Exposed Piping: Open vents at high points of the piping system to purge air while the pipe is being filled. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four (4) hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

G. Hydrostatic Testing of Buried Piping:

1. Where any section of the piping contains concrete thrust blocks, thrust collars or encasement; do not make the pressure test until at least 28 days after the concrete has been poured. If high-early cement is used for the concrete thrust blocking, the time may be reduced to ten (10) days if the Owner concurs that the concrete has cured and reached adequate strength. When testing mortar-lined piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

2. Each section of pipe to be tested, as determined by the Owner, shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered in consequence of this pressure test, all such items shall be removed and replaced by the Contractor with sound material and the test shall be repeated until satisfactory results are obtained. Provisions of AWWA C-600, where applicable, shall apply.

3. Apply and maintain the test pressure by means of a hydraulic force pump. Maintain the test pressure ± 3.0 psi for a minimum duration of four (4) hours.

H. Leakage Test for Buried Piping:

1. After completion of the pressure test, use a meter to measure the additional water added to maintain the test pressure during the four hour test. This amount of water is the loss due to leakage under the specified test pressure in the piping system. Applicable provisions of AWWA C600 shall apply.

2. The allowable leakage rate, in gallons per hour for the pipeline tested shall not be greater than that determined by the formula:

$$L = \frac{SD\,(P)^{1/2}}{133{,}200}$$

Where:

L	=	Allowable leakage in gallons per hour during the test period.
S	=	Length of pipe tested, in feet.
D	=	Diameter of the pipe, in inches.
P	=	Average test pressure during the leakage test, in pounds per square inch gauge.

3. Leakage is defined as the quantity of water to be supplied in the newly laid pipe or any valved section under test, which is necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. Should any of the pipe tested disclose leakage greater than that allowed, the Contractor shall locate and replace or repair the defective joints, pipe or valves until the leakage from subsequent testing is within the specified allowance.

4. Repair and retest any pipes showing leakage rates greater than that allowed.

I. Pneumatic Pressure Testing:

1. Test Pressure: Minimum 1 1/2 times working pressure.

2. Perform pneumatic testing using dry nitrogen gas. Perform tests only after the piping has been completely installed including supports, hangers, and anchors. Protect test personnel and Owner's operating personnel. Secure piping to be tested to prevent the pipe from moving and to prevent damage to adjacent piping and equipment. Remove or isolate from the pipe any appurtenant instruments or devices that could be damaged by the test, prior to applying the test.

3. Apply an initial pneumatic leakage test of 25 psig to the piping system prior to final leak testing. Examine for leakage, detected by soap bubbles, at joints and connections. After correcting visible leaks, gradually increase the pressure in the system to not more than one-half of the test pressure. Then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Continuously maintain the

pneumatic test pressure for a minimum time of four hours and for such additional time as may be necessary to conduct a soap bubble examination for leakage. The piping system shall show no leakage. Correct any visible leakage and retest.

TABLE 15144-1

PIPING PRESSURE TEST SCHEDULE

Service	Description	Test Pressure (psig)
Gravity Process Pipe (IPS Influent Lines)	Raw Wastewater, RWW	75
Pressure Process Pipe (IPS Pump Discharge)	Raw Wastewater, RWW	100
Potable Water Pipe	Potable Water, PW	150
Reclaimed Water Pipe	Reclaimed Water, RW	150
Gravity Flow Pipe	Drain Lines	See Notes 2, 3

NOTES:

1. Piping not listed and portions of piping in gross conflict with listed pressure shall be tested at a minimum of 1.5 times working pressure.
2. Non-pressure process piping shall be tested at 1.5 times the maximum head pressure on the pipe.
3. Gravity drain lines within the new buildings shall be hydrostatically tested by capping or plugging the drains and system ends and filling the system through the vent lines to the top of the vents. Leaking shall be calculated from this static head pressure and amount of water required to refill the vent pipe after the test duration.

TABLE 15144-2

PRESSURE TEST FORM

[ ]	OWNER:	_____	No. Copies _____	
[ ]	ENGINEER:	Reiss Engineering, Inc.	No. Copies _____	PRESSURE
[ ]	ARCHITECT:	_____	No. Copies _____	TEST
[ ]	CONTRACTOR:	_____	No. Copies _____	NUMBER_____
[ ]	FIELD:	_____	No. Copies _____	
[ ]	OTHER:	_____	No. Copies _____	

PROJECT DATA:

Name: _____ Owner: _____

Location: _____ Contractor: _____

Number: _____ Subcontractor: _____

Date: _____

LOCATION OF TEST:

COMPUTATION FOR MEASURED LEAKAGE:

Time-End of Test_____ Pressure-End of Test (psi)_____

Time-Start of Test_____ Pressure-Start of Test (psi)_____

Test Time (Hours)_____ Average Test Pressure (psi)_____

Pipe Material_____

Quantity of Water Required to Return to Original Pressure (gals.) _____

Computation for Allowable Leakage (for bell and spigot Ductile Iron Pipe):

D = Size of Line Tested: Diameter (inches)
S = Length of Pipe Tested: (feet)
T = Test Time: (hours)
P = Average Test Pressure: (psi)

Q = Allowable Leakage: $\frac{S \times D \times (P)^{1/2} \times T}{133{,}200}$ (gal.) Per AWWA Std. C600

Allowable Leakage for bell and spigot PVC pipe shall be 90% of value calculated above. Allowable Leakage for solvent welded and threaded PVC pipe shall be zero.

TABLE 15144-2

PRESSURE TEST FORM (Cont)

REMARKS:

THE ABOVE TEST (DOES) (DOES NOT) MEET THE SPECIFICATIONS

TEST WITNESS

by Contractor	by Subcontractor	by Engineer

END OF SECTION

SECTION 15150
HVAC CONDENSATE WASTE PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes condensate waste piping.

1.02 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Condensate Piping: 10-foot head of water (30 kPa).

1.03 SUBMITTALS

A. Field quality-control inspection and test reports.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - EXECUTION

A. PIPING APPLICATIONS

B. Condensate piping shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

2.02 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section 15053 "Mechanical Materials and Methods."

B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section 15053 "Mechanical Materials and Methods."

C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section 15053 "Mechanical Materials and Methods."

D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

G. Install condensate drainage piping at the following minimum slopes, unless otherwise indicated:

1. Horizontal Drainage Piping: 2 percent downward in direction of flow.

H. Install PVC piping according to ASTM D 2665.

I. Install underground PVC drainage piping according to ASTM D 2321.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section 15053 "Basic Mechanical Materials and Methods."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

2.04 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.

2.05 HANGER AND SUPPORT INSTALLATION

A. Note: install hangers to not conflict with process piping. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.

F. Install supports for vertical PVC piping every 48 inches (1200 mm).

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

2.06 CONNECTIONS

A. Connect condensate piping to storm system as indicated on the drawings. Use transition fitting to join dissimilar piping materials.

B. Connect drainage piping to the following:

1. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

2.07 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test piping according to procedures of authorities having jurisdiction.

1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
2. Prepare reports for tests and required corrective action.

2.08 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

2.09 PROTECTION

A. Exposed PVC Piping: Protect piping exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

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SECTION 15200
HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.02 SCOPE OF WORK

A. The Work shall include the furnishings of systems, equipment, and materials specified in this Division and as required by Contract Documents to include: supervision, operation, methods, and labor for the fabrication, installation, start-up, and tests for the complete mechanical installation.

B. Drawings for the Work are diagrammatic, intended to convey the scope of the Work and to indicate the general arrangement and locations of the Work. Because of the scale of the Drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown. This Contractor shall be responsible for selecting the equipment to fit the space provided. The location and sizes for ductwork, pipe fittings, sleeves, inserts, and other basic items required by code and other sections shall be coordinated and included for the proper installation of the work.

C. Equipment Specification may not deal individually with minute items required such as components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for in the Contract Documents.

D. Where the words "provide", "furnish", "include", or "install" are used in the Specification or on the Drawings, it shall mean to furnish, install, and test complete and ready for operation, the items mentioned. If an item is indicated in the Contract Documents, it shall be considered sufficient for including same in the work.

E. Where noted on the Drawings or where called for in other Sections of the Project Manual, the Contractor for this Division shall install equipment furnished by Others, and shall make required service connections. Contractor shall verify with the supplier of the equipment the requirements for the installation.

F. Coordinate with all trades in submittal of shop drawings. Shop drawings shall be prepared clearly indicating all applicable components. Space conditions shall be detailed to the satisfaction of all concerned trades, subject to review and final acceptance by the

Engineer. In the event that the Contractor installs his work before coordinating with other trades or so as to cause any interference with work of other trades, the necessary changes shall be made in the work to correct the condition, at no additional cost to the Owner.

1.03 CODES AND STANDARDS

A. Conform to latest edition of governing codes, ordinances, or regulations of city, county, state, or utility company having jurisdiction. Where local codes are not applicable, conform to Standard Plumbing Code; Standard Mechanical Code; Rules of Department of Air and Water Pollution Control; and National Electrical Code.

B. Work not regulated by Governmental Bodies shall be performed in accordance with current issues of the following Codes and Standards.

1. Air Moving and Conditioning Association - AMCA
2. American National Standards Institute - ANSI
3. American Society of Mechanical Engineers - ASME
4. American Society for Testing and Materials - ASTM
5. American Water Works Association - AWWA
6. Factory Mutual - FM
7. Manufacturers Standardization Society of the Valve and Fittings Industry - MSS
8. National Electrical Manufacturers Association - NEMA
9. National Fire Protection Association, National Electrical Code - NEC
10. National Fire Protection Association - NFPA
11. Occupational Safety and Health Act of 1970, as amended - OSHA
12. Sheet Metal and Air Conditioning Contractors National Association - SMACNA
13. Underwriters' Laboratories - UL
14. Local and State Plumbing Code
15. Utility Company Regulations as pertains to services provided
16. Other Codes and Standards as individually referred to in the Technical Sections of the Specification.

1.04 FEES, PERMITS, AND INSPECTIONS

A. Secure all permits and pay all fees required in connection with the Work.

B. Coordinate and provide such inspections as are required by the Authorities with jurisdiction over the site.

C. Where applications are required for procuring of services to the building, prepare and file such application with the Utility Company. Furnish all information required in connection with the application in the form required by the Utility Company.

1.05 ACTIVE SERVICES

A. Existing active services; water, gas, sewer, electric, when encountered, shall be protected against damage. Do not prevent or disturb operation of active services which are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the Utility or Municipality having jurisdiction.

1.06 SITE INSPECTION

A. Contractor shall inspect the site to familiarize himself with conditions of the site which will affect his work and shall verify points of connection with utilities, routing of outside piping to include required clearances from any existing structures, trees or other obstacles.

B. Extra payment will not be allowed for changes in the Work required because of Contractor's failure to make this inspection.

1.07 OPENINGS, CUTTING, AND PATCHING

A. Coordinate the placing of openings in the new structure as required for the installation of the Mechanical Work.

B. When additional patching is required due to failure to inspect work; then provide the patching required to properly close the openings, including patch painting.

C. When cutting and patching of the structure is made necessary due to failure to install piping, ducts, sleeves, or equipment on schedule, or due to failure to furnish, on schedule, the information required for the leaving of openings, then provide the cutting and patching as required, including patch painting.

1.08 WIRING FOR MECHANICAL EQUIPMENT

A. Division 16 shall provide power services for motors and equipment furnished by this Contractor to include safety disconnect switches and final connections.

B. Division 15 shall provide all motors, motor starters, and contactors for equipment furnished under this Division, except where they are an integral part of a motor control center which is provided under another Division.

C. Provide internal wiring, alarm wiring including for fire protection and/or security, control wiring, and interlock wiring for equipment furnished, to include temperature control wiring.

D. Coordinate with Division 16 all motors and other mechanical equipment which require electrical services. Provide schedule which shall include the exact location for rough-in, electrical load, size, and electrical characteristics for all services required.

E. Where motors or equipment furnished require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, provide material as required to fit the substitute equipment.

F. Electrical work provided under Division 15 shall conform to the requirements of Division 16.

1.09 PROTECTION

A. Special care shall be taken for the protection of equipment furnished. Equipment and material shall be completely protected from weather elements, painting, plaster, etc. until the project is completed. Damage from rust, paint, scratches, etc. shall be repaired as required to restore equipment to original condition.

B. Where the installation or connection of equipment requires work in areas previously finished by other Contractors, the area shall be protected and not marred, soiled, or otherwise damaged during the course of such work. Contractor shall arrange with the other Contractors for repairing and refinishing of such areas which may be damaged.

C. When welding is required inside building, provide one man for a fire watch. Fire watch shall require adequate protection of existing surfaces and observance of lower floors where penetrations exist.

1.10 SUBMITTALS

A. GENERAL:

1. Submit to Architect/Engineer shop drawings and product data required by the drawings and specifications.

2. Contractor shall compile all data including but not limited to ductwork materials and construction details, manufacturers catalog and product data, controls wiring diagrams and material data, piping, insulation, water treatment, and test and balance.

3. Submit a minimum of 7 copies of data; more if required by the Architect.

B. SUBMITTAL REQUIREMENTS

1. Prepare submittals compiled in a 3 ring, hard bound, loose leaf binder. The face of the binder shall be clearly marked with the project title and number, the name of the Owner, Architect, Engineer, General Contractor and this contractor.
2. The first page inside the binder shall provide an index, numerically indicating all sections applicable to this submittal.
3. Separate binders shall be provided for HVAC and plumbing trades.
4. Where multiple options are available from a manufacturer, clearly indicate those which are intended to be included with project submittal.
5. Provide plastic, see-through hard tab dividers for each section submitted. In the event an item appears on the drawings not specifically covered by the specifications, provide an additional numeric tab at the end of the index detailing the item and include the submittal data in the binder.
6. Submit only complete project submittals. Partial submittals or submittals not complying with the above requirements shall be returned to the contractor un-marked and rejected.
7. In the interest of project expediency the contractor may pre-submit long lead items for pre-approval. However, the contractor shall not be relieved of including the same data as required by submittal binder and shall be included therein.
8. The Contractor may turn in submittals without control drawings if they require a longer production time. All other items shall be included.
9. Provide a tab for items not included and include an explanation of why item is not included in the submittal and the expected submittal date.
10. Review shop drawings and product data prior to submission to Architect/Engineer.
11. Verify field measurements, field construction criteria, catalog numbers, and similar data.
12. Coordinate each submittal with work of the project and Contract Documents.
13. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Architect/Engineer's review of submittals, unless Architect/Engineer gives written acceptance of specific deviations.
14. Notify Architect/Engineer in writing of deviations from requirements of Contract Documents at time submittals are made.
15. A "deviation" shall be construed to mean a minor change to the sequence indicated on drawings or specification.
16. A "deviation" is not intended to allow substitutions or product options.

17. Do not begin work which requires submittals until submittals have been returned with Architect/Engineer's stamp and initials or signature indicating review and approval.

18. Shop Drawings and/or submittals requiring resubmission to the Architect/Engineer due to non-compliance with the Contract Documents and/or incompleteness shall be thoroughly reviewed by the Contractor prior to delivery to the Architect/Engineer for review. The Contractor shall ensure the completeness and compliance of the submittal materials and shall reimburse the Architect/Engineer at their standard hourly billing rates for review of submittals/shop drawings beyond the second submission.

19. Attention is directed to the fact that Architect/Engineer's review is only to check for general conformance with the design concept of the project and general compliance with Contract Documents. No responsibility is assumed by Architect/ Engineer for correctness of dimensions, details, quantities, procedures shown on shop drawings or submittals.

20. Omission in shop drawings of any materials indicated in Contract Drawings, mentioned in Specifications, or required for proper execution and completion of Work, does not relieve the Contractor from responsibility for providing such materials.

21. Approval of a separate or specified item does not necessarily constitute approval of an assembly in which item functions.

1.11 OPERATING AND MAINTENANCE MANUALS:

A. GENERAL:

1. Provide three up-to-date copies of shop drawings, product data, and other information described in this Section for use in compiling operating and maintenance manuals.

2. Provide legible submittals made by permanent reproduction copy equipment from typewritten or typeset originals.

3. Pre-punch 8-1/2 inch x 11 inch sheets for standard three ring binders.

4. Submit larger sheets in rolled and protected packages.

B. COMPILATION:

1. The Contractor will receive shop drawings, brochures, materials lists, technical data of all types, warranties, guarantees, and other pertinent information and will assemble, catalog, and file information in loose-leaf, hardback three-ring binders.

2. Submittal Format: (Provide each of the following items, as applicable, for each required item or system. Requirements will vary, depending on the equipment. Refer to specific Specification section requirements.)

3. Item: (Use appropriate Section title.)

4. System Description: (Provide a detailed narrative description of each system, describing function, components, capacities, controls and other data specified, and including the following:

   a. Number of.
   b. Sizes.
   c. Type of operation.
   d. Detailed operating instructions, including start-up and shut-down of each system, with indications for position of all controls, as applicable.

5. Wiring Diagrams: (Complete wiring diagrams for internally wired components including controls.)

6. Operating Sequence: (Describe in detail.)

7. Manufacturers Data: (Provide catalog data sheets, specifications, nameplate data and parts list.)

8. Preventative Maintenance: (Provide manufacturer's detailed maintenance recommendations.)

9. Trouble Shooting: (Provide manufacturer's sequence for trouble-shooting procedures for operational problems.)

10. Extra Parts: (Provide a listing of extra stock parts furnished as part of the Contract.)

11. Warranties: (Provide specific manufacturer's warranty. List each component and control covered, with day and date warranty begins, date of expiration, and name, address and telephone number of person to contact regarding problems during warranty period.)

C. Directory: (Provide names, addresses and telephone numbers of Contractor, its subcontractors, suppliers, installers and authorized service and parts suppliers. Format as follows:

Contractor:
Address:
Telephone No.:
Person to Contact:

Subcontractor:
Address:
Telephone No.:
Person to Contact:

Installer:
Address:
Telephone No.:
Person to Contact:

Manufacturer:
Address:
Telephone No.:
Person to Contact:

Local Service Representative:
Address:
Telephone No.:
Person to Contact:

1.12 RECORD DRAWINGS

A. DETAILED REQUIREMENTS FOR RECORD DRAWINGS

1. During the progress of the work, the Contractor shall require the job superintendent for the plumbing, air conditioning, heating, ventilating, and fire protection subcontractors to record on their field sets of drawings the exact locations, as installed, of all conduits, pipes, and ducts whether concealed or exposed which were not installed exactly as shown on the contract drawings.

2. Upon completion of the work this data shall be recorded to scale, by a competent draftsman on sepia line prints or transparent paper of the contract drawings. Sepia will be furnished to the Contractor by the Architect/Engineer, but cost shall be borne by Contractor. Where changes are to be recorded, the sepia line prints shall be erased before the changes are made. Where the work was installed exactly as shown on the contract drawings the sepia line prints shall not be disturbed other than being marked "As-Built". In showing the changes the same legend shall be used to identify piping, etc., as was used on the contract drawings. A separate set of drawings shall be prepared for plumbing, heating, air conditioning, and ventilating work unless two or more divisions are shown on the same sheets of the contract drawings, in which case the various subcontractors shall also show their changes on the same sheets. Each sheet shall bear the date and name of the subcontractor submitting the drawings.

3. The Contractor shall review the completed As-Built drawings and ascertain that all data furnished on the sepia drawings are accurate and truly represent the work as actually installed. Where plumbing, hot or chilled water pipes, inverts etc., are involved as part of the work, the Contractor shall furnish true elevations and locations, all properly referenced by using the original bench mark used for the institution or for this project. The sepia line prints including those unchanged and changed shall be submitted to the Architect/Engineer.

4. The Contractor shall submit as-built drawings to the Architect/Engineer for review.

5. The Engineer shall authorize the Contractor to produce and distribute the as-built drawings as follows:

   a. One (1) blue line to the Engineer.
   b. One (1) blue line to the Architect.
   c. One (1) sepia to the Owner.

1.13 SUBSTITUTIONS AND PRODUCT OPTIONS:

A. For products specified only by reference standard, select product meeting that standard, by any manufacturer.

B. For products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with specifications.

C. For products specified by naming several products or manufacturers and stating "or equivalent", "or equal", or "or Architect/Engineer approved equivalent", or similar wording, submit a request for proposed substitutions for any product or manufacturer which is not specifically named; for review and approval by the Engineer.

D. For products specified by naming only one product and manufacturer, there may be an option of an Engineer approval of a product of equal or greater quality or size.

1.14 SUBMISSIONS:

A. Contractor's Base Bid shall be per contract documents.

B. Submit separate request for each substitution. Support each request with:

1. Complete data substantiating compliance of proposed substitution with requirements stated in contract documents:
2. Product identification, including manufacturer's name and address.
3. Manufacturer's literature; identify:

   a. Product description.
   b. Reference standards.
   c. Performance and test data.
   d. Name and address of similar projects on which product has been used, and date of each installation.

4. Itemized comparison of the proposed substitution with product specified; list significant variations.
5. Data relating to changes in construction schedule.
6. Any effect of substitution on separate contracts.
7. List of changes required in other work or products.

8. Designation of availability of maintenance services, sources of replacement materials.

9. Provide certification of product compatibility with adjacent materials.

C. Substitutions will not be considered for acceptance when:

1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.

2. Acceptance will require substantial revision of contract documents.

3. In judgement of Engineer, do not include adequate information necessary for a complete evaluation.

4. Substitute products shall not be ordered or installed without written acceptance of Engineer.

5. Architect/Engineer will determine acceptability of proposed substitutions.

1.15 PRIME (GENERAL) CONTRACTOR'S REPRESENTATION:

A. In making formal request for substitution, Prime (General) Contractor represents that:

1. He has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.

2. He will provide same warranties or bonds for substitution as for product specified.

3. He will coordinate installation of accepted substitution into the work, and will make such changes as may be required for the work to be complete in all respects.

4. He waives claims for additional costs caused by substitution which may subsequently become apparent.

B. Cost data is complete and includes related costs under his contract, but not:

1. Costs under separate contracts.

2. Architect/Engineer's costs for redesign or revision of contract documents.

1.16 ARCHITECT/ENGINEER DUTIES:

A. Review Contractor's requests for substitutions with reasonable promptness.

B. Notify Contractor in writing of decision to accept or reject requested substitution.

1.17 FINISHING

A. General: Prior to acceptance of the installation and final payment of the Contract, the Contractor shall perform the work outlined herein.

B. Cleaning: At the conclusion of the construction, the site and structure shall be cleaned thoroughly of all debris and unused materials remaining from the mechanical construction. All closed off spaces shall be cleaned of all packing boxes, wood frame members, and other waste materials used in the mechanical construction.

C. The entire system of piping and equipment shall be cleaned internally. The Contractor shall open all dirt pockets and strainers, completely blowing down as required and clean strainer screens of all accumulated debris.

D. All tanks, fixtures, and pumps shall be drained and proven free of sludge and accumulated matter.

E. All temporary labels, stickers, etc., shall be removed from all fixtures and equipment. (Do not remove permanent name plates, equipment model numbers, ratings, etc.).

F. Heating and air conditioning equipment, tanks, pumps, etc., shall be thoroughly cleaned and new filters or filter media installed.

1.18 TEST AND DEMONSTRATIONS

A. Systems shall be tested and placed in proper working order prior to demonstrating systems to Owner.

B. Prior to acceptance of the mechanical installation, demonstrate to the Owner or his designated representatives all essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems. The contract shall allow for five (5) working days to perform the demonstrations.

C. Provide necessary trained personnel to perform the demonstrations and instructions. Provide manufacturer's representatives for systems as required to assist with the demonstrations.

D. Dates and times for performing the demonstrations shall be coordinated with the Owner.

E. Upon completion of demonstrations, provide a certificate testifying that demonstrations have been completed. Certificate shall list each system demonstrated, dates demonstrations were performed, names of parties in attendance, and shall bear signatures of contractor and owner.

1.19 PAINTING AND IDENTIFICATION

A. Provide painting as scheduled below:

1. Touch-up paint where damaged on equipment furnished with factory applied finished, to match original finish.

B. Identification of mechanical systems shall be as specified in Section 15190; MECHANICAL IDENTIFICATION.

1.20 EXCAVATING, TRENCHING, AND BACKFILLING

A. Provide excavation necessary for underground water piping, etc., and backfill such trenches and excavations after work has been installed and tested. Care shall be taken in excavating, that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing. Where a line must pass under footing, the crossing shall be made by the smallest possible trench to accommodate the pipe. Excavation shall be kept free from water by pumping if necessary. No greater length of trench shall be left open, in advance of pipe and utility laying, than that which is authorized.

B. Trenches for piping and utilities located inside foundation walls and to point five (5) feet outside of the wall shall be not less than sixteen (16) inches nor more than twenty-four (24) inches wider than the outside diameter of the pipe to be laid. The widths of trenches for piping and utilities located more than five (5) feet outside of building foundation walls, other than for sewers, shall be governed by conditions found at the site.

C. Bottoms of trenches shall be so shaped that when pipe is in place the lower fourth of the circumference for the full length of the barrel will be supported on compacted fill. Bell holes shall be dug so that no part of the weight of the pipe is supported by the bell but shall be no larger than necessary for proper jointing. All sewers and piping required for the structure shall be excavated to at least (6) inches below pipe invert.

D. Immediately after testing and/or inspection, the trench shall be carefully backfilled with earth free from clods, brick, etc., to a depth one-half the pipe diameter and then firmly puddled and tamped in such a manner as not to disturb the alignment or joints of the pipe. Thereafter, the backfill shall be puddled and tamped every vertical foot.

1.21 CONCRETE WORK

A. Provide concrete bases and housekeeping pads for mechanical equipment unless indicated otherwise. Concrete work shall be as specified in the applicable Civil/Site and Structural Sections. Vibration pads, equipment bases, pipe supports and thrust blocks shall be provided by this Contractor.

B. Provide equipment anchor bolts and coordinate their proper installation and accurate location.

1.22 ACCESS PANELS

A. Provide access panels where required and not shown on the drawings for installation by the drywall Contractor. Access panels shall be as specified in the applicable

architectural section. All access panel locations which allow access to mechanical equipment shall be approved by the Architect/Engineer.

1.23 SLEEVES

A. Sleeves passing through non-load bearing or non-fire rated walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: for pipes 2-1/2" size and smaller - 24 gauge; 3" to 6" - 22 gauge.

B. Sleeves passing through load bearing walls, concrete beams, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.

C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.

D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions, and ceilings, and shall extend 1/2" above finished floors. Extend sleeves 1" above finished floors in areas likely to entrap water.

E. Pipe to wall penetration closures for underground pipe penetrations of walls shall be "Link-Seal" as manufactured by Thunderline Corporation, or equal.

1.24 ESCUTCHEONS

A. Provide chrome plated escutcheons at each sleeved opening into finished and exposed exterior spaces. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension. Secure escutcheons or plates to sleeve but not to insulation with set screws or other approved devices.

1.25 INSULATION PROTECTION

A. Where exposed insulated piping extends to floor, provide sheet metal guard around insulation.

1.26 ANCHORING OF EQUIPMENT

A. All equipment located on floor slab, that is not mounted on wheels and is capable of being moved shall be secured to the floor with anchor bolts. A minimum of two bolts are required per each piece of equipment and bolts shall be of sufficient size to prevent equipment from overturning.

1.27 PROTECTION OF ELECTRICAL EQUIPMENT

A. Water piping shall not be installed in electrical rooms or directly above electrical equipment.

1.28 CONNECTIONS FOR FIXTURES AND EQUIPMENT UNDER ANOTHER SECTION OR BY OWNER

A. Rough all equipment requiring connection to systems provided under this Division. Verify requirements and current locations before proceeding with work.

B. Make all connections to equipment furnished under another Section or by owner as required to obtain complete and working systems.

1.29 SYSTEM GUARANTEE:

A. Work required under this Division shall include one-year guarantee. Guarantee by Contractor to Owner to replace for Owner any defective workmanship or material which has been furnished under contract at no cost to the Owner for a period of one year from date of acceptance of systems. Guarantee shall also include all reasonable adjustments of system required for proper operation during guarantee period. Guarantee shall not include normal preventative maintenance services or filters.

B. At "Demonstration", one-year guarantee provision by Contractor shall be explained to Owner.

C. All sealed hermetic refrigeration systems shall be provided with five-year factory warranty.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 15258
DUCTWORK INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Work of this section shall include providing the thermal insulation for mechanical systems and shall include the following principal items:

1. Supply, Return, Outside, and Relief Air ductwork concealed.
2. Supply, Return, Outside, and Relief Air ductwork exposed.
3. Supply, Return, Outside, and Relief Air ductwork concealed outside of building insulation envelope (attic/crawlspace).
4. Exhaust Air ductwork concealed.
5. Exhaust Air ductwork exposed.
6. Lined ductwork.

B. Not all of the insulation types specified herein may be required on this project. The contractor is only to provide those insulation types required for the applications on this project.

C. This work shall be performed by a competent insulation contractor regularly engaged in the scope of work described herein.

1.02 SUBMITTALS

A. Submittals and product literature for each insulation type, finish type, and equipment served. Provide submittals on method of installation for each type of insulation used.

PART 2 - PRODUCTS

2.01 THERMAL INSULATIONa

A. All insulating systems shall be tested on a composite basis in accordance with NFPA and UL 723 and shall have a maximum flame spread rating of 25 and a maximum smoke developed rating of 50 under ASTM E-84.

B. Insulation Types:

1. FIBERGLASS BLANKET

a. Made of flame - attenuated glass fibers, bonded with a thermosetting resin. Reinforced with fiberglass scrim facing laminated to UL rated kraft. FSK facing, .02 perms, .00035" foil thickness per ASTM E-96, procedure A. 2" thick, 0.75 PCF, 7.1 R value. Equal to Manville, MicroLite.

2. RIGID FIBERGLASS

a. 3 lb. density, .23 k factor. Mil spec HH-1-558B.. Inorganic glass fibers bonded by a thermosetting resin with an FSK jacket in compliance with NFPA 90A AND 90B standards. Equal to Manville 814, 3 lb density, 2" thick with FSK jacket.

3. FIBERGLASS BLANKET

a. Made of flame - attenuated glass fibers, bonded with a thermosetting resin. Reinforced with fiberglass scrim facing laminated to UL rated kraft. FSK facing, .02 perms, .00035" foil thickness per ASTM E-96, procedure A. 3" thick, 3/4 lb., 10.7 R value. Equal to Manville, Microlite.

4. SEMI RIGID FIBERGLASS BOARD

a. 3lb. density, thermal conductivity compliance ASTM C 518, 650 degrees F temperature limit, 1 1/2" thick. High temperature fiberglass bonded to a flexible jacketing. Jacketing is a laminate of white kraft and aluminum foil, reinforced with fiberglass, chemically treated for fire and smoke safety. Equal to Manville Pipe and Tank Insulation.

5. DUCT LINER

a. Acoustical and thermal insulation manufactured from long textile, type glass fibers firmly bonded together with a thermosetting resin. Air stream surface is coated to protect against air erosion. Up to 250 degrees F (ASTM C 411), NFPA 90A and 90B, ASTM C 1071: not greater than 0.5% moisture by volume at 120 degrees F and 96% RH. Equal to Certainteed 1" thick, type 150, .28 K value for up to 2,500 FPM velocity.

6. DUCT LINER

a. Same as number 5 except type 300, 1" thick, .24 K factor, up to 6000 FPM.

C. Weather Barrier Mastics

1. An emulsion type material compounded of selected and processed bitumens and mineral fillers. Equal to INSULKOTE ET. and INSULKOTE PRIMER E.

D. Duct Tape

1. FSK, glass fiber impregnated with foil facing, 4"wide, M.L spec HHB100, 25/50, ASTM E-84.

E. Adhesives

1. Water based adhesives for attaching low density fibrous insulation and duct liner to metal. Service temperature limits-20 degrees F to 250 degrees F, UL MJAT-2, ASTM C 916, type 11, NFDA 90A and 90B. Equal to Foster Quick Tack Adhesive 85-60.

F. FIELD-APPLIED JACKETS

1. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

2. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

a. Products: Polyguard; Alumaguard 60.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. All materials shall be applied by Workmen skilled in this trade. Unsightly work shall be cause for rejection.

B. Mechanical fasteners shall be used whenever possible to assure permanent construction.

C. Materials shall be applied only after systems have been tested and all surfaces are clean and dry.

D. All insulation of cold surfaces shall be vapor sealed. All joints, laps, breaks and faults in vapor barriers of insulations covering cold surfaces shall be thoroughly sealed.

E. Insulation that becomes wet for any reason shall be removed, replaced and resealed at the expense of this Contractor.

3.02 APPLICATION

A. Interior, Concealed Square or Round Ductwork

1. Use FIBERGLASS BLANKET as per Part 2, 2.01, B-1. For square ducts with any one dimension not greater than 24". Insulation shall be wrapped around ducts and secured with outward clinching staples at 4 inches o.c.. Ducts 24

inches and greater shall have insulation additionally secured with stick clips on 18 inch centers or with 4 inch wide bands of adhesive applied on 18 inch centers. Insulation shall be lapped a minimum of 4" and all seams and penetrations shall be sealed with FSK Duct tape as per Part 2, 2.01, D-1.

B. Rectangle, Interior Supply, Return, Outside Relief and Exhaust Air Ductwork, Exposed.

1. Use FIBERGLASS BOARD insulation as per Part 2, 2.01, B-2, and shall be applied to ducts with mechanical fasteners such as stick cups or weld pins at 12 inch centers. Install fiberglass board in full pieces. Joints and seams shall be covered with 4" tape as per Part 2, 2.01, D-1. Where standing seams or angle supports exceed insulation thickness an additional layer of board will be used.

C. Supply, Return, Outside, Relief or Exhaust Ductwork Outside of Building Insulation

1. Use FIBERGLASS BOARD insulation as per Part 2, 2.01, B-2, and shall be applied to ducts with mechanical fasteners such as stick cups or weld pins at 12 inch centers. Install fiberglass board in full pieces. Joints and seams shall be covered with 4" tape as per Part 2, 2.01, D-1. Where standing seams or angle supports exceed insulation thickness an additional layer of board will be used.
2. Provide Self adhesive outdoor jacket Part 2, 2.01, F.

3.03 MISCELLANEOUS

A. Ductwork indicated on the drawings to be internally lined shall not be insulated externally.

B. All insulating systems described herein shall conform to the latest edition of SMACNA and will comply with NFPA-90A, 90B, 30; TIMA AHC-101; ASTM C390, C167, C553, E84, C177, C423, C411, C916, D903, D93, D1151; ASHRAE; ACGIH; Tested for UL 181; Mil Spec A 3316B

C. The engineer will reserve the right to accept or reject any and all work not in compliance with the aforementioned. The engineer will be contacted for inspection during any of the following operations:

1. During installation of any ductwork wrapping.
2. During the installation of ductwork that has been lined.

END OF SECTION

SECTION 15736
SELF CONTAINED AC UNIT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (Package units) with the following components and accessories:

1. Direct-expansion cooling.
2. Electric-heating coils.
3. Gas furnace.
4. Economizer outdoor- and return-air damper section.
5. Integral, space temperature controls.
6. Package unit curbs.

1.02 DEFINITIONS

A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

F. VVT: Variable-air volume and temperature.

1.03 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Performance:

1. Basic Wind Speed: 150 mph

1.04 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Warranty.

1.05 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.

2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigerant system safety.

2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2010 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.

2. Provide parts warranty(excluding refrigerant), including but not limited to, belts, filters, lubricants etc., for one year from start-up or 18 months from shipment, whichever occurs first.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Carrier Corporation.

2. Daikin.

3. Trane.

2.02 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge. Cabinet to be sprayed with Luvata Insitu corrosive resistant or similar product.

C. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.

D. Cabinet construction shall allow for all service/ maintenance from one side of the unit.

E. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

F. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

G. Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

H. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.

I. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.

J. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

2.03 FANS

A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.

C. Provide units with ECM motor, multiple speed, dynamically balanced supply fans.

D. Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.

E. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.

F. Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.

2.04 ELECTRIC HEATING SECTION

A. Provide heavy duty nickel chromium heating elements internally wired. Heater shall have pilot duty or automatic reset line voltage limit controls and any circuit carrying more than 48 amps shall have fuse protection in compliance with N.E.C.

B. Heater shall be internal to unit cabinet.

C. Heater shall be UL and CSA listed and approved and provide single point power connection.

2.05 COILS

A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.

B. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.

C. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

2.06 CONDENSER SECTION

A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing. Provide cathodic epoxy type electrodisposition or similar corrosive resistant coating for condenser coil.

2.07 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.

B. Units shall have cooling capabilities down to 0 degree F as standard. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.

C. Provide each unit with one (or two) refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

D. For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.

2.08 AIR FILTRATION

A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. One-inch thick glass fiber disposable media filters shall be provided with the provisions within the unit for 2 inch thick filters to be field-provided and installed.

2.09 OUTDOOR AIR SECTION

A. Provide economizer.

B. Provide adjustable minimum position control located in the economizer section of the unit.

C. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

2.10 OPERATING CONTROLS

A. Provide microprocessor unit-mounted DDC control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling, and ventilating decisions through resident software logic.

B. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

C. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

D. Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

2.11 STAGING CONTROLS

A. Provide programmable electronic microcomputer based zone control.

B. Zone control shall incorporate:

C. Automatic changeover from heating to cooling.

D. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.

E. Instant override of setpoint for continuous or timed period from one hour to 31 days.

F. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.

G. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.

H. Economizer Minimum Position Override: Allows the unit controller to override and close the minimum position setting on the economizer damper during unoccupied time periods.

I. Zone sensor display shall be capable of:

J. Time of day.

K. Actual room temperature.

L. Programmed temperature.

M. Programmed time.

N. Duration of timed override.

O. Day of week.

P. System mode indication: heating, cooling, low battery, and fan on.

Q. Provide remote temperature sensor capability.

R. Provide mixed air sensor in supply air to close outside air damper.

2.12 BUILDING MANAGEMENT SYSTEM

A. Interface control module to Energy Management System to be furnished and mounted by Package unit manufacturer. Through this interface module, all Energy Management functions (specified in Energy Management Section) shall be performed. If not furnished by Package unit manufacturer, this shall be furnished by Energy Management System Contractor for factory mounting by Package unit manufacturer in Package unit and rated for service up to 140 F. The only field connection to Energy Management System shall be a single communication link.

B. Control Functions: Include unit scheduling, occupied/unoccupied mode, start-up and coast-down modes, nighttime free-cool purge mode, demand limiting, night setback, discharge air set point adjustment, timed override and alarm shutdown

2.13 CURB

A. Contractor shall provide 24” minimum high engineered curb with engineered wind load calculations to meet Florida Building Code

PART 3 - EXECUTION

PART 4 - EXAMINATION

Contractor shall verify that Ground is ready to receive work.

Contractor shall verify that proper power supply is available.

4.01 INSTALLATION

A. Contractor shall install in accordance with manufacturer's instructions.

B. Mount units on factory built mounting frame providing watertight enclosure to protect ductwork and utility services. Install ground mounting curb level.

END OF SECTION

SECTION 15815
METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa).

B. See Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 SEALANT MATERIALS

A. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.04 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use stainless steel 316 concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Coated stainless steel, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Use 316 stainless steel screws if exposed.

D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

2.05 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.

2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.

a. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Lockformer.

2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.

3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

PART 3 - EXECUTION

3.01 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following: (Applies to all duckwork)

1. Supply Ducts: 2-inch wg (500 Pa).
2. Return Ducts (Negative Pressure): 1-inch wg (250 Pa).
3. Exhaust Ducts (Negative Pressure): 2-inch wg (250 Pa).

3.02 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install ducts with fewest possible joints.

C. Install fabricated fittings for changes in directions, size, and shape and for connections.

D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

N. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction.

3.03 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

B. Seal ducts before external insulation is applied.

3.04 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION

SECTION 15820
DUCT ACCESORIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Volume dampers.
2. Turning vanes.
3. Flexible connectors.
4. Back draft dampers.

1.02 SUBMITTALS

A. Product Data: For the following:

1. Volume dampers.
2. Turning vanes.
3. Flexible connectors.
4. Back draft dampers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Special fittings.
2. Manual-volume damper installations.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 VOLUME DAMPERS

A. Manufacturers:

1. Greenheck
2. Nailor Industries Inc.
3. Ruskin Company.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.

3. Blade Axles: Galvanized steel.

4. Bearings: [Oil-impregnated bronze] [Molded synthetic] [Stainless-steel sleeve].

5. Tie Bars and Brackets: Galvanized steel.

D. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.04 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, [single] [double]-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.05 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.06 BACKDRAFT DAMPERS

A. Manufacturers:

1. Greenheck
2. Prefco Products, Inc.
3. Ruskin Company.

B. General Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.063-inch (1.6 mm) thick extruded aluminum with welded corners and mounting flange.

D. Blades: 0.050-inch (1.3 mm) thick aluminum sheet.

E. Blade Seals: Vinyl

F. Blade Axles: 304 Stainless Steel.

G. Tue Bars and Brackets: 304 Stainless Steel.

H. Return Spring: Adjustable tension.

I. Coating: Hi-Pro Polyester

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

E. Provide test holes at fan inlets and outlets and elsewhere as indicated.

3.02 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

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SECTION 15855
DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes registers, and grilles.

1.02 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
5. See plans for schedule of basic of design.

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.02 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 15900
HVAC CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.02 SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule.

C. Retain two subparagraphs below for DDC systems.

1. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
2. Control System Software: Schematic diagrams, written descriptions, and points list.

D. Software and firmware operational documentation.

E. Field quality-control test reports.

F. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.01 SECTION INCLUDES

A. General Description

B. Architecture/Communication

C. Operator Interface

D. Application and Control Software

E. System Controllers

F. General Programmable Controllers

G. Terminal Unit Programmable Controllers

2.02 GENERAL DESCRIPTION

A. The Building Automation System (BAS) shall be a web-based Trane Tracer SC™ or equivalent. Supervisory controller or System Controller shall be capable of communication via BACnet MS/TP and LonTalk™ protocol simultaneously at the system level to allow for seamless integration with future equipment expansions and with the site SCADA network. User interface shall be web based with access available via any standard internet browser. Systems employing local workstations or proprietary PC software to facilitate remote access shall not be acceptable.

B. The BAS shall interface with the existing SCADA network via MODBUS communication protocol and serve up control points which shall be visible through the SCADA interface for monitoring and alarming purposes. Refer to mechanical plans for points of interface specific to each building.

C. Interface between BAS and SCADA network shall be facilitated by a LynxSpring JENsys PC1000 series controller. PC1000 shall communicate with SCADA system via MODBUS TCP protocol.

2.03 ARCHITECTURE/COMMUNICATION

A. The BAS installed in accordance with this contract shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between System Controllers and Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers shall utilize BACnet MS/TP communications.

B. Each System Controller shall perform communication to a network of Custom Application Controllers using BACnet MS/TP as prescribed by the BACnet standard.

a. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.
b. Above indicated requirement for LonTalk™ capability does not constitute approval for substitutions of LonTalk™ systems. The basis of design for this project is a BACnet "top to bottom" installation. The purpose of the requirement is to provide flexibility to the system owner and facilitate a change of desired protocol in the future if applicable.

C. The Owner will provide all communication media, connectors, repeaters, network switches, and routers necessary for the high speed Ethernet network. An active Ethernet port will be provided adjacent to each System Controller and for connection to this high speed Ethernet network.

2.04 OPERATOR INTERFACE

A. A dedicated PC shall not be required to access the operator interface. The interface shall be Web-Based. Systems employing local workstations or proprietary PC software to facilitate remote access shall not be acceptable.

B. The operator interface shall reside on the Enterprise wide network, which is same high-speed communications network as the System Controllers. The Enterprise wide network will be provided by the owner and support the Internet Protocol (IP).

C. Operator Interface

a. The operator interface shall be accessible via a web browser.
b. The operator interface shall support the following Internet web browsers:

i. Internet Explorer 8.0+
ii. Firefox 4.0+
iii. Chrome 10.0+

c. The operator interface shall support the following mobile web browsers:

i. iOS (iPad/iPhone) V4.0+
ii. Android (Tablet) V4.0+
iii. Android (Phone) V2.3+

d. System Security

i. Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.

ii. User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.
iii. Each operator shall be allowed to change their user password
iv. The System Administrator shall be able to manage the security for all other users
v. The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
vi. User logon/logoff attempts shall be recorded.
vii. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
viii. All system security data shall be stored in an encrypted format.

e. Database

i. Database Save. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC.
ii. Database Restore. The system operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.

f. On-Line Help and Training

i. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
ii. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

g. System Diagnostics

i. The system shall automatically monitor the operation of all network connections, building management panels, and controllers.
ii. The failure of any device shall be annunciated to the operators.

h. Equipment & Application Pages

i. The operator interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:

I. Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:

a) Each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These

graphics shall show all points dynamically as specified in the points list.

b) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.

II. Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.

III. Historical Data (As defined in Automatic Trend Log section below) for the equipment or application without requiring a user to navigate to a data log page and perform a filter.

2. System Graphics:

a. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.

i. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point and-click navigation between zones or equipment, and to edit set points and other specified parameters.

ii. Graphic imagery: graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.

iii. Animation: Graphics shall be able to animate by displaying different Image lies for changed object status.

iv. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.

v. Format: Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

b. Custom Graphics

i. The operator interface shall be capable of displaying custom graphics in order to convey the status of the facility to its operators.
ii. Graphical Navigation: The operator interface shall provide dynamic color graphics of building areas, systems and equipment.
iii. Graphical Data Visualization: The operator interface shall support dynamic points including analog and binary values, dynamic text, static text, and animation files.
iv. Custom background images: Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as GIF and JPEG.

c. Graphics Library:

i. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

d. Manual Control and Override.

i. Point Control: Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
ii. Temporary Overrides: The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
iii. Override Owners: The system shall convey to the user the owner of each override for all priorities that an override exists.
iv. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

e. Engineering Units

i. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system.
ii. Unit selection shall be able to be customized by locality to select the desired units for each measurement.
iii. Engineering units on this project shall be IP.

D. Scheduling: A user shall be able to perform the following tasks utilizing the operator interface:

1. Create a new schedule, defining the default values, events and membership.

    a. Create exceptions to a schedule for any given day.
    b. Apply an exception that spans a single day or multiple days.
    c. View a schedule by day, week and month.
    d. Exception schedules and holidays shall be shown clearly on the calendar.
    e. Modify the schedule events, members and exceptions.

E. Trend Logs

1. Trend Logs Definition:

    a. The operator interface shall allow a user with the appropriate security permissions to define a trend log for any data in the system.
    b. The operator interface shall allow a user to define any trend log options as described in the Application and Control Software section.

2. Trend Log Viewer:

    a. The operator interface shall allow Trend Log data to be viewed and printed.
    b. The operator interface shall allow a user to view trend log data in text-based (time –stamp/value).
    c. The operator shall be able to view the data collected by a trend log in a graphical chart in the operator interface.
    d. Trend log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.
    e. Each data point trend line shall be displayed as a unique color.
    f. The operator shall be able to specify the duration of historical data to view by scrolling and zooming.
    g. The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.

3. Export Trend Logs

    a. The operator interface shall allow a user to export trend log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.

F. Alarm/Event Notification

1. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.

2. Alarm/Event Log: The operator shall be able to view all logged system alarms/events from any operator interface.

    a. The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.

b. Alarm/event messages shall use full language, easily recognized descriptors.
c. An operator with the proper security level may acknowledge and clear alarms/events.
d. All alarms/events that have not been cleared by the operator shall be stored by the building controller.
e. The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.

3. Alarm Processing

a. The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.
b. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

G. Reports and Logs

1. The operator interface shall provide a reporting package that allows the operator to select reports.

2. The operator interface shall provide the ability to schedule reports to run at specified intervals of time.

3. The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Acceptable formats include:

a. CSV, HTML, XML, PDF

4. Provide a means to list and access the last 10 reports viewed by the user.

5. The following standard reports shall be available without requiring a user to manually configure the report:

a. All Points in Alarm Report: Provide an on demand report showing all current alarms.
b. All Points in Override Report: Provide an on demand report showing all overrides in effect.
c. Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
d. Points report: Provide a report that lists the current value of all points

2.05 APPLICATION AND CONTROL SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator interface.

B. Scheduling: Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1. Weekly Schedule: Provide separate schedules for each day of the week.
2. Exception Schedules: Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
3. Holiday Schedules: Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
4. Optimal Start: The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

C. Trend Log Application

1. Trend log data shall be sampled and stored on the System Controller panel and shall capable of being archived to a BACnet Workstation for longer term storage.
    a. Trend logs shall include interval, start-time, and stop-time.
    b. Trend log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.
2. Automated Trend Logs
    a. The system controller shall automatically create trend logs for defined key measurements for each controlled HVAC device and HVAC application.
    b. The automatic trend logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The automatic trend logs shall be user adjustable.
    c. The following is a list of key measurements required for Automatic Trending:

D. Alarm/Event Log

1. Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.
2. Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.
3. An alarm/event shall be capable of triggering any of the following actions:
    a. Route the alarm/event to one or more alarm log
        i. The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself.
    b. Route an e-mail message to an operator(s)
    c. Log a data point(s) for a period of time
    d. Run a custom control program

E. Point Control: User shall have the option to set the update interval, minimum on/off time, event notification, custom programming on change of events.

F. Timed Override: A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, operator interface, or the local operator display. The amount of time that the override takes precedence will be selectable from the operator interface.

G. Anti-Short Cycling: All binary output points shall be protected from short cycling.

2.06 SYSTEM CONTROLLERS

A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section (Trane Tracer SC™ or approved equivalent)

B. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.

C. The controller shall provide a USB communications port for connection to a PC

D. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

E. All System Controllers shall have a real time clock.

F. The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

1. Assume a predetermined failure mode.
2. Generate an alarm notification.
3. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
4. Automatically reset the System Controller to return to a normal operating mode.

G. Environment: Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 F to 122 F.

H. Clock Synchronization:

1. All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.
2. All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.
3. All System Controllers shall automatically adjust for daylight savings time if applicable.

I. Serviceability

1. Provide diagnostic LEDs for power, communications, and processor.
2. The System Controller shall have a display on the main board that indicates the current operating mode of the controller.
3. All wiring connections shall be made to field removable, modular terminal connectors.
4. The System controller shall utilize standard DIN mounting methods for installation and replacement.

J. Memory: The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller

K. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage

L. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.

2.07 GENERAL PROGRAMMABLE CONTROLLERS

A. Controllers shall be Trane UC600 fully programmable units or approved equivalent. Application specific controllers not capable of accepting custom programs shall not be acceptable. Controller operation shall not be dependent upon presence of a BAS. If

no BAS exists, communication with the BAS is lost, the controller shall be capable of standalone operation utilizing local programming and set points.

B. Operation:

C. Shall operate a schedule in a standalone application using a Real Time Clock.

1. The Controller shall have a built in schedule (assessable with or without a display)
2. Support will be for at least 3 schedules with up to 10 events for each day of the week.
3. Each of the 3 schedules can be Analog, Binary or Multi-State
4. The controller shall support a minimum of 25 exceptions each with up to 10 events.

D. For ease of troubleshooting, the Controller shall support data trend logging

1. 25,000 samples minimum
2. Trends shall be capable of being collected at a minimum sample rate of once every second
3. Trends shall be capable of being scheduled or triggered.

E. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.

F. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Storage conditions:
   a. Temperature: -67°F to 203°F (-55°C to 95°C)
   b. Humidity: Between 5% to 100% RH (non-condensing)
2. Operating conditions:
3. Temperature: -40°F to 158°F (-40°C to 70°C)
4. ‘Humidity: Between 5% to 100% RH (non-condensing)

G. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum

H. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 F to 158 F [-40 C to 70 C].

I. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls pro-

vided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:

1. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
2. Shall support flexibility in sensor type, the Controller shall be of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
3. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
4. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
5. The controller support pulse accumulator for connecting devices like energy meters.
6. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.
7. Any I/O that is unused by functionality needed for the equipment shall be available to be used by custom program on the Controller and by any other controller on the network.
8. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
9. The Controller shall provide a dedicated static pressure input.

J. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:

1. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
2. Expansion I/O can be mounted up to 200m from control
3. Expansion I/O can be added in as small as 4 point increments.
4. To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed)

K. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.

1. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.

2. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box

3. Software service tool connection through all of the following methods: direct cable connection to the Controller, connection through another controller on BACnet link and through the Controller's zone sensor.

4. For configuration, programming, and testing of controller programs must, for safety purposes, be able to be accomplished with the power off to the equipment and the controller.

5. The Controller software tool service port shall utilize standard of-the-shelf USB printer cable.

6. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.

7. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.

8. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).

9. To aid in service replacement, the Controller shall allow for setting its BACnet address must be rotary switches that correspond to a numerical value for the address to allow the setting of the address without the need of a service tool or the control being powered (DIP switch methodologies are not allowed).

10. Controller data shall persist through a power failure.

L. Software Retention: All Controller operating parameters, set points, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

M. Transformer for the Controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads for a maximum of 12 VA for each binary output.

N. Controller must meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment

2. UL94-5V, Flammability

3. FCC Part 15, Subpart B, Class B Limit

4. BACnet Testing Laboratory (BTL) Listed

5. cUL Marked for international compliance

6. CE Marked for international compliance

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install guards on thermostats in the following locations:

1. Expand list of locations below or clearly indicate on Drawings.
2. Where indicated.

C. Install automatic dampers according to Division 15 Section "Duct Accessories."

D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

E. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

F. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

G. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

H. Install electronic and fiber-optic cables according to Division 16 Section "Voice and Data Communication Cabling."

3.02 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

B. Install building wire and cable according to Division 16 Section "Conductors and Cables."

C. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.

3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

6. Test each system for compliance with sequence of operation.

7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.

2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check instrument tubing for proper fittings, slope, material, and support.

5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

6. Check temperature instruments and material and length of sensing elements.

7. Check control valves. Verify that they are in correct direction.

8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.

9. Check DDC system as follows:

10. Verify that DDC controller power supply is from emergency power supply, if applicable.

11. Verify that wires at control panels are tagged with their service designation and approved tagging system.

12. Verify that spare I/O capacity has been provided.

13. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

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SECTION 15980
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide all labor, equipment and instrumentation necessary to perform the testing, adjusting and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems which shall include, but not be limited to:

1. Supply air systems
2. Return air systems (including plenum returns)
3. Exhaust air systems
4. Outside air
5. Mixed air
6. Adjustment of controls and equipment as required for proper operation of systems
7. Air leakage testing of ductwork
8. Heat transfer equipment
9. Adjust all systems to maintain building pressure design

1.02 REFERENCES

A. Associated Air Balance Council (AABC)

B. National Environmental Balancing Bureau (NEBB)

C. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

D. Sheet Metal and Air Conditioning Contractor's Association (SMACNA)

1.03 THE TAB AGENDA

A. The TAB Agenda Contractor shall prepare a TAB agenda for review and approval by the Engineer. The TAB Agenda shall be provided during the submittal process. The TAB Contractor shall not commence work until the TAB Agenda has been approved by the Engineer.

B. The Agenda shall include the following detailed narrative procedures, system diagrams and forms for test results.

1. Specific standard procedures required and proposed for each system. Additional procedures for variable flow systems shall be developed by the TAB Contractor and included for review and approval.

2. Specific test forms for recording each TAB procedure and additional test forms for any variable flow systems shall be developed by the TAB Contractor and submitted for review and approval.

3. System diagrams for each air system. Diagrams may be single line. In addition to the information recorded for standard AABC or NEBB procedures, report the following information:

   a. Air handling units: Prepare profile and show design and actual CFM (outside air, return air, supply air). Measure and record each mode (minimum OA and 100% OA) where economizer cycle is specified. Record pressure drops of all components (coils, heat recovery devices, filters, sound attenuators, louvers, dampers, fans) and compare with design values. Pressure profile and component pressure drops are performance indicators and are not to be used for flow measurements. Set and record purge air flow for heat recovery wheels. Record temperatures of outside air, return air, mixed air and supply air.

   b. Duct distribution systems: Prepare pressure profiles from the air handling units to the extremities of the system. As a minimum, show pressures at each floor, main branch, and air flow measuring device. Make pitot tube traverses of all trunk lines and major branch lines where required for analysis of distribution system. Air flow measuring devices installed in ductwork may be utilized. Record residual pressures at inlet of volume controlled terminals at ends of system. Show actual pressures at all static pressure control points utilized for constant or variable flow systems.

   c. Variable flow systems: Include specific test forms provisions for measuring and reporting CFM (supply, return, exhaust, outside), system pressures, motor loads, other pertinent data, at full unthrottled capacity and at design (100 percent) flows. Record additional flow, pressure, and motor loads for supply and return/exhaust system capacities in 10 percent increments down to a minimum attainable by the system to verify fan tracking and control. Modulate Systems by varying the supply temperature of the medium or other approved means.

4. Specific test forms for recording sound and vibration measurements.

1.04 SUBMITTALS

A. The TAB Contractor shall submit the following items prior to commencing work. All submittals shall be bound in a binder complete with cover sheet, index, and tabs separating specific sections of the submittal.

   1. The TAB agenda as detailed in paragraph 1.03-A

2. Warranty information

3. TAB Contractor qualifications including TAB Engineer and company experience on similar projects

4. Submit project supervisor and qualifications

5. Submit TAB equipment and last date of calibration

B. After completion of all TAB procedures and before warranty period commences, submit complete test reports as provided for by the prior approved TAB agenda, for Engineer review and approval. Where test results differ from specified design conditions, indicating a contract deficiency, include explanatory comments and possible resolutions in the report. After review by the Engineer, the TAB Contractor shall make any adjustments deemed necessary by the Engineer.

C. Final report shall be submitted for acceptance and record. Submit six (6) copies of final reports.

1.05 WARRANTY

A. For a period of one year after acceptance by the Owner, the TAB Contractor shall, at the request of the Engineer, return to the project to retest and/or rebalance any problem areas. This shall be done within ten (10) working days at no additional expense to the Owner or the Engineer. The purpose of this is to correct a problem, not to retest/rebalance revisions made by the Owner.

B. During the first year after acceptance by the Owner, the TAB Contractor shall return to the project during the peak heating and cooling seasons to rebalance the applicable systems to maintain the required discharge air temperatures. The T&B report shall be amended to reflect the results.

PART 2 - EQUIPMENT (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. The TAB Contractor shall review and become thoroughly familiar with the job site when the erection of the building is in the early stages. An additional visit shall be made when the rough-in is complete. Prior to any closing in of ductwork and piping, verify that all fittings, dampers, control devices, test devices and valves are properly located and installed.

B. The TAB Contractor shall examine each distribution system to verify that it is free from obstructions. The TAB Contractor shall determine that all dampers, registers and valves are in a set or full open position; that moving equipment is lubricated; and that the

required filters are clean and functioning. The TAB Contractor shall request that the installing contractor perform air adjustments necessary for proper functioning of the system.

C. The TAB Contractor shall use test instruments that have been calibrated within a time period recommended by the manufacturer (no more than 6 months) and have been checked for accuracy prior of the start of the testing, adjusting and balancing.

D. The TAB Contractor shall verify that all equipment performs as designed and specified. The TAB Contractor shall adjust all variable type drives, volume dampers, control dampers, balancing valves, control valves, etc., as required by the TAB work.

E. Coordinate TAB procedures with all construction requirements for the project so that usable increments of finished work may be accepted for beneficial occupancy. Systems serving partially occupied phases of the project may require balancing for each phase prior to final balancing.

F. Allow sufficient time in construction schedule for TAB prior to final inspection for the project.

G. Conduct final TAB after system has been completed and is in full working order. Put all HVAC systems into full operation and continue operation of the systems during each working day of TAB. Accomplish TAB in accordance with the Agenda approved by the Engineer.

3.02 AIR BALANCE

A. Place all interactive systems in operation with all filters installed and automatic control systems completed and operating. Artificially load air filters by partial blanking or other means to produce air pressure drop midway between the clean and dirty condition. Set/reset room thermostats as necessary to check heating and cooling function, and maximum/minimum flow rates for factory set air terminal units and adjust units if not correct.

B. Balance systems to design ratings. Adjust fan speeds to provide design flows, including system diversities, at actual system pressures. Provide additional sheaves and belts as required to achieve design CFM. Coordinate VAV balancing, including supply and return fan volume controls, with the controls Contractor and set supply fan static pressure control as low as practicable and still maintain required pressure at the remote terminal units.

C. Make pilot tube traverses of all trunk lines and major branches when required to determine proper proportioning of air flows. Air flow measuring devices, where installed, may be utilized for this purpose.

D. Record pressure drop readings across all major system components and significant drops within duct systems.

E. Adjust air systems with doors leading outside closed. Balance individual rooms simulating occupied conditions. (Windows and doors closed, etc.)

F. Log air flows for occupied and unoccupied conditions.

G. Make flow and pressure measurements at each terminal device, and each supply, return, or exhaust diffuser. Adjust each air outlet unit within plus or minus 10 percent of design requirements, but total air for each system shall be not less than shown. Adjust grilles and diffusers to minimize drafts in all areas. Maintain the building pressure relationships between different zones.

H. Adjust outside air and return air quantities for all systems to within plus or minus 10 percent. Total supply air quantity for any system shall be not less than shown.

I. Adjust exhaust systems to CFM requirements.

J. Test function of automatic dampers and operation of air terminal units. Check all controls for proper operation.

3.03 HEAT TRANSFER EQUIPMENT DATA

A. A. For all heat transfer equipment, which for the purposes of this specification section shall include coils, etc.

B. The following data shall be measured and included in the TAB report:

1. Ambient conditions, dry bulb, wet bulb, relative humidity
2. Entering air wet bulb and dry bulb
3. Entering relative humidity
4. Leaving air we bulb and dry bulb
5. Leaving air relative humidity
6. Air pressure drops

3.04 AIR LEAKAGE TESTING OF DUCTWORK

A. Ductwork leakage shall be tested in accordance with SMACNA manual, "HVAC Air Duct Leakage Test Manual", latest edition.

3.05 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements as specified in Section, NOISE VIBRATION AND SEISMIC CONTROL. Field vibration balancing is specified in Section, BASIC METHODS AND REQUIREMENTS. Provide measurements for all rotating HVAC equipment 1/2 horsepower and larger, including centrifugal compressors, fans and motors.

B. Record initial and final measurements for each unit of equipment on test forms. Where vibration readings exceed the allowable tolerance and efforts to make corrections have proved unsuccessful, forward a separate report to the Engineer.

3.06 SOUND TESTING

A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section, NOISE AND VIBRATION CONTROL. Take readings in rooms, approximately ten percent of total rooms, designated by the Engineer.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.

C. Sound reference levels, formulae and coefficients shall be according to ASHRAE Handbook, 1987 SYSTEMS AND APPLICATIONS Volume, Chapter, SOUND AND VIBRATION CONTROL.

D. Determine compliance with specifications as follows:

1. Where sound pressure levels are specified, including the NC Criteria in Section, NOISE AND VIBRATION CONTROL.

    a. Reduce the background noise as such as possible by shutting off unrelated audible equipment.
    b. Measure octave band sound pressure levels with specified equipment "off".
    c. Measure octave band pressure levels with specified equipment "on".
    d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

DIFFERENCE:	0	1	2	3	4	5 - 9	10 or more
FACTOR:	10	7	4	3	2	1	0

    e. Sound pressure level due to equipment equals sound pressure level with equipment "on" minus FACTOR.
    f. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.

2. When sound power levels are specified:

    a. Perform steps 1.a. thru 1.d., as above.
    b. For in equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
    c. For outdoor equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power

level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor.

3. Where sound pressure levels are specified in terms of dbA, measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.

E. Where measured sound levels exceed specified level, the installing Contractor or equipment manufacturer shall take remedial action approved by the Engineer and the necessary sound tests shall be repeated.

END OF SECTION

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SECTION 15990
HVAC COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Commissioning shall be the responsibility of the contractor. Contractor shall engage a certified commissioning agent to perform all commissioning, and coordinate commissioning activities between all trades.

1.02 DEFINITIONS

A. Consultant: Includes Consultant identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. BoD: Basis of Design.

C. BoD-HVAC: HVAC systems basis of design.

D. CxA: Commissioning Authority.

E. OPR: City's Project Requirements.

F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

G. TAB: Testing, Adjusting, and Balancing.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. Contractor:

1. Engage and include in contractor’s cost services required by CxA.
2. Attend procedures meeting for TAB Work.
3. Certify that TAB Work is complete.

B. Mechanical Contractor:

1. Attend TAB verification testing.

2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

C. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

D. TABContractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:

i. Accessibility of equipment and components required for TAB Work.
ii. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iv. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
v. Air and water flow rates have been specified and compared to central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.
c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 15 Section "Testing, Adjusting, and Balancing."

2. Additional Responsibilities: Participate in tests specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation."

E. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems.

2. Attend TAB verification testing.

1.04 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 1 Section "General Commissioning Requirements."

B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

C. Test Checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Strength of control signal for each set point at specified conditions.
5. Responses to control signals at specified conditions.
6. Sequence of response(s) to control signals at specified conditions.
7. Electrical demand or power input at specified conditions.
8. Power quality and related measurements.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
11. Interaction of auxiliary equipment.
12. Issues log.

1.05 SUBMITTALS

A. The following submittals are in addition to those specified in Division 1 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 15 Section "Testing, Adjusting, and Balancing."

E. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

F. Corrective Action Documents: CxA shall submit corrective action documents.

G. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
    b. Operation of terminal units in both heating and cooling cycles.
    c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    d. Building pressurization.
    e. Total exhaust airflow and total outdoor-air intake.
    f. Operation of indoor-air-quality monitoring systems.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 15 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:

1. Occupied and unoccupied.
2. Warm up and cool down.
3. Smoke control.
4. Fire safety.
5. Temporary upset of system operation.
6. Partial occupancy conditions.
7. Special cycles.

3.02 TAB VERIFICATION

A. TAB Contractor shall coordinate with CxA for work required in Division 15 Section "Testing, Adjusting, and Balancing." TAB contractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. TAB Preparation:

1. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 15 Section "Testing, Adjusting, and Balancing."

a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

C. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.

2. CxA shall notify TAB Contractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item is defined as follows:

a. For all readings other than sound, a deviation of more than 10 percent.

i. For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)

b. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

D. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and consultant in writing, and shall take action to remedy the deficiency. Consultant shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

E. CxA shall certify that TAB Work has been successfully completed.

3.03 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Contractor Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation." The CxA, HVAC contractor, and the HVAC Instrumentation and Controls contractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

E. HVAC Distribution System Testing: HVAC contractor shall prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

F. Vibration and Sound Tests: HVAC contractor shall prepare testing plans to verify performance of vibration isolation and seismic controls. CxA shall witness and certify tests and inspections.

G. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

H. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

a. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

I. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION

SECTION 16050
ELECTRICAL WORK – GENERAL

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete and operational systems for both normal and standby electric power systems, normal and emergency lighting systems, grounding systems and other specified systems, including the installation and wiring of miscellaneous equipment and devices. Perform all work and testing as indicated and specified.

1. Provide conduit, wiring and connections for power, control, lighting, instrumentation and alarms for equipment furnished by others unless otherwise specified and indicated.

2. Provide temporary circuits, overcurrent devices, conduit and wiring, and other equipment required during construction and change-over from existing to proposed electric system. Perform work at the convenience of the Owner.

3. Provide electrical system studies including a short circuit and protective device coordination study and an arc-flash study for the electrical distribution system constructed under this contract.

4. Disconnecting, removing, and relocating existing electrical equipment is a part of this Contract and is specified under Section 02410 and this Section. Make equipment scheduled for removal free of shock hazard.

5. Provide electrical relocation work associated with the relocation of equipment for the existing and new facilities, including disconnecting all existing wiring and conduits and providing new wiring and conduit to the relocated equipment. Make equipment scheduled for relocation free of electrical shock hazard.

6. The equipment enclosure classification of the plant areas are indicated on the drawings. Provide all equipment, devices and material meeting the requirements for these area classifications unless otherwise noted or specified.

7. Review the electrical underground system and the civil yard piping. Install the electrical underground system in a manner that avoids conflicts with manholes, catch basins, etc. provided under other Divisions of the specifications

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

1.03 SEQUENCING AND SCHEDULING:

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots and openings in the building structures during the progress of construction to allow for the electrical installation.

C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate and integrate the installation of electrical materials and equipment for efficient flow of the work.

E. Coordinate the installation of large equipment prior to closing in the building.

F. Sequencing and scheduling work at existing facilities:

1. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of power. Continuous service is required on all circuits and outlets affected by the work detailed in the contract, except where the Owner will permit an outage for a specific time. Obtain Owner's consent before removing any circuit from continuous service.

2. Coordinate electrical power outages to the electrical systems and equipment with the Owner. Where duration of proposed outage cannot be allowed by the Owner, phase the work to allow the system or equipment to be re-connected to the electrical power system within the time frame allowed by the Owner or provide temporary power connections as required to maintain service to the systems or equipment. The temporary power can be from a generator or another part of the facility not affected by the outage provided there is sufficient spare capacity.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. The final, complete installation shall comply with all state and local statutory requirements having jurisdiction. The Contractor shall arrange for all necessary permits, pay all fees and arrange for all required inspections by local authorities. In general, all work shall comply with the requirements of NFPA 70 (National Electrical Code), all state codes and the codes and ordinances of the city or town in which the work is to be done.

1.05 QUALIFICATIONS OF ELECTRICAL SUBCONTRACTOR

A. The Electrical Subcontractor shall have been engaged in work of a similar nature to this contract for the past 5 years.

B. The Electrical Subcontractor shall have a minimum of five projects of equal or greater size with the type of equipment specified under this project.

1.06 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. The following defines a minimum for all Division 26 shop drawing and data submittals:

a. Submit shop drawings delineated by specification number with all information for one piece of equipment provided as one package.
b. Partial submittals will be returned without action.
c. Submit bills of material: Include a numbered list of all components, with manufacturer's name, catalog number, rating, and other identification. Place item number or similar identification on all other drawings where item appears.
d. Submittal shall include:

i. Manufacturer’s drawings
ii. Panel layout
iii. Equipment layout
iv. Schematic diagram
v. One line diagram
vi. Control sequence diagrams
vii. Interconnection diagrams
viii. Wiring diagrams
ix. Catalog data

e. Submit only completed drawings showing all local and remote devices associated with each item.
f. Mark shop drawings and data submitted showing only items applicable to specific contract.
g. Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new work.
h. Submit time-current characteristic curves for all submitted protection devices such as circuit breakers and fuses.
i. Submit other documentary or descriptive information as required for each assembly to demonstrate compliance with the applicable contract documents.

2. Shop drawings and data are required for the following list:

a. Short Circuit and Coordination Studies Arc-Flash Studies
b. Harmonic Analysis
c. Conduit and Fittings
d. Wire and Cable

e. Wiring Devices
f. Pad-Mounted Transformers
g. Dry-Type Transformers
h. Low Voltage Switchgear
i. Manholes, Handholes, and Associated Equipment and Devices
j. Grounding Equipment and Devices
k. Panelboards
l. Lighting Fixtures and Accessories
m. Lightning Protection System
n. Control Stations
o. Enclosures
p. Control Panels
q. Safety Switches
r. Mats
s. 600 Volt Motor Control Centers and Motor Controls
t. Variable Frequency Controllers
u. Field Acceptance Test Reports
v. Record Drawings

3. Submit instruction manuals for installation, operation, and maintenance of equipment, and parts list for equipment listed below. Specifically mark standard publications forming a part of this contract. Cross out, blank out, or otherwise delete non-applicable items. Submittals which do not clearly indicate items and features provided shall be rejected.

a. Low Voltage Switchgear
b. Pad-Mounted Transformers
c. Dry-Type Transformers
d. 600 Volt Motor Control Centers
e. Variable Frequency Controllers

1.07 NAMEPLATES AND LABELING:

A. Provide nameplates and labels as specified in Section 16075.

1.08 INTERFERENCE AND ERRONEOUS LOCATIONS:

A. Locations of electrical equipment, devices, outlets, and similar items, as indicated, are approximate only. Exact locations shall be determined during construction.

B. Verify in field, all data and final locations of work installed under other sections of specifications, required for placing of electrical work.

C. In case of interference with other work or erroneous locations with respect to equipment or structures, furnish all labor and materials to complete the work.

1.09 APPROVAL AND MARKING EQUIPMENT:

A. Insure that devices and materials are listed and/or labeled by UL, wherever standards have been established by that organization. Where a UL listing is not available for equipment, submit certified test reports of a Nationally Recognized Testing Laboratory (NRTL), approved by the local inspecting authority, indicating that equipment is in conformance with local code requirements or any other applicable requirements. Tests and inspections for approval of equipment shall be performed at no additional cost to Owner.

B. Clearly mark equipment, devices and material with name or trademark of manufacturer and rating in volts and amperes and other pertinent information on a nameplate.

1.10 ELECTRIC SERVICE:

A. Electrical power system for the facility operates at 480/277 volt, 3-phase, 4 wire, 60 Hertz.

1. Provide electrical low voltage distribution system that operates on 208/120 volt, 3-phase, 60 Hertz obtained from the power system by dry-type transformer(s).

B. Earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints required for electrical work is included under this section and shall conform to requirements specified under applicable sections of Contract for General Construction.

1.11 EQUIPMENT SPECIFIED ELSEWHERE:

A. Certain items of control equipment and other equipment are indicated on electrical drawings for connection, but are specified in other sections pertaining to plumbing, heating, ventilating and air conditioning, mechanical process, instrumentation, etc. Such items are not furnished as part of electrical work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 REMOVAL AND RELOCATION OF MATERIAL AND EQUIPMENT:

A. Carefully dismantle and salvage electrical equipment, switches, fixtures, conduits, cables, wiring, boxes, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

B. Remove from site and dispose of material and equipment not indicated for reuse.

3.02 WORK IN EXISTING STRUCTURES:

A. In general, any or all existing electrical equipment and services are to remain in operation and shall not be disturbed unless otherwise noted in these Specifications and/or on the drawings or as required for the proper execution of the work.

B. In each area of the work, disconnect and carefully remove the existing electrical equipment and devices so noted. With the exception of items indicated as having to be re-used, all such existing equipment and devices shall be disposed of as specified herein. If not required by the Owner, remove them from the premises and site. All existing electrical equipment and devices indicated as not removed or abandoned are to be maintained in operation and any circuits disturbed by the construction shall be restored.

C. Maintain existing electrical services and systems to and in the buildings throughout the project and all "down-time" shall be scheduled at least two weeks in advance with the permission of the Engineer and such scheduling shall be rigidly adhered to.

3.03 DEMOLITION:

A. Survey the existing electrical systems and equipment identified for removal with representatives from the other trades prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

B. Where a piece of equipment is to be removed all associated ancillary components (e.g. solenoid valves, pressure switches, etc) and associated wiring and conduit shall also be removed.

C. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect all electrical power, communications, alarm and signal system.

D. Equipment scheduled to be turned over to the Owner shall be carefully disconnected, removed and delivered to the Owner where indicated. Provide labor, hoisting and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site.

E. Remove electrical work associated with equipment scheduled for demolition except those portions to remain or be reused.

F. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned circuit above accessible ceiling finishes. Removed unused wiring back to source (or nearest point of usage).

G. Disconnect abandoned outlets and removed devices. Removed abandoned outlets if conduit services them is abandoned or being removed. Provide blank covers for abandoned outlets which are not removed.

H. Disconnect and remove abandoned electrical equipment unless otherwise indicated or specified.

I. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

L. The electrical and process equipment to be removed or relocated under this contract has been identified on the Drawings.

M. Trace out existing wiring that is to be relocated, or removed and perform the relocation or removed work as required for a complete operating and safe system.

N. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

O. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc. furnished and installed to the temporarily keep circuits energized shall be removed when the permanent installation is fully operational.

3.04 PROTECTION OF ELECTRICAL EQUIPMENT:

A. Store equipment in compliance with manufacturer's recommendations and as specified herein.

B. Protect electrical equipment from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage, and construction.

C. Do not store equipment outdoors.

D. Where equipment is installed or stored in moist areas, or unheated buildings, provide acceptable means to prevent moisture damage. Provide uniformly distributed source of heat in electrical equipment to prevent condensation and damage to electrical insulation systems.

3.05 DEFECTIVE OR DAMAGED EQUIPMENT:

A. Damaged equipment shall not be used. Equipment damaged in shipment, storage, installation or through other means shall be replaced without additional cost to the Owner.

B. All equipment showing signs of water damage shall be rejected regardless of dielectric test results.

C. All electrical equipment is considered "in storage" regardless of location until first energized. Manufacturer's recommendations for storage precautions, conditions and care shall be followed.

3.06 STARTING EQUIPMENT DATA LIST:

A. Obtain data from the equipment supplier shop drawing submittals or equipment nameplates, and prepare a complete tabulation of all motors over 1/3 hp, electric heaters over 3 kW, and starting equipment for both, to be furnished on the project.

1. Include in tabulation firm the following information:

a. Name and identification of equipment.
b. Manufacturer.
c. Horsepower or kilowatt rating.
d. Voltage.
e. Phase.
f. Speed.
g. Full load current.
h. Locked rotor current or code letter.
i. Type of enclosure (open drip-proof, totally enclosed, fan cooled, etc.).
j. NEMA size of starter or contactor.
k. Overload heater size.
l. Type of starter (full-voltage, reduced-voltage, autotransformer, etc.).
m. Breaker trip setting or fuse size.
n. Voltage of starter operating coil.
o. If starter is at a motor control center, list motor control center number.

2. Final acceptance of the electrical system is contingent upon submittal of the complete motor and electric heater tabulation.

3. Arrange tabulation in groups by MCC or building location.

4. Furnish six copies of the tabulation to the Engineer when a submission is made.

3.07 DRAWINGS AND SPECIFICATIONS:

A. Drawings and specifications are typical of work to be done and of the arrangement desired. Provide accessories and appurtenances which the Engineer deems

functionally necessary for a complete installation, whether or not explicitly indicated or described.

3.08 AS-BUILT DRAWINGS:

A. The Contractor shall maintain a master set of as-built drawings showing the changes and deviations from the contract drawings.

B. A minimum of 30 days prior to application for Final Payment, submit two sets of drawings for approval that are marked to show the as-installed equipment, devices, raceway locations and wiring. The markings on the drawings are to be neat, clean and legible.

3.09 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16070
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide supports from building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. A653/A653M: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. A924/A924M: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
5. E119: Standard Method for Fire Tests of Building Construction and Materials.
6. E814: Standard Test Method of Fire Tests of Through Penetration Firestops.

B. FM Global (FM):

1. Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. Underwriters Laboratories, (UL): Applicable listings.

1. FRD: Fire Resistance Directory.
2. 263: Fire Tests of Building Construction and Materials.
3. 723: Test for Surface Burning Characteristics of Building Materials.
4. 1479: Fire Tests of Through-Penetration Firestops.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Steel or malleable iron.

B. Aluminum where indicated.

C. Stainless steel where indicated.

2.02 COATINGS:

A. Protect steel and malleable iron supports, support hardware, and fasteners with zinc coating.

B. Provide products for use outdoors.

C. Use PVC coating where indicated on Drawings.

2.03 MANUFACTURED SUPPORTING DEVICES:

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Type 316 stainless steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Powder-Driven Threaded Studs: Heat-treated stainless steel, designed specifically for intended service.
4. Nuts, Washers, and Bolts: Stainless steel.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser

conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers.

E. U-Channel Systems: Channels, with 9/16 inch diameter holes, at minimum of 8 inch on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

2.04 U-CHANNEL SYSTEMS:

A. Manufacturers, Stainless Steel Channel.

1. Unistrut Corp.
2. Power-Strut.
3. B-Line Systems, Inc.

B. Manufacturers, Fiberglass Channel.

1. Omnistrut, Champion Fiberglass.
2. Durostrut, Enduro Composite Systems.
3. Struttech, Entrum Industries.

C. Provide Type 316 stainless steel channel or fiberglass channel with corresponding accessories.

D. Channels, with 9/16 inch diameter holes, at minimum of 8 inch on center, in top surface.

E. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

F. Provide channel of the proper material to match equipment classifications.

2.05 FABRICATED SUPPORTING DEVICES:

A. Shop or field fabricate supports or manufacture supports assembled from U-channel components.

B. Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves using one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal for interior dry locations and Type 316 stainless steel for corrosive and exterior locations; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gage metal for sleeve diameter noted:

a. 3 inch and smaller: 20 gage.
b. 4 inch to 6 inch: 16 gage.
c. Over 6 inch: 14 gage.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

2.06 FIRE RESISTANT JOINT SEALERS:

A. Manufacturers:

1. "Dow Corning Fire Stop Foam," Dow Corning Corp.

2. "Pensil 851," General Electric Co.

B. Two part, foamed-in-place, silicone sealant formulated for use in through penetration fire stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

C. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with structural system and with other electrical installation.

C. Raceway Supports: Comply with NEC and following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by safety factor of at least 4. Where this determination results in safety allowance of less than 200 lbs., provide additional strength until there is minimum of 200 lbs. safety allowance in strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for interior 1 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch diameter or larger threaded steel for interior locations. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing. Use Type 316 stainless steel for exterior locations.

6. In vertical runs, arrange support so load produced by weight of raceway and enclosed conductors is carried entirely by conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors.

E. Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

F. Conduit Seals: Install seals for conduit penetrations of slabs below grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

G. Conduit extending through roof shall pass through ceiling box at roof line.

1. Provide 14 gage minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.

2. Install conduit and pitch pocket in advance of roofing work.

H. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to building structure, including but not limited to conduits, raceways, cables, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with following:

1. All hardware shall be Type 316 stainless steel. Fasten by means of wood screws or screw type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring tension clamps on steel. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.

2. Holes cut in concrete shall not cut main reinforcing bars. Fill holes that are not used.

3. Load applied to any fastener shall not exceed 25 percent of proof test load. Use vibration and shock resistant fasteners for attachments to concrete slabs.

3.02 CHANNELS:

A. Support electrical components as required to produce same structural safety factors as specified for raceway supports.

B. Install metal U-channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

C. Install Type 316 stainless steel for mounting of electrical equipment in outdoor areas and on below grade, outside building and structure walls.

D. Install galvanized steel channels for interior building mounting of electrical equipment except for those locations listed above and unless otherwise indicated.

E. Install fiberglass channel in chemical areas with NEMA 4X enclosures.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16075
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Identification of electrical materials, equipment, and installations.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. A13.1: Scheme for the Identification of Piping Systems

B. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Product Data:

C. Submit for each type of product specified.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

PART 2 - PRODUCTS

2.01 RACEWAY AND CABLE LABELS:

A. Manufacturer’s Standard Products: Where more than one type is listed for specified application, selection is Installer’s option, but provide single type for each application category. Use colors prescribed by ASME A13.1, NFPA 70, or as specified elsewhere.

B. Components and installation shall comply with NFPA 70.

C. Conform to ASME A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.

2. Legend: Indicates voltage.

D. Adhesive Labels: Preprinted, flexible, self adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.

E. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

F. Colored Adhesive Tape: Self adhesive vinyl tape not less than 3 mils thick by 1 to 2 inch wide.

G. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6 inch wide by 4 mils thick.

2. Compounded for permanent direct burial service.

3. Embedded continuous metallic strip or core.

4. Printed Legend: Indicates type of underground line.

H. Tape Markers: Vinyl or vinyl cloth, self adhesive, wraparound type with preprinted numbers and letters.

I. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 inch thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

J. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

K. Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

L. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 inch by 0.05 inch.

2.02 ENGRAVED NAMEPLATES AND SIGNS:

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application

category. Use colors prescribed by ASME A13.1, NFPA 70, or as specified elsewhere.

B. Engraving stock, melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, 1/8 inch thick for larger sizes.

1. Engraved Legend: Black letters on white face.

2. Punched for mechanical fasteners.

C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 inch grommets in corners for mounting.

D. Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396 inch, galvanized steel backing, with colors, legend, and size appropriate to application. 1/4-inch grommets in corners for mounting.

E. Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS:

A. Cable Ties: Fungus-inert, self extinguishing, 1 piece, self locking, Type 6/6 nylon cable ties with following features:

1. Minimum Width: 3/16-inch.

2. Tensile Strength: 50 lb minimum.

3. Temperature Range: -40 to 185 degrees F (-40 to 85 degrees C).

4. Color: As indicated where used for color coding.

B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install identification devices according to manufacturer’s written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in

Contract Documents or required by codes and standards. Use consistent designations throughout Project.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

F. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.
3. Apply 1 intermediate and 1 finish coat of silicone alkyd enamel.
4. Apply primer and finish materials according to manufacturer's instructions.

G. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Pressure sensitive, self adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card stock tags.
3. Labeling Legend: Permanent, water proof listing of panel and circuit number or equivalent.

H. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground, magnetically detectable, plastic line marker located directly above line at 12 inches below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16 inch, use single line marker.

1. Install line marker for underground wiring in raceway.

I. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchgear rooms.

1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Fasten tags with nylon cable ties; fasten bands using integral ears.

J. Conduit Identification: Provide permanent labels for all conduits entering and exiting manholes and handholes indicating conduit number, voltage, phase, and source.

K. Apply identification to conductors as follows:

1. Conductors to Be Extended in Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.

3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape.

L. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with accepted legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

2. Install arc flash labels on equipment as indicated in Section 16990.

3. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer and or emergency operations.

M. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with 1/2-inch high lettering on 1-1/2 inch high label; where 2 lines of text are required, use lettering 2 inch high. Use black lettering on white field. Include source, voltage, and phase for each piece of equipment. Apply labels for each unit of following categories of equipment.

   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Motor control centers.
   e. Variable Frequency Controller enclosures.
   f. Push button stations.
   g. Contactors.
   h. Control devices.
   i. Transformers.

2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and

alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16110
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete raceway systems, with matching accessories, fittings, boxes, and other hardware, as indicated and specified. When non-metallic raceway systems are specified, provide green insulated grounding conductor sized per National Electrical Code (NEC) requirements.

B. All raceway runs are indicated diagrammatically to outline general routing of raceway. Unless specifically identified for installation in concrete walls or slabs, raceways shall be run exposed with raceway supporting systems. Avoid interfering with pipes, ducts, structural members, or other equipment. Any installation deviations from the contract requirements shall be corrected at no cost to Owner.

C. Provide raceway systems in accordance with the following:

1. Within finished walls or ceilings, use rigid aluminum raceway systems.
2. In exposed NEMA 12 or NEMA 1 indoor areas, use rigid aluminum raceway systems.
3. In exposed exterior building applications, use rigid aluminum raceway systems.
4. In classified hazardous areas, areas designated NEMA 7, and where noted in the drawings, use PVC-coated rigid steel with tapered threads and sealing fittings as required by the NEC for hazardous applications.
5. Inside concrete slabs or walls, use PVC Schedule 80 raceway systems.

D. All raceway systems shall be installed in accordance with the criteria described in this section. Any proposed deviations from these requirements shall be submitted to the Engineer in writing for review and disposition.

1. Use Type 316 stainless steel support systems for exterior application and in NEMA 4X areas.
2. All NEMA 1 and NEMA 12 areas shall use Type 316 stainless steel support systems.

1.02 REFERENCES:

A. National Electrical Manufacturers Association (NEMA):

1. RN-1: Polyvinylchloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

2. TC-3: Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

B. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

C. Occupational Safety & Health Act (OSHA).

1. Regulation 1910.7

D. Underwriter's Laboratories, Inc. (UL):

1. 1: Electrical Flexible Metal Conduit

2. 6: Rigid Metal Electrical Conduit

3. 94: UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

4. 360: Electrical Liquid-Tight Flexible Steel

5. 651: Schedule 80 PVC Conduit

6. 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations, Class 1, Groups A, B, C, and D and Class 11, Groups E, F, and G

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Items provided under this section shall be listed and labeledby UL or other Nationally Recognized Testing laboratory (NRTL).

1. Term “NRTL” shall be as defined in OSHA Regulation 1910.7.

2. Terms “listed” and “labeled” shall be as defined in NFPA 70, National Electrical Code, Article 100.

C. Regulatory requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Polyvinylchloride-coated rigid steel conduit.

1. Perma-Cote Industries.
2. Robroy Industries.

B. Polyvinylchloride (PVC) Conduit:

1. Triangle/PWC, Inc.
2. Robroy Industries.
3. Carlon Electrical Sciences, Inc.

C. Rigid Aluminum Conduit:

1. Allied Tube and Conduit.
2. Wheatland.
3. Republic Conduit.

D. Flexible Conduit:

1. American Flexible Conduit Company.
2. Anamet, Inc.
3. Electri-Flex Company.
4. International Metal Hose Company.

E. Boxes and Fittings:

1. O.Z./Gedney Company.
2. Crouse-Hinds Electrical Construction Materials.
3. Appleton Electric Company.

F. Support Systems:

1. Michigan Hanger Co., (O-Strut).
2. Thomas & Betts (Superstrut).
3. Unistrut Corp.

2.02 MATERIALS AND COMPONENTS:

A. Flexible-Metal Conduit:

1. Provide flexible-metal conduit for use in dry areas and match fittings, size, and material to rigid conduit to which it is connected. Flexible-metal conduit shall conform to UL 1.

2. Provide stainless steel, braided flexible conduit in all areas. On larger than 1-1/4 inch, furnish separate external ground wire. Conduit shall conform to UL 360.

B. Polyvinylchloride (PVC) Conduit:

1. Provide PVC conduit, Schedule 80 conforming to NEMA Standard TC-2 and UL-651.

2. Fittings and Conduit Bodies: NEMA TC 3 as recommended by the conduit manufacturer.

C. Polyvinylchloride-Coated Rigid Steel Conduit:

1. Provide polyvinylchloride-coated (PVC-Coated), rigid steel conduit conforming to NEMA Standard RN-1 consisting of hot-dipped galvanized rigid steel conduit, as specified hereinbefore, with a polyvinylchloride jacket bonded to the outside of all conduit surfaces with a nominal thickness of 40 mils meeting the requirements of NEMA RN-1, 3.1. The adhesive strength of the bonding to equal or exceed tensile strength of the coating. Provide couplings and fittings for this conduit conforming to the requirements of NEMA RN-1, 3.5.

2. A two-part urethane coating shall be applied to the interior of all conduit and fittings at a two mil thickness. The interior coating shall be flexible to allow field bending without cracking or flaking.

D. Rigid Aluminum Conduit and Fittings

1. Conduit shall be extruded from 6063 alloy in Temper Designation T-1 with maximum 0.1% copper content and conforming to ANSI C80.5 and UL-6.

2. Locknuts: Copper-free (less than 0.5% copper) aluminum.

3. Bushings: Threaded type, of copper-free (less than 0.5% copper) aluminum, with 105°C rated plastic insulated throat. Plastic bushings with a temperature rating of 105°C may be used for conduits 1 inch and smaller.

4. Box Connectors for Damp and Wet Locations: Provide a watertight cast aluminum threaded hub on enclosure consisting of sealing fitting with tapered conduit thread, neoprene O-ring, and 105°C rated insulating throat with grounding and bonding lug.

5. Couplings: Threaded, made of conduit material.

6. Conduit Bodies: Use copper-free (0.4% maximum) cast aluminum conduit bodies equipped with threaded covers or gasketed covers secured with at least two captive screws.

7. Contact with Concrete: Coat conduit at all concrete penetrations and 6 inches beyond both sides of penetrations.

E. Boxes:

1. In NEMA 1 and NEMA 12 areas, provide standard, painted sheet-metal, outlet and junction boxes constructed of code-gauge, galvanized sheet steel. Size each box as required by the NEC.

2. In all exterior areas and non-hazardous corrosive areas, provide NEMA 3R Type 316 stainless steel boxes and accessories.

3. Provide boxes containing fixture studs for hanging fixtures. Use concrete-tight boxes for installation in concrete. Do not use shallow boxes unless building construction is such that it is impossible to use standard-depth boxes.

4. Provide outlet boxes and fittings for hazardous locations conforming to UL 886 for class, group, and division indicated.

5. Provide boxes and covers for polyvinylchloride-coated steel conduit made of galvanized cast iron, with a polyvinylchloride factory-applied coating over the galvanizing. Provide coating thickness of 40 mil minimum. Boxes shall have hubs with extruded sleeves extending beyond the hub in the same manner as specified for conduit couplings. Provide cover screws of stainless steel.

6. Provide cast boxes with covers or device plates suitable for the area classification. Use cover screws of stainless steel or high brass for iron boxes.

7. Boxes of dimensions 10 inches by 10 inches by 6 inches deep and larger shall be hung from ceilings constructed of angle or channel frames, and shall be made of sheet metal with welded joints. All welds shall be ground smooth. Provide neoprene gaskets for complete sealing. Sectionalize covers longer than 36 inch to facilitate handling and gasket sectionalized covers where covers meet, using angle iron or channel cross members at the joint. Sheet metal shall be not less than No. 12-gage galvanized sheet steel. Fabricate interior angles and supports of galvanized steel. Provide each box with a grounding lug for connection to the nearest ground bus. Current capacity of ground lug shall be at least that required by the NEC for the largest feeder entering the equipment.

F. Fittings:

1. Provide cast-iron fittings of malleable iron or a mixture of gray iron and cast steel.

2. Provide suitable expansion fittings where conduits cross expansion joints. Equip these fittings with grounding straps, clamps, and copper bonding jumpers.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Perform all work in accordance with the NEC.

B. Use no conduit less than 3/4-inch in diameter, unless otherwise indicated.

C. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's printed instructions.

D. Methods of Restraining Raceways:

1. Utilize threaded rod with rod stiffeners and transverse channel braces at approximately 45 degrees angle, at 15 feet on center, maximum, and on one side of rod support.
2. Utilize longitudinal bracing with channel braces at 30 feet on center, maximum.
3. Strap raceways directly to transverse channel braces, using pipe strap with both ends of strap bolted into the channel brace.
4. Do not rigidly brace raceways to different parts of a building that may respond differently during an earthquake. Seismic restraints shall not limit expansion and contraction of the raceway support system.
5. Provide flexible connections for conduits 2 inch outside diameter or greater than when terminating to fixed equipment to prevent loss of raceway integrity in the event of an earthquake.

3.02 INSTALLATION OF FITTINGS:

A. Install expansion fittings wherever conduits cross structural expansion joints. Keep the fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

B. Do not install fittings to replace elbows and pull boxes, unless space or other problems make use of fittings necessary. Use oversize fittings whenever large cable is installed, in order to maintain proper bending radius.

C. Terminate ends of all floor conduits installed for future use with couplings and readily removable plugs set flush with finished floor surface. Cap spare wall conduits at wall where they enter building. Provide identification labels and all future and spare conduits.

D. Equip ends of all conduits with conduit fittings. Fit conduits terminating at motor control center or power distribution equipment, or in box above or below, with grounding type bushings, or solidly ground by locknuts or other acceptable fittings.

Connect each grounding bushing to ground bus by a bare or green-covered copper wire. Do not use ground wire smaller than 12 AWG. Install ground wire larger than 12 AWG when required by NEC. Where conduits terminate in unprotected areas or where bonding is required over expansion joint, flexible conduit or equivalent; use ground wires 6 AWG. copper or larger.

E. Terminate conduits entering gasketed sheet-metal boxes or gasketed sheet-metal equipment enclosures with gasketed hubs.

F. Terminate conduits entering nongasketed sheet-metal boxes or enclosures with double locknuts and insulated bushings, or with acceptable equivalent.

G. Join raceways with fittings listed for the purpose. Make joints tight. Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2. Use insulating bushings to protect conductors.
3. Tighten set screws of threadless fittings with suitable tool.

3.03 INSTALLATION OF RACEWAYS:

A. Install exposed raceways parallel or at right angles to walls and ceiling beams. Make all changes in directions with listed bends, elbows, and pull boxes. Space parallel runs uniformly throughout. Secure in place by hangers and fasteners. Ground raceways by connection to properly grounded enclosures, bonding, or other means, to obtain permanent low resistance path to ground throughout installation. Ensure that raceway sections in single run and in parallel runs are of same type and finish.

1. Run parallel or banked raceways together, on common supports where practical.
2. Install raceways level and square and at proper elevations. Provide minimum 7 feet headroom.

B. Support raceways concealed above suspended ceilings from slab above ceiling in same manner as exposed raceways. Do not support raceways from ceiling supports.

C. Provide cast-in-place inserts in concrete to support all runs, unless otherwise permitted. Use stainless steel sleeve type concrete anchors for installing boxes, and conduit supports. Provide Type 316 stainless steel nut, bolts, and washers, for use with concrete anchors.

D. Support conduits by hangers or pipe straps spaced according to NEC, but in no case more than 10 feet on centers.

E. Provide Type 316 stainless steel supports for aluminum conduit.

F. When specified on the Contract Drawings, install conduits in slabs as close to middle of concrete slabs as practicable without disturbing reinforcement. Do not use conduit with outside diameter exceeding one-third of slab thickness. Do not place conduits closer than three diameters on centers, except at cabinet locations where slab thickness is increased as permitted by Engineer.

G. Where conduits are concealed in bottom floor slab, place in concrete slab and not in fill below slab. Install in middle third of the slab thickness where practical, and leave at least 4 inches of concrete cover.

1. Secure raceways to reinforcing rods and to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in the concrete.

3. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

H. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the housekeeping pad. All conduits penetrating concrete floors and all floor-mounted equipment shall have 4-inch high concrete housekeeping pads as detailed on the drawings. Extend conductors to equipment with rigid metal conduit. Flexible metal conduit may be used 6 inches above the pad. Where equipment connections are not made under this Contract, terminate ends of floor conduits installed for future use with couplings and readily removable plugs 8 inch above housekeeping pad surface. Cap spare wall conduits at wall entrance to building.

I. Provide sleeves passing through exterior walls and slabs which are wall entrance seals of watertight construction. For new construction, furnish watertight seal between slab and sleeve, and between sleeve and conduit or cable similar to O.Z./Gedney Type "FSK". For existing construction, furnish watertight seal for use in core bit drilled holes that provides seal between concrete and conduit or cable similar to O.Z./Gedney Type "CSM1". Use wall-entrance seals of malleable iron with watertight sealing gland which may be tightened any time after installation.

J. Do not use dissimilar metals in conjunction with each other. Use an insulation between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. Maintain electrical continuity of system. Use bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials as insulation.

K. Install fittings to match raceway being used.

L. Where conduits pass through firewalls, grout hole around the conduit to the full depth of the material penetrated.

M. Provide separate raceways for all low voltage instrumentation raceways (50 volts and below) from control and power raceways.

N. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box; use two locknuts, one inside and one outside the box.

O. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

P. Install pull wires in all empty raceways. Use 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 lb. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

Q. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

R. Complete raceway installation before beginning conductor installation.

S. Use temporary closures to prevent foreign matter from entering raceway.

T. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished housekeeping pad.

U. Where metal conduits rise through floor slabs in wet areas, provide PVC-coated rigid steel conduits for a distance of 6 inches above housekeeping pad and below slab grade.

3.04 BENDS:

A. Make all bends carefully to prevent distortion of circular cross section. Field bend conduit shall have an inside radius of not less than nine diameters.

B. Where bends of less than nine diameters are necessary, use standard factory elbows. Size conduit to permit cable-bending radius within the factory elbow of at least eight times cable diameter.

C. Allow no conduit greater than 50 feet to have more than two 90 degree bends or equivalent thereof between pulling points. For conduits less than 50 feet in length, allow only three 90 degree bends between pulling points.

3.05 CUTTING, THREADING AND CONNECTING:

A. Make all field cuts in conduits squarely, file cut ends, ream to remove rough edges and thread in accordance with NEC. No running thread permitted. Make all

connections mechanically strong and tight, and with acceptable connectors. Where conduit surface coating is damaged or removed in the cutting, threading or reaming process, restore the surface to its original condition.

3.06 CONDUIT CLEANING:

A. Clean all conduit carefully before and after installation, ream ends free of burrs, and free inside surfaces from all imperfections likely to injure cable.

B. After installation of each complete new conduit run, snake the run with band to which is attached a tube cleaner with cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit. Remove and replace all conduit through which mandrel will not pass.

C. Use a sponge with steel brush to clean steel conduit and use a sponge with nylon brush to clean PVC conduits.

D. After cleaning, protect ends of all conduit with standard caps to prevent entrance of water, concrete, debris, or other foreign substance.

3.07 CONDUIT DRAINAGE:

A. Where practicable, pitch conduit to drain to outlet boxes, or install so as to avoid trapping moisture. Where dips are unavoidable in exposed conduits, install fitting with drain hole at low point.

3.08 INSTALLATION OF BOXES:

A. Unless otherwise indicated, install sheet metal boxes only in dry, accessible locations. Install cast-metal boxes in exterior concrete or masonry walls, in floor slabs, in basements, all other below grade locations and elsewhere as indicated. Cast metal boxes shall be used (unless otherwise indicated) where vapor-tight fixtures are required, for all surface mounting of wall switches and receptacles and for all outdoor use. Install pull boxes for motor control centers and large ceiling hung boxes where indicated.

B. Install boxes in conformance with all the requirements of NEC. Install boxes designed for type of construction involved. Support boxes in same manner as required for conduit. Size boxes to provide bending radius for wire or cable of at least eight times diameter or in accordance with NEC, whichever is larger.

C. Center all outlets in panels, or spaces and adjust to structural finish. Where specific locations are not indicated, locate outlets with respect to equipment served.

D. Place all outlet boxes, junction boxes and pull boxes, in accessible locations when they are installed above or behind plastered ceilings, furred spaces, or suspended ceilings. Install access panels of suitable size. Mark all access panels for all boxes so

panels can be readily located in future. Mark, using metal tabs or plastic buttons which cannot mark ceilings or walls, appropriate for type of construction being used.

E. Assemble cast-metal boxes with threaded conduit hubs in such manner that conduit connections and gasketed covers are watertight. Close all unused threaded openings with pipe plugs and compound.

F. Provide cast boxes with covers and device plates suitable for the area classification. Install screws of stainless steel or high brass for iron boxes.

3.09 FLEXIBLE CONNECTIONS TO MOTORS AND EQUIPMENT:

A. At all motors and electrically operated equipment to which conduit connections are made, install with a complete connection between end of conduit and terminal box of motor or other equipment.

B. Install the conduits in locations permitting direct connection to motors.

C. Make connections between rigid raceway and motor or equipment subject to vibration and adjustment using flexible conduit. Make each connection with at least one quarter bend so that no vibration can be transmitted beyond flexible connection.

D. Install flexible metal conduit, fittings, and accessories in dry areas in accordance with requirements of NEC.

E. Install liquid-tight, stainless steel braided flexible metal conduit in damp, wet, and corrosive areas. Locate conduit to reduce the possibility of damage to the exterior coating. Use fittings that screw into flexible conduit and provide gaskets.

F. Use maximum of 6 feet of flexible conduit for recessed and semirecessed lighting fixtures and; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install liquid-tight flexible metal conduit in areas subject to wetting due to fire protection sprinklers or broken or ruptured water line. Locate conduit to reduce the possibility of damage to the exterior flexible conduit jacket. Use fittings that screw into flexible conduit and provide gaskets. Install separate ground conductor across flexible connections.

3.10 HAZARDOUS AREAS:

A. Install all conduits, fittings, equipment and devices within areas to comply with requirements of NEC for Hazardous Locations, Class, Division, and Group as indicated on the drawings.

B. In such hazardous locations, seal conduits terminating at boxes enclosing circuit-opening equipment at entrance to enclosure with compound-filled, commercial,

sealing fittings to prevent passage of explosive or combustible gases through conduits.

C. Seal all conduits leading from or entering such hazardous locations at points of exit or entrance with two-part epoxy sealant.

D. Install conduit connections with at least five threads tightly engaged, and made up with suitable thread compound.

E. Where drain/seal fittings are required, they shall be of malleable iron construction with an internal drainage path which provides a visual means to ensure that the compound chamber is properly filled. The installation shall enable the drain/breather fitting and filler plug to be installed right after the compound is poured.

3.11 PROTECTION:

A. Provide protection and install in accordance with manufacturer printed instructions. The conduit and raceway equipment manufacturers, to ensure that coatings, finishes, and enclosures are without damage or deterioration at completion of project.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

3.12 FINAL SYSTEM ACCEPTANCE:

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions and at no additional cost to the Owner.

B. Label all raceways and boxes in accordance with the requirements of Section 16050.

3.13 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16120
ELECTRIC WIRES AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide wires and cables for complete electrical systems as indicated and specified.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. B3: Soft or Annealed Copper Wire.
2. B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Insulated Cables Engineers Association, Inc. (ICEA)/National Electrical Mfg's Association (NEMA):

1. S-61-4021/WC 5: Thermoplastic Insulated Wire & Cable.
2. S-66-524/NEMA WC 7; Cross-Linked-Thermosetting-Polyethylene Insulated Wire and Cable.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/Electronic Industries Association (EIA):

1. ANSI/TIA/EIA-568-B; Commercial Building Telecommunications Cabling Standards.

E. Underwriters Laboratories, Inc. (UL):

1. 44: Thermoset-Insulated Wires and Cables.
2. 83: Thermoplastic-Insulated Wires and Cables.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturer's product data in accordance with the requirements of Sections 01300 and 16050.

1.04 WARRANTY:

A. The manufacturer shall warrant the cable against failures for a period of 40 years from date of installation and shall remove and replace failed cables at their own expense during this warranty period.

1.05 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Deliver wire and cables in full reels protected against injury. Deliver reels with factory attached UL approved tags showing the manufacturers name and the type of insulation, size, and length of wire in each coil or reel.

C. Accept wire and cable on site in manufacturer's packaging. Inspect for damage.

D. Store and protect in accordance with manufacturer's instructions.

E. Protect from weather. Provide adequate ventilation to prevent condensation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. 600V Cable:

1. Okonite.
2. Southwire.
3. American Insulated Wire.

B. Control and Metering Wire:

1. Belden Wire and Cable.
2. Alpha Wire.
3. Coleman Cable.

C. Cable Fireproofing Tape:

1. MAC Products, Inc.
2. 3M Electrical Products.

2.02 MATERIALS AND COMPONENTS:

A. Furnish copper conductors. Material and stranding of conductors to conform to ASTM B3, ASTM B33, and to ASTM B8, for the appropriate class.

B. Uncoated, soft or annealed copper wire conforming to ASTM B3.

C. Wires and Cables for Maximum 600-Volt Power Circuits: For No. 8 AWG gauge and smaller provide type XHHW. Where used in lighting or receptacle branch circuits provide No. 12 AWG gauge and No. 10 AWG gauge as solid conductor. Provide other wire with Class C stranding. Provide No. 6 AWG gauge and larger as XHHW-2with Class B stranding. Provide wires and cable conforming to UL 83.

D. Wires and Cables for Control, Indicating, Metering, or Alarm Circuits: Single and multi-conductor control cable, copper conductors, Class B or C stranding. Insulation; 600-volt polyethylene, polyvinylchloride, or EPR. Continuous rating of 90C dry and 75C wet. Color coding conforming to Table K-2, ICEA/NEMA S-61-4021/WC 5.

E. Multi-conductor control cable shall be used for the underground system and shall be No. 12 or 14 AWG, stranded with overall jacket.

F. Ground wires shall be Type XHHW, green insulation. Bare ground wires shall be soft drawn copper, 98 percent conductivity.

G. Shielded Cable for Instrumentation Wiring: 7-strand copper conductors, size No. 16 AWG. Insulate conductors individually with color coded polyethylene or polyvinylchloride. Twist pairs with varying lay (if more than one pair) and cover with cable tape and copper or aluminum coated Mylar shielding tape and tinned copper drain wire. Jacket: polyvinylchloride. Cables: rated 600 volts and 90 degrees C.

H. Category 6 Cable: Category 6 cable shall consist of 4 twisted pairs of different lay and ground wires, enclosed by an overall conductive mylar backed aluminum foil shield. This shall be enclosed by an overall thermoplastic jacket. The cable shall meet the applicable requirements of ANSI/TIA/IEA-568-B.

I. PROFINET Cable:

1. Provide PROFINET data cable for connection to all PROFINET-capable devices. Meet the following requirements:

   a. Approvals: IEC : 60332-1-2
   b. IEEE 1202/383
   c. Data Pair: 4/22 AWG, solid
   d. Outer Jacket: PVC, Yellow-green color, 8.1mm nominal diameter
   e. Shields: Foil/braid
   f. Manufacturer: Belden 7960A

2. Provide cables in lengths necessary to meet requirements as shown on the drawings.

3. Provide connectors as necessary.

J. PROFIBUS DP Cable:

1. Provide PROFIBUS DP data cable for connection to all PROFIBUS-capable devices. Meet the following requirements:

   a. Approvals: NEC
   b. UL: Type PLTC
   c. Data Pair: 2/22 AWG, solid
   d. Outer Jacket: PVC, Violet color, 8.92mm nominal diameter
   e. Shields: Foil and tinned copper braid
   f. Manufacturer: Belden 3079A

2. Provide cables in lengths necessary to meet requirements as shown on the drawings.

3. Provide connectors as necessary.

PART 3 - EXECUTION

3.01 GENERAL:

A. Perform work in accordance with the National Electrical Code.

B. Provide power cable identification as follows:

System Voltage	Neutral	Phase A	Phase B	Phase C
208/120V	White	Black	Red	Blue
240/120V	White- Gray Stripe	Black- Blue Stripe	Red- Blue Stripe	None
480/277V	Gray	Brown	Orange	Yellow

C. Use green to identify insulated ground conductors.

D. NOTE: Colored insulation, tapes or sleeves may be used to provide color coding. Insulated ground conductors must have green covering.

E. Permanently post means of identification of grounded and ungrounded conductors for each nominal voltage system at each panelboard and motor control center.

F. In power and multiconductor cables manufactured without a grounding conductor identify one of the multiconductors as the equipment grounding conductor at each cable end and at every point where the conductors are accessible.

3.02 INSTALLATION OF WIRING:

A. Unless otherwise indicated, use no conductor smaller than No. 12 AWG for power, No. 14 AWG for control, and No. 16 AWG for shielded applications.

B. Install conductors continuous from outlet to outlet and make no splices except within outlet or junction boxes.

C. Install cable in underground raceway system without splices. There shall be no splices between connection points unless otherwise indicated.

D. Draw all conductors contained within a single conduit at the same time.

E. Apply wire pulling compound to conductors being drawn through conduits. Use pulling compound, Minerallac No. 100, Y-er-Eas, Yellow 77, or High Performance Polywater Cable Lubricant.

F. Use no cable bend with radius of less than eight times its diameter.

G. Wires and cables installed without prior submittal review are subject to removal at no additional expense.

3.03 CONDUCTOR IDENTIFICATION:

A. Label each wire at both termination points. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification clearly stamped on terminal boards and printed on directory cards in distribution cabinets and panelboards.

B. Identify each wire in junction boxes, cabinets, and terminal boxes where total number of control, indicating, and metering wires is three or more and no terminal board is provided, including all power wire. Where no termination is made use a plastic-coated, self-adhesive, wire marker and where termination is made use a, plastic, pre-printed sleeve wire marker.

C. In cases similar to above where terminal boards are provided for the control, indicating, and metering wires, identify all wires including motor leads and other power wires too large for connection to terminal boards, by sleeve wire markers as specified above.

D. In manholes and handholes, identify each power wire by laminated plastic tag located so it is easily seen. Control wires to be bundled and marked as listed in conduit and wire schedule.

3.04 CONNECTORS, TERMINAL LUGS AND BOARDS:

A. For wiring of circuits consisting of No. 10 or No. 12 AWG solid wires, such as for lighting branch circuits, use self-insulated pressure type connectors for all splices or joints.

B. Terminate all wires connected to terminal boards, terminal blocks, or to other similar terminals by means of ring and tongue, nylon self-insulated, tin-plated copper pressure terminals.

C. Terminal boards shall be 600 volts and rated for 125 percent of the ampacity of the connected circuit. They shall have screw terminals, with white marking strips for wire identification, of the 4-, 6-, 8-, or 12-pole type, as necessary.

D. Wire connections for which terminals are not supplied, for example, at solenoids or motor terminal junction boxes:

1. 10 AWG and smaller: Use self insulated pressure-type connectors.

2. 8 AWG and larger: Use insulated, mechanical type with set screw or follower bearing directly on the wire. Split bolt connectors are not acceptable.

E. Clearly and permanently mark terminal strips with ink or indelible pencil. Mark each wire consistently throughout entire system, using notation of wires given on manufacturer's wiring diagrams wherever possible.

3.05 FIELD TESTING:

A. Submit results of all cable tests on forms indicating cable size, voltage, and date with name of tester and witness.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16124
MEDIUM VOLTAGE CABLES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide medium voltage cables, and accessories for systems rated above 2001 volts to 15,000 volts.

1.02 REFERENCES:

A. Association of Edison Illuminating Companies (AEIC):

1. CS8-00: Specification for Extruded Dielectric Shielded Power Cables rated 5 through 46 Kv.

B. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE):

1. C2: National Electrical Safety Code.
2. 386: Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
3. 404: Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5000V Through 46,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500V Through 500,000V.

C. ASTM International (ASTM):

1. B3: Standard Specification for Soft or Annealed Copper Wire.
2. B8: Standard Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium Hard, or Soft.

D. Institute of Electrical and Electronics Engineers (IEEE):

1. 48: Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.
2. 592: Standard for Exposed Semi conducting Shields on High Voltage Cable Joints and Separable Insulated Connectors.
3. Std. 400.2: Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

E. Insulated Cable Engineers Association (ICEA):

1. S-93-639/NEMA WC74: 5-46KV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

2. S-97-682: Utility Shielded Power Cable rated 5-46kV.

3. T-25-425: Guide for Establishing Stability of Volume Resistivity for Conducting Polymeric Components of Power Cables.

F. National Fire Protection Association (NFPA):

1. 70: National Electrical Code.

G. Underwriters Laboratories, Inc. (UL).

1. 1072: Medium-Voltage Solid Dielectric.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Submit qualifications of third party independent NETA-certified testing firm.

C. Test Reports:

1. Certified copies of production sampling and completed cable test reports described in Paragraph 1.04 of this Specification shall be submitted prior to shipping cable in a legible and coherent format. This data should include the X-Y plot of the partial discharge test per ICEA.

2. Test reports shall be in a legible and coherent format and reported in accordance with AEIC CS8.

D. Catalog Data: Submit catalog data showing physical information, specifications used for manufacturing and materials used to manufacture cable.

E. Submittal Data Shall Include:

1. Letter stating cable meets specification and the date of cable manufacture.

2. Conductor size.

3. Conductor shield materials.

4. Insulation material.

5. Insulation thickness.

6. Diameter over insulation.

7. Insulation semi-conductor thickness.

8. Jacket material.

9. Jacket thickness.

10. Diameter of cable.

11. Weight per unit length of cable.

12. Cable pulling calculations including direction of pull.

F. Certification of the Qualifications of Medium-Voltage Cable Installers: The certification shall be accompanied by satisfactory proof of the training and experience of persons listed by the Contractor as cable installers.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Cable furnished under this specification shall conform to the latest edition of Insulated Cable Engineers Association (ICEA S-93-639) or its successors, except as specifically modified herein.

C. The completed cable shall meet or exceed all Insulated Cable Engineer's Association (ICEA), and Association of Edison Illuminating Companies (AEIC) physical and electrical tests. Tests shall be performed and frequency of sampling shall be in accordance with the latest edition of ICEA S-93-639 except as modified herein. All tests required by this specification, AEIC and ICEA shall be performed.

D. Cable shall be manufactured and tested using good care and workmanship.

E. EPR insulated cable shall be manufactured by a dry or steam curing process.

F. The conductor shield, the insulation, and the semiconducting insulation shield extrude in a triple tandem, dual tandem, or true triple process.

G. Production sampling tests shall be in accordance with ICEA S-93-639, ICEA S-97-682, and AEIC CS8.

H. AC Voltage Tests: Each factory reel length shall withstand AC voltage tests by the manufacturer at the factory in accordance with ICEA S-93-639.

1.05 WARRANTY:

A. The manufacturer shall warrant the cable against failures for a period of 40 years from date of installation and shall remove and replace failed cables at their own expense during this warranty period.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. The cable shall be placed on the shipping reel with both ends of cable accessible for proof testing. Ends of cable shall be sealed with weatherproof material prior to shipment.

C. Each end of each length of cable shall be hermetically sealed and securely attached to the reel.

D. Minimum reel drum diameter shall be 14 times the overall diameter of the cable.

E. A pulling eye shall be installed by the manufacturer for each length of cable supplied for installation in ducts, manholes, and utility tunnels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Medium voltage cables as manufactured by:

1. Okonite.
2. Prysmian Cables & Systems.
3. Southwire.

B. The cable manufacturer shall have a minimum of 10 years proven and successful experience with the manufacturing of EPR insulated cables.

C. All cable furnished shall be installed within 12 months of manufacture date. Labeling of cable shall be per NEMA and shall contain no less than the following information:

1. Name of Manufacturer
2. NEC Designation

D. Cable shall be operated at 60 Hertz, single or three phase at system voltage of 5 kV or 15 kV. Suitable installations include in conduit for wet or dry location and in open air in sunlight.

2.02 CONDUCTOR:

A. The conductor shall be Class B concentric lay stranding, uncoated copper in accordance with ASTM B3 and B8 and ICEA S-93-639 with the minimum number of wires noted below:

Conductor Size Range	Number of Strands
1 - 4/0	19
250 - 500	37

B. Conductor shall be free from moisture, corrosion and excessive drawing lubricant before conductor shielding is applied.

2.03 CONDUCTOR SHIELD (STRAND SCREEN):

A. The strand screen shall consist of an extruded semiconducting thermosetting compound applied over the conductor. It shall be of a material compatible with the thermal characteristics of this conductor metal and insulation, shall be uniformly and firmly bonded to the overlying insulation, and shall be free stripping from the conductor. A semiconducting tape may be applied between the conductor and the extruded conductor screen. Okonite EPR based semiconductor is an approved exception.

B. The D-C volume resistivity of the extruded conductor shield shall not exceed 1000 meter-ohms at the maximum normal operating and emergency operating temperature accordance with ICEA Publication T-25-425.

C. The extruded strand shield shall have a minimum elongation of 100 percent after an air oven test at 250 degrees F (121 degrees C) for seven days and a brittleness temperature not warmer than 14 degrees F (-10 degrees C).

D. The contact area between the insulation and conductor shield shall not exhibit projections or irregularities which extend from the cylindrical surface of the conductor shield by more than 5 mils toward the insulation or 10 mils away from the insulation.

2.04 INSULATION:

A. Insulation shall conform to ICEA S-93-639 except as modified herein and shall be the following:

1. The insulation shall be a high quality heat, moisture, ozone, and corona resistant high dielectric strength ethylene propylene rubber compound. It shall be contrasting in color from the extruded strand and insulation screens. It shall contain less than 5 percent polyethylene, and the ethylene content of the elastomer shall not exceed 72.5 percent by weight of ethylene to limit susceptibility to treeing.
2. Insulation shall be for use in wet or dry locations at conductor temperatures not exceeding 220 degrees F (105 degrees C) for continuous operation, 285 degrees F (140 degrees C) emergency overload conditions, and 480 degrees F (250 degrees C) short circuit conditions.

B. The insulation shall have a minimum and maximum thickness for a 133 percent insulation level as specified in Table II below:

TABLE II			
Rated Circuit Voltage (kV) Phase to Phase	**Conductor Size (AWG or kcmil)**	**Minimum Insulation Thickness (mils)**	**Maximum Insulation Thickness (mils)**
15	2 – 1,000	210	250

C. Insulation shall be homogeneous and free of gels or discolorations larger than 10 mils.

D. The insulation shall meet or exceed the requirements of all tests specified in ICEA S-93-639.

E. The interface between the insulation and insulation shield shall be free of contaminants larger than 4 mils. The insulation shall be free from contaminats, gels and agglomerates larger than 10 mils.

2.05 INSULATION SHIELD (INSULATION SCREEN):

A. Insulation shield shall conform to ICEA S-93-639, except as modified herein.

B. The insulation screen shall consist of an extruded, semiconducting thermosetting compound applied over and compatible with the insulation. It shall be of a material compatible with the thermal and chemical characteristics of the insulation and the overlaying metallic shield. Okonite EPR based semiconductor is an approved exception.

C. The thickness with corresponding minimum and maximum points shall be as specified in Table III:

TABLE III		
Calculated Minimum Diameter over Insulation inches (mm)	**Insulation Shield Minimum Point Thickness, mils (mm)**	**Insulation Shield Maximum Point Thickness mils (mm)**
0 - 1.000 (0 - 25.4)	24 (0.6)	60 (1.5)
1.001 - 1.500 (25.5 – 38.1)	32 (0.8)	60 (1.5)
1.501 - 2.000 (38.2 – 50.8)	40 (1.0)	75 (1.9)
2.001 (50.9) & Larger	40 (1.0)	90 (2.3)

D. The insulation shield shall not alter its physical or electrical properties from exposure to sunlight or the elements.

1. The extruded insulation shield shall have a minimum elongation of 100 percent after an air oven test at 250 degrees F (121 degrees C) for 7 days and a brittleness temperature not warmer than minus 22 degrees F (-30 degrees C).

E. The D-C volume resistivity of the extruded insulation shield shall not exceed 75 meter-ohms at 194 degrees F (90 degrees C) when tested in accordance with ICEA Publication T-25-425.

F. The insulation shield shall be free stripping from the insulation, and the tension necessary to remove the extruded insulation shield shall be 3 to 24 pounds at room temperature when tested in accordance with ICEA S-93-639.

G. The contact area between the insulation and insulation shield shall not exhibit projections or irregularities, which into the insulation from the insulation shield more than 5 mils and into the insulation shield from the insulation more than 7 mils.

2.06 METAL TAPE SHIELD:

A. Cable shall have a metal tape or metal tape with wire shield.

B. A copper tape with nominal thickness of 0.005 inches shall be applied directly over the insulation shield. The tape shall be of suitable width and shall lap at least 12.5 percent of its width. The tape shall be free from burrs and, where jointed, shall be made electrically continuous. (If wire shield is used, it shall be mechanically and electrically comparable).

C. Application of tape shield or wire shield shall not deform the insulation.

2.07 JACKET:

A. The jacket shall be black polyvinyl chloride compound meeting the requirements of ICEA S-93-639.

B. The average thickness of the jacket shall be not less than the values specified in the following table. The minimum thickness of the jacket at any point shall be not less than 80 percent of the specified minimum average thickness.

TABLE IV

Calculated Diameter of Cable under Jacket, inches (mm)	Min. Thickness of Jacket, mils (mm)
0.700 (18) and Smaller	55 (1.40mm)
0.701 - 1.500 (19 - 38)	70 (1.78mm)
1.501 - 2.500 (39 - 63)	100 (2.54mm)
2.501 (64) and Larger	125 (3.17mm)

C. Linear shrinkage of the jacket shall not exceed the linear shrinkage of the insulation.

D. The jacket shall be sunlight resistant in accordance with the requirements of UL 1072.

2.08 CABLE DIMENSION:

A. Cable dimensions shall be in accordance with ICEA S-97-682.

B. Diameters over insulation shall be in accordance with ICEA S-97-682.

2.09 CABLE TERMINATIONS:

A. Outdoor: Terminations that are exposed to the weather, such as riser poles.

1. Terminations of the shielded power cables shall be manufactured molded rubber terminations, IEEE 48, Class 1. Elastimold type 35MTG with the grounding device for the metallic shield (Elastimold Type 20 MA for metallic type shield) and NEMA 2-hole, long-barrel terminal connector. The connector shall be listed for copper/aluminum applications.

B. Indoor: Terminations that are inside equipment or weatherproof compartments of outdoor equipment, such as transformers and switchgear.

1. Terminations of shielded power cables rated 15 kV or less shall be done with an IEEE Standard 48 Class 1 termination. It shall either be a one-piece design, where high-dielectric constant stress control is integrated within a skirted insulator made of silicone rubber, gray in color or provide for positive placement of the stress control with the installation of a stress patch. The termination shall not require heat or flame for installation. The terminations shall be 3M Brand 5630 K Series Quick Term II cold shrink Termination Kits or Raychem TFT-E-SG. Only a NEMA 2-hole, long-barrel terminal connector shall be used. The connector shall be listed for copper/aluminum applications.

C. Cable terminations shall have voltage ratings of not less than 15,000 volts (ungrounded neutral). The standard withstand test voltage of the completed terminations shall conform to IEEE Standard No. 48.

2.10 SPLICES:

A. Splices are not allowed.

2.11 CABLE IDENTIFICATION TAGS:

A. The cables shall have identification tags in manholes (at conduit entrances) and at equipment terminations indicating feeder number and routing (Example: Routing: "To MH-36", "To SW0893-1B". Feeder: "3501"). The tags shall be 1 inch polypropylene plastic (Almetek EZH9) affixed to cables with plastic or nylon ties.

B. At underground riser poles where feeders make a transition from underground to overhead, the feeder number will be 2 inch x 2 inch black letters on yellow background adhesive-backed numbers. These numbers shall be attached to an

aluminum strip nailed to wood or banded to steel pole above the cable terminator bracket.

2.12 FIREPROOFING:

A. Cables in manholes shall be fireproofed with one layer of one half-lapped 3M 77 tape applied and held in place with 3M 69 tape. The fireproofing tape shall completely cover each cable from duct entrance to duct exit.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. All work on primary conductors shall be done only when such conductors and equipment are de-energized.

1. Written request for outages shall be submitted twenty-one (21) calendar days in advance of the outage date. This request will delineate the particular circuit or service interrupted and the approximate hours the utility shall be off.
2. The work to be performed during an interruption of electrical utilities will be preceded by all possible preparation and will be carefully coordinated to minimize the duration of the interruption and work will proceed continuously until the system is restored to normal.
3. Phasing of reconnected feeders shall be identical to the existing phasing.

B. Install and terminate primary cables in accordance with the manufacturer's approved recommendations and tools suggestions. The conductors shall be free of kinks and twists, and all bends shall be formed with smooth radius not smaller than twelve times the diameter of the cable nor smaller than the minimum radius recommended by the manufacturer, whichever is greater. All 600 amp and 200 amp terminations shall be mounted to avoid any stress on the terminations.

C. The two-hole cable connectors shall be crimped with only the manufacturer's approved tool recommendations.

D. All cables in one conduit shall be pulled in together using a suitable patented grip on the conductors with a basket weave grip over the insulation, arranged so the stress of pulling is applied to the conductor and not the insulation.

E. Use a swivel between the cable grip and pulling rope.

F. Lubricate cables with Cable lube or Minnearallac cable pulling compound or the type approved by the cable manufacturer.

G. Maximum pull tensions shall not exceed values recommended by the cable manufacturer or as specified on the drawings. Pulls shall be made in the directions shown in the submitted cable pulling calculations.

H. Install cables in manholes along wall as specified on drawing providing proper support. In manhole, route cables a minimum of 3/4 of manhole perimeter.

I. Cable shield shall be grounded with #6 bare copper to manhole ground at all terminations to provide permanent, low-resistance bond.

J. After cables have been terminated and fireproofing tape applied, each cable shall have a spiral wrap of colored 1/2-inch wide tape 3M #35 vinyl plastic applied over the fireproofing tape. Spiral wrap of colored tape shall be over the total length of cable, with maximum of 5-inch separation between spirals. The color coding is as follows:

1. 12470 volt - Blue Tape (3M #10240)

K. Seal all duct runs in manholes going inside buildings with a water-tight seal.

L. Cables of the same circuit shall be identified by tags in manholes (at conduit entrances) and entrances into equipment. Information on tags shall include: circuit number and routing (circuit number will be confirmed at the outage coordination meeting). Tags shall be installed on each cable after fireproofing (see Part 2.12).

M. Cables of the same circuit shall have the phasing identified with color tape in manhole. Phase A with one wrap, Phase B with two wraps, Phase C with three wraps.

3.02 CABLE ENDS:

A. After cutting, if cable ends are not to be terminated in same working day cut, immediately protect cable ends from damage or moisture by sealing with cable caps and silicone sealant. Provide stress relief at all terminations. Provide correct phasing of the conductors of each circuit at all terminations. Provide proper connections of tape shield or tape shield and drain wire to ground.

3.03 TEST PREPARATION:

A. Contractor to engage services of a recognized testing firm to inspect and test the installed cables prior to energizing. Testing of the cable shall be performed in the presence of the Engineer.

B. Exposed ends of cable shall be prepared and cleaned prior to testing in order to minimize any leakage current.

C. Cable circuit ends must be cleaned and guarded for personnel safety during cable testing. Circuits not under test in the immediate vicinity shall be grounded.

3.04 FIELD TESTING AND RECORDS:

A. Each power cable shall first be given a full dielectric-absorption test with 5000-volt insulation-resistance test set.

1. Test shall be applied for a long enough time to fully charge the cable.

2. Readings shall be recorded every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter.

3. Test shall continue until three equal readings, 1 minute apart, are obtained.

4. Minimum reading shall be 200 megohms at an ambient temperature of 68 degrees F (20 degrees C).

5. Readings taken at other than 68 degrees F (20 degrees C) ambient temperatures shall be corrected accordingly.

B. Upon successful completion of the dielectric adsorption tests, the cable shall be subjected to a direct-current high-potential test for 5 minutes with test voltages applied in accordance with AEIC CS8 and IEEE Std. 400.2 for cross-linked, polyethylene-insulated cable; and AEIC CS8 and IEEE Std. 400.2 for ethylene propylene rubber-insulated cable.

1. Leakage current readings shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter for the remainder of the test.

2. When the leakage current continues to increase after the first minute, the test shall be immediately terminated and steps taken to find and correct the fault. When a second test becomes necessary, this test procedure shall be repeated.

C. Upon satisfactory completion of the high-potential test, the cable shall be given a second dielectric adsorption test as before.

D. Results of the second dielectric-adsorption test shall agree with the first test and shall indicate no evidence of permanent injury to the cable caused by the high-potential test.

E. Test data shall be recorded and shall include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

F. Final acceptance shall depend upon the satisfactory performance of the cable under test.

G. Exposed circuit ends under test require a minimum separation from all elements not subjected to a test of 1 inch per 10 kV of test potential. After testing, cables shall be grounded for a minimum of 4 times (4X) as long as the test voltage was applied during the hi-potential tests to assure complete discharge.

H. When all cables and terminations have been tested and test results have been accepted by the Engineer, the cable system may be placed in service.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16135
CONTROL PANELS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section describes materials and installation of custom control panels.

1.02 REFERENCES:

A. Underwriters' Laboratories, Inc., (UL):

1. 486A: UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors
2. 508: Electrical Industrial Control Equipment.
3. 508A: Industrial Control Panels.
4. 1059: Safety Terminal Blocks.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Submit a complete list of equipment, materials, and any details required to demonstrate that the equipment will function properly as a unit. This material shall include:

1. System configuration with single-line diagrams.
2. Detailed descriptions of equipment including weights, dimensions, installation requirements, and heat dissipations.
3. Internal panel layouts indicating spacing and dimensions.
4. Panel front layouts.
5. Catalog cuts of devices used.
6. Control schematics, ladder diagrams, and interconnection drawings.
7. Nameplates.
8. Program and programming data for the PLC including logic diagrams.

1.04 MANUFACTURER'S SERVICES:

A. Services of Manufacturer’s Representative as stated in Section 01400 and as specified herein.

B. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Check installation and calibrate the equipment:

a. 1 person-day.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 1 person-day.

4. Performance Testing: Field performance test equipment specified.

a. 1 person-day.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. 1 person-day.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 DIAGRAMS:

A. Schematic diagrams shall show the equipment serial or tag number, the Owner's drawing number, contract number, or similar identification which will indicate the particular equipment to which the diagrams apply. Diagrams shall show all equipment in the electrical system including internal wiring of subassemblies. Diagrams of subassemblies may be furnished on separate sheets.

B. Identify each device by a unique number or number-letter combination.

C. Conductor Identification: Identify each conductor by a unique number, letter, or number-letter combination. Consecutive numbering is preferred. Conductors connected to the same terminal or tie point shall have the same identification. Where multiconductor cable is used, a color code may be used to supplement the above identification. Where color- coded multiconductor cable is used for wiring identical components, such as limit switches, the color code used shall be consistent and charted on related diagrams.

D. Provide a schematic diagram for each electrical system. The schematic diagram shall be drawn between vertical lines that represent the source of control power. Show control devices between these lines. Show actuating coils of control devices on the right-hand side. Show contacts between the coils and the left vertical line.

1. Where the internal wiring diagrams of subassemblies are furnished on separate sheets, they shall be shown as a rectangle in the schematic diagram with external points identified and cross-referenced to the separate sheets of the control circuit. Show coils and contacts internal to the subassemblies in the rectangle connected to their terminal points.

    a. Exception No. 1: Where relay and electronic circuits are mixed, diagrams may be drawn between horizontal lines that represent the source of control power.
    b. Exception No. 2: Overload relay contacts may be connected to the right of the coil (common) if the conductors between such contacts and the coils of the magnetic devices do not extend beyond the control enclosure.

2. For clarity, show control device symbols in the order in which the controls are positioned on the diagram.

3. Use a cross-referencing system in conjunction with each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet.

4. Show spare contacts.

5. Show limit, pressure, float, flow, temperature sensitive, and similar switch symbols on the schematic diagram with utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position.

6. Show contacts of multiple contact devices, e.g., selector switches, on the line of the schematic diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow. This does not apply to control relays, starters, or contactors.

7. Additional charts or diagrams may be used to indicate the position of multiple contact devices such as drum, cam, and selector switches.

8. Show the purpose or function of switches adjacent to the symbols.

9. Show the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram adjacent to their respective symbols. Show the number of positions of solenoid valves adjacent to the valve solenoid symbol.

10. Show values of capacitors and resistors on the diagram.

11. Descriptive terms for command and status functions shall be in the present or past tense. For example, Raise Transfer-Transfer Raised; Advance Transfer-Transfer Advanced. Do not use terms such as "Transfer Up."

E. The panel front and internal layouts shall show the general physical arrangement of components on the control panel. Identify devices with the same marking as used on the schematic diagram. Spare panel space shall be dimensioned. The drawings shall include a layout of the operator's console or push-button station, but terminal numbers need not be shown.

F. Install laminated copy of diagram and layout on inside front door of enclosure.

2.02 CONTROL ENCLOSURES:

A. Design and test control enclosures in conformance with UL 508. Enclosure types shall be as follows unless noted otherwise in the drawings:

Indoor Use	NEMA 1
Outdoor Use	NEMA 3R Type 316 Stainless Steel

B. The depth of the control enclosure or compartment shall be a minimum consistent with the maximum depth of the control devices plus the required electrical clearance. In no case shall the depth of the enclosure be less than 8 inches.

C. Provide mounting panel for mounting of interior components. Panel finish shall be white enamel.

D. Where heating from control devices results in a temperature rise which is detrimental to the contained equipment or its operation, provide louvers or forced air ventilation. Design ventilating openings to prevent the entrance of any deleterious substance. When forced air ventilation is required, the cabinets shall be pressurized. Air filters shall be of commercially available types and sizes.

E. Provide a permanent metal data pocket attached to the inside of the enclosure. If space permits, the pocket shall be at least 10 1/2 inches wide and of depth and thickness to accommodate electrical diagrams.

F. NEMA 1 enclosure construction shall be minimum 14 gage steel. Finish shall be white enamel inside and gray prime outside over phosphatized surface. NEMA 3R enclosure construction shall be Type 316 stainless steel with sunshields on top, front,

back, and sides. Provide continuous hinges for enclosure doors with external screw clamps. Provide hasp and staples for padlocking.

2.03 CONTROL WIRING:

A. 120-volt control wiring shall be Type MTW, THWN, or THHN. Conductors shall not be smaller than No. 14 AWG. Ampacity shall be in accordance with the NEC.

B. Instrumentation signal cables shall be of the type used for field wiring.

2.04 MARKING:

A. Identify wire terminations with a number to correspond with the schematic diagrams. Identification tags shall be preprinted white heat-shrinkable tubing, Raychem Thermofit TMS.

B. Plainly and permanently identify control and power devices using the same identification as shown on the schematic diagrams. Show identification for devices inside the enclosure on a plate adjacent to, not on, the device.

1. Exception No. 1: Where the size or location of the devices make individual identification impractical, such as on electronic assemblies, use group identification.

2. Exception No. 2: Where panel layouts do not permit mounting identification plates adjacent to components, such as relays, place the permanent relay identification on the relay where it is plainly visible, and provide a second identification on the top of the panel wireway cover directly below the relay. Identify the wireway covers to show their proper location.

C. Identification plates for devices mounted inside and outside the control enclosure shall be one of the following:

1. Laminated phenolic for engraving stock; a minimum of 0.062 inch thick. Hold plates in place with metallic drive screws or the equivalent. Use permanent adhesives for attaching nameplates to wireway covers.

2. Noncorrodible metal; a minimum of 0.031 inch thick for engraving stock or 0.012 inch thick for embossing stock. Hold plates in place with metallic drive screws.

2.05 SUPPLY CIRCUIT DISCONNECTING MEANS:

A. Provide a supply circuit disconnect for each control panel. Disconnect shall be a circuit breaker mounted within the control enclosure operated by a variable depth flange-mounted circuit breaker operating mechanism.

2.06 CONTROL DEVICES:

A. Provide 120 volt control circuit transformer if incoming power supply is not 120 volts. Provide 100 volt-ampere spare capacity that is in addition to the loads specified. Fuse one side of secondary winding and ground other side. Provide primary winding fuses on both lines.

B. Provide indicator lights, selector switches, push buttons, meters, etc., as shown in the schematic diagrams, single-line diagrams, and as required for correct operation. Mount on the front panel of the control enclosure.

C. Push buttons and selector switches shall be NEMA Type 13 for indoor applications or NEMA 4X Type 316 stainless steel for outdoor applications. Provide with quantity of contact blocks required for correct operation. Units shall be UL listed with NEMA A600 rated contacts.

D. Push buttons shall be standard size, round, flush head with momentary contacts.

E. Selector switches shall be round with standard operator.

F. Indicating lights shall be round, transformer type, NEMA Type 13, complete with color of lens indicated in drawings or as required and legend plate. Lamps shall be high-density LEDs. Indicating lights shall be push-to-test type.

G. Control relays shall be magnetically held and shall have convertible contacts. Control relays shall be UL listed with NEMA A300 rated contacts and coil voltage, number of poles, and pole arrangement as indicated in the drawings. All relays shall be of the same manufacturer. Relays shall be Allen-Bradley Bulletin 700.

H. Time delay relays shall be UL listed with contacts rated 10 ampere noninductive load, 120 volts, with coil voltage, number of poles, pole arrangement, and maximum timing adjustment as indicated in the drawings. Relays shall be plug-in, solid-state type with timing knob adjustment. Provide Potter Brumfield, Syracuse Electronics, ISSD, or Allen-Bradley Type RT.

I. Mechanically held relays shall have coil voltage, number of poles, and pole arrangement and rating as shown in the drawings. Provide integral coil clearing contacts.

J. D-C power supplies shall have ratings as required by the powered equipment. Provide integral overcurrent protection.

2.07 TERMINAL BLOCKS:

A. Provide terminal blocks for incoming and outgoing control wires. Wire and mount terminal blocks so that internal and external wiring do not cross over the terminals. Do not terminate more than two conductors at each terminal connection.

B. Field wiring shall terminate on the "field side" of the terminal blocks. Do not connect internal panel wiring to the "field side" of the terminal blocks. Do not connect field wiring to the "panel side" of the terminal blocks.

C. Terminal blocks shall be modular, rail mounted, rated at 20 amperes, 600 volts capable of terminating wire sizes No. 12 through No. 24 AWG and constructed of polyamide thermoplastic. Terminal blocks shall be UL listed in accordance with UL 486A and UL 1059. Current-carrying parts shall be copper or brass electroplated with tin/lead. Terminal connection shall be a screw clamp pressure plate connection, designed such that the clamping screw does not clamp the screw directly to the wire.

D. Provide symmetrical steel assembly rails, end brackets, jumper bars, and other accessories as required for a complete terminal block assembly.

E. Consecutively number terminal blocks from top to bottom with preprinted marking tags. Tags shall be white polyamide and hot printed with black symbols so that the print is permanent.

2.08 WIRING METHODS:

A. Panel wiring shall be neatly contained in panel wireways, including incoming and outgoing field control wiring. Panelways shall be white or light gray colored, restricted slot design, with matching snap-on covers. Provide panelways with mounting holes and nylon "push" rivets for mounting. Panelways material shall be PVC or noryl.

B. Provide minimum 2 inches of clearance between panelway and wire terminations to allow for clear viewing of wire identification marking.

C. Tie wiring run to control devices on the front door together at short intervals and secure to the inside front door with adhesive mounts. Mounts shall be adjustable releasable-clamp type for wire bundles 0.69 inch in diameter or smaller or releasable nylon cable ties for bundles larger than 0.69 inch in diameter. Attach mounts to front panel with adhesive.

2.09 FACTORY TESTS:

A. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and fault grounds.

PART 3 - EXECUTION

3.01 FIELD TESTS:

A. Test control panel with field wiring connected. Set adjustable set points and time delays for proper operation of equipment. Check operation of control panel and field

devices to verify correct operation. Perform required adjustments for correct operation.

3.02 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide field test, and place in operating condition, wiring devices as indicated and specified.

1.02 REFERENCES:

A. Federal Specifications (FS):

1. W-C-596-F: Plug, Electrical Connector, Receptacle, Electrical.
2. W-S-896-F: (1P-2P-3W) Switch, Toggle, Single Unit with wall plates.

B. National Electrical Manufacturers Association (NEMA):

1. WD 1: General Requirements for Wiring Devices
2. WD 6: Wiring Devices – Dimensional Requirements

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. Underwriters' Laboratories, Inc. (UL):

1. 20: General Use Snap Switches.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturer's product data in accordance with requirements of Sections 01300 and 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S COMPLIANCE:

A. Manufacturer’s acceptance contingent upon products compliance with specifications.

B. Provide all devices with UL label.

2.02 MANUFACTURERS:

A. Appleton Electric Co.

B. Cooper Wiring Devices.

C. Crouse-Hinds Co.

D. Hubbell Electrical Products.

E. Pass & Seymour, Legrand.

F. OZ Gedney.

2.03 MATERIALS AND COMPONENTS:

A. Wall Switches:

1. Provide alternating current, general-use, snap switches, in flush device boxes or on outlet box covers, totally enclosed in composition case, with insulated mounting yoke and sidewired, binding screw-type terminals. Single-pole, 2-pole, 3-way, or 4-way switches rated 20 amperes at 120/277 volts a.c. Switch to meet Fed. Spec. W-S-896-F and UL-20.

2. Switches for controlling lighting:

a. Cooper Wiring Device Cat. No. 2221, 222, 2223, or 2224.
b. Hubbell Cat. No. 1221, 1222, 1223 or 1224.
c. Pass & Seymour, Cat. No. 20AC1, 20AC2, 20AC3 or 20AC4

B. Flush Receptacles:

1. Provide 20-ampere, 125-volt flush receptacles constructed in flush device boxes, and of grounding type in composition case with insulated mounting yoke, side-wired, binding screw-type terminals. Receptacles to conform to Fed. Spec. W-C-596-F.

2. Duplex receptacles:

a. Cooper Wiring Devices Cat. No. 5362.
b. Hubbell Cat. No. 5362.
c. Pass & Seymour Cat. No. 5342.

3. Duplex GFCI Type Receptacles:

a. Harvey Hubbell, Inc. Cat. No. CR5352.
b. Cooper Wiring Devices Cat. No. GF20.

C. Special Receptacles:

1. Provide weatherproof devices rated 20 ampere, 125-volt, consisting of single receptacles with spring-loaded, soft-gasketed hinged covers with stainless steel spring. Covers as follows:

   a. Hubbell Cat. No. 5206.
   b. Crouse-Hinds Cat. No. WLRS-1.

2. Provide in corrosive areas (NEMA 4X) a receptacle similar to the weatherproof device described above. Cover as follows:

   a. Crouse-Hinds Cat. No. WLRS-1-S752.

D. Outlet Boxes and Enclosures:

1. Provide outlet boxes and enclosures conforming to Section 16110.

E. Device Plates:

1. Provide device plates suitable for type of outlet boxes and enclosures used. Plates for flush-mounting by device manufacturer. Plates for surface-mounting boxes by either device manufacturer or box manufacturer.
2. Provide flush device plates of high corrosion resistant, Type 302 stainless steel.

PART 3 - EXECUTION

3.01 GENERAL:

A. Perform all work in accordance with the NEC.

3.02 CONNECTION:

A. Securely and rigidly attach wiring devices in accordance with regulating agency, and as indicated, avoiding interference with other equipment.

B. Securely fasten nameplates using screws, bolts, or rivets and centered under or on the device, unless otherwise indicated.

3.03 GROUNDING:

A. Ground all devices in accordance with NEC.

B. Ground switches and their metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through positive ground connection to outlet box and grounding system. Maintain ground to each receptacle by spring-

loaded grounding contact to mounting screw, or by grounding jumper, both making positive connection to outlet box and grounding system at all times.

3.04 LABELING:

A. All wall plates to be engraved with the panelboard alpha-numeric identifier and circuit breaker number.

1. Characters to be 5/16 inch in size and black in color.

2. All engravings to match panelboard typed circuit breaker directories.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16160
PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide panelboards rated 600 volts or less and 1200 amperes or less.

B. Provide with circuit breakers and cabinets complete, as indicated and specified.

1.02 REFERENCES:

A. Federal Specifications (FS):

1. QQ-S-365B: General Requirements for Silver Plating, Electro Deposited
2. W-C-375B: Automatic Circuit Breakers.
3. W-P-115A: Panel, Power Distribution.

B. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum)
2. AB 1: Molded Case Circuit Breakers
3. PB 1: Panelboards

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC)

D. Underwriter's Laboratories, Inc. (UL):

1. 50: Cabinets and Boxes
2. 67: Panelboards
3. 86A: Wire Connectors and Soldering Lugs for Use with Copper Conductors
4. 489: Circuit Breakers, Molded Case and Circuit Breaker Enclosures

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturer's product data in accordance with requirements of Sections 01300 and 16050.

1.04 WARRANTY:

A. All panelboards supplied under this section shall be warranted by the Contractor and the equipment manufacturer for a period of three (3) years.

B. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and restored to service at no additional cost to the Owner.

C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. All panelboards shall be designed, manufactured and assembled in accordance with the referenced standards.

C. Listing and Labeling: All panelboards shall be listed and labeled by Underwriter's Laboratories, Inc. (UL), or other nationally-recognized testing laboratory (NRTL).

D. Single-source Responsibility: Provide panelboards products that are new, and from the same manufacturer for each building or job. Panelboard components shall be from the same manufacturer, or listed as an assembly thereof.

PART 2 - PRODUCTS

2.01 PANELBOARD MANUFACTURERS:

A. Manufacturers acceptable contingent upon products' compliance with the specifications:

1. Cutler-Hammer Products.
2. General Electric Company.
3. Siemens Corp.
4. Schneider Square D.

2.02 PANELBOARDS:

A. Factory assembled deadfront type panelboards.

B. Furnish panelboards complete with branch circuit breakers and a main circuit breaker or main lugs only as indicated.

C. Furnish panelboards with full capacity separate ground bus, separate insulated neutral bus and furnish panelboards connected to a 3 phase, 4 wire service as indicated.

D. Provide panelboards with the voltage, frequency and current ratings as indicated conforming to NEMA Standard PB1, Federal Specification W-P-115A. U.L. 67, and the NEC.

E. Furnish the panelboard main and neutral buses, with minimum 98 percent conductivity rectangular copper bars provided with bolted type lugs as necessary.

F. Drill buses to fit either "A", "B" or "C" Phase connectors, and ensure that connectors are inter-changeable and installed in a distributed phase sequence.

G. Tin plate buses, connectors and terminals to a minimum thickness of 0.005-in., conforming to the requirements of Federal Spec. QQ-S-365B.

H. Prevent terminal lugs from turning per NEMA standard PB 1 and ensure they are suitable for the conductor material and size.

I. Provide main bus-bracing for each panel board adequate for 10,000 amperes symmetrical short circuit at 240 volts and 14,000 amperes symmetrical short circuit at 480 volts unless otherwise indicated.

J. Where the word “space” occurs on panel schedules, provide all necessary hardware in the space, including connection straps, mounting brackets, and filler plates so that only the addition of a future circuit breaker is required. Connection straps shall be rated a minimum of 100A in panelboards of 400A rating or less and a minimum of 225A in panelboards above 400A rating, unless otherwise noted on panel schedules.

K. Provide integral surge protective devices (SPDs) in accordance with Section 16400 where indicated on the drawings.

2.03 CIRCUIT BREAKERS:

A. Each circuit breaker shall be bolted into position in the panelboard, whether by direct bolted connection to the bus or by being bolted to the panelboard frame. Each circuit breaker shall be replaceable without disturbing adjacent units. Plug-on circuit breakers held in place only by spring force of the bus lug and the pressure of the deadfront are not acceptable.

B. Furnish frame sizes, trip settings and number of poles as indicated. Clearly and visibly mark circuit breakers with ampere trip rating. Furnish breakers meeting the requirements of F.S. W-C-375B and NEMA AB1.

C. Furnish all breakers with quick-make, quick-break, toggle mechanisms and thermal-magnetic, inverse time-limit overload and instantaneous short circuit protection on all poles, unless otherwise indicated. Automatic tripping indicated by the breaker handle

assuming a clearly distinctive position from the manual ON and OFF position. Furnish breaker handle that is trip-free on overloads.

D. Do not use single pole breakers with handle ties or bails in lieu of multi-pole breakers.

E. For each panelboard, furnish quantity four handle lock devices for individual breakers to prevent the manual opening of the selected breakers. Turn devices over to Owner at completion of the project work.

F. Ensure that voltage and interrupting rating of all breakers in a panelboard is not less than voltage and short circuit rating of the panelboard main buses, as indicated. Furnish breakers suitable to operate satisfactorily at the frequency indicated.

G. Furnish single pole breakers with full module size. Do not install two pole breakers in a single module.

H. Furnish time-current characteristic curves and catalog information and data for each size of breaker furnished.

2.04 CABINETS:

A. Provide cabinets with NEMA 1 enclosure type and without knockouts. Drill cabinets only for the exact conduit entrances and mounting bolts.

B. Finish cabinet fronts, trims and surface-mounted boxes in ANSI No. 61 or 49, light-gray enamel over a rust-inhibitive primer. Attach the fronts (exterior trims) to the boxes or interior trims, by quarter-turn, indicating trim clamps. Design cabinets for surface or flush mounting as indicated.

C. Unless otherwise specified, construct panelboard cabinets of code-gauge galvanized, sheet steel and equip with gutters of ample size for the risers and outgoing circuits. Ensure that the cabinets do not exceed 78 inches in height.

D. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the Owner's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

E. All accessories including bolts, nuts, washers, and mounting equipment shall be Type 316 stainless steel.

F. Provide enclosure with the following side gutter dimensions:

1. Left side minimum 4-1/2 inch measured from inside lip of the box to the installed deadfront.

2. Right side; minimum 4-1/2 inch measured from inside lip of the box to the installed deadfront. With the door-in-door cover in place; minimum 3-1/4 inch from installed outer door hinge to the installed deadfront.

2.05 FACTORY TESTING:

A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Mount panelboards, plumb and rigid without distortion of the box. Mount such that the height of the top operating handle does not exceed 6 feet 7 inches from the floor.

B. Hang each door of the cabinet on semi- or fully-concealed hinges with a combination catch and lock.

C. On cabinets 48 inch high and over, install a 3 point catch assembly latching at top, bottom and approximate middle.

D. Verify all panelboard locks are keyed alike.

E. Provide typed directory card filled-out to clearly indicate the load served.

F. Door hinge to be on the side opposite escape route if applicable.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16260
VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete simplex type Variable Frequency Drive (VFD) units and appurtenances including drive reactors, DC chokes, harmonic filters, enclosures, and certain auxiliary items, as indicated and as specified, to provide a complete operating system.

B. All conduit and wire installations associated with each VFD shall be provided under Division 16.

C. VFD units shall be manufacturer's standard technology and in production for a minimum of 2 years.

D. Provide control system operation, input and control signals, status signals and devices in accordance with Section 13300.

E. Provide VFD output filter or reactor, when cable length between VFD and motor is greater than 100 feet, to insure motor terminals do not experience overvoltage condition as defined by NEMA Standard MG-1.

F. Each VFD unit shall exhibit less than 5 percent voltage total harmonic distortion and less than 3 percent voltage distortion on each harmonic at their immediate upstream distribution bus as verified by calculation and testing. Harmonic current distortion to be in accordance with Table 16260-1. This bus shall be referred to as the point of common coupling (PCC).

1.02 REFERENCES:

A. National Electrical Manufacturers Association (NEMA):

1. ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.
2. AB 1: Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
3. KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
4. MG 1: Motors and Generators.

B. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

C. Underwriter's Laboratories Inc. (UL):

1. 489: Molded-Case Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.

2. 508: Electrical Industrial Control Equipment.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions for all major components.

C. Complete wiring and schematic diagrams for the equipment furnished. Each wiring diagram shall be legible and not reduced from the original design drafted format. Provide a list of equipment on each wiring diagram for which it is applicable.

D. Panel layout and front view drawings.

E. Time versus current curves for protection devices.

F. Data sheets for all devices provided as part of the assembly.

G. All other details required to demonstrate that system has been coordinated and will properly function as a unit.

H. Provide data to verify that drives can be used for motor lead lengths up to 100 feet without output filters. Include information from the VFD manufacturer or output filter or reactor manufacturer (if required) stating that the motor terminal voltage limitations as defined by NEMA Standard MG 1, Part 31are met. For VFDs located more than a cable length of 100 feet from the motor load, provide drawings which include information demonstrating that an output filter or reactor is included within the VFD.

I. Provide enclosure drawings and details showing all dimensions and construction details.

J. Harmonic Analysis Report: Provide harmonic analysis report. Report to be accepted by Engineer prior to release of drives for fabrication.

1. Submit voltage THD frequency scan of each type of VFD supplied for use in field testing.

K. Submit information relative to location and expertise of local service office and personnel.

L. For informational purposes only, submit manufacturer's printed installation instructions.

M. Spare Parts Data: Submit a list of spare parts for the equipment specified.

N. Operating and Maintenance Instruction Manuals:

1. Furnish:

a. Operating instruction manuals outlining step-by-step procedures required for system startup and operation.
b. Manufacturer's name, model number, service manual parts list.
c. Brief description of equipment and basic operating features.
d. Maintenance instruction manuals outlining maintenance procedures.
e. Troubleshooting guide listing possible breakdown and repairs.
f. Point-to-point connection wiring diagram for the system.
g. Performance Test Reports: Upon completion of installed system, submit in booklet form all shop and field tests performed to prove compliance with specified performance criteria.
h. Licensed copy of any software required to program and maintain the equipment.

O. Submit Pump, Motor and VFD Statement of Compliance Coordinate Certificate.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Provide variable frequency drives in accordance with UL 508A, supplement SB, and Article 409 of the National Electrical Code (NEC). All VFD units shall be provided with a UL label.

C. Ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Coordinate all design information with the Electrical Contractor. Review the proper installation of each type of VFD unit with the equipment supplier prior to installation.

1. Services of Service Engineer, specifically trained on type of equipment specified. Person-day requirements listed exclusive of travel time.

a. Assist in location of devices, methods of mounting, field erection, etc.
2 person-days.
b. Functional Completion Testing
2 person-days.
c. Startup.
2 person-days.
d. Commissioning.
2 person-days.

e. At the end of start-up service provide for a maximum of six members of the owners staff at the facility site to receive training from the startup/testing service Engineer.
1 person-day.

f. Service-inspections during first year of operation, for use at Owner's request, and exclusive of repair, malfunction or other trouble-shooting service calls:
5 person-days.

g. Person-day is defined as one 8-hour day, excluding travel time.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Shipping:

1. Ship equipment and materials, except where partial disassembly is required by transportation regulations or for protection, complete with identification and quantity of items.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. Deliver spare parts after installation but as specified before start-up of drives. Deliver to Owner after completion of work.

C. Storage:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts.

a. If the equipment cannot be placed into service after its receipt, store in a closed building or structure, in a clean, dry and ventilated area free from temperature, dirt and moisture extremes. Acceptable storage temperatures are from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) with temporary heaters provided within enclosures to prevent condensation. Provide heavy plastic envelope directly over VFD enclosure to protect against dust, dirt, and moisture. Provide lifting angles outside of envelope.

1.06 WARRANTY AND SERVICE:

A. Provide in accordance with Section 01740 and as specified.

B. Guarantee components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a period of 5 years after turning the equipment over to the Owner, and in this time period include onsite, parts and labor warranty. All labor to be performed by local factory trained service engineers.

C. Ensure that equipment manufacturer has local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturer shall have at least five years commercial experience in the manufacture, operation and servicing of equipment of type, size, quality, performance, and reliability equal to that specified.

B. Variable Frequency Drive Units:

1. Square D Company.
2. Siemens Inc.

C. VFD Input Filters and Output Filters/Reactors:

1. Trans-Coil, Inc.
2. MTE Corporation.
3. Power Quality International.

2.02 HARMONIC ANALYSIS:

A. Each VFD unit shall be designed such that there is less than 5 percent voltage total harmonic distortion at the PCC. Current distortion at the PCC will be in accordance with Table 16260-1. For the purpose of the analysis, it will be assumed that the facility transformer feeding the electrical system is at a lightly (50 percent) loaded condition.

Table 16260-1
Maximum Harmonic Current Distortion In Percent Il

	Odd Harmonic					
Ratio	5 to 9	11 to 15	17 to 21	23 to 33	35 +	TDD
Less than 20	4.0	2.0	1.5	0.6	0.3	5.0
20 to 50	7.0	3.5	2.5	1.0	0.5	8.0
50 to 100	10.0	4.5	4.0	1.5	0.7	12.0
100 to 1000	12.0	5.5	5.0	2.0	1.0	15.0
1000 +	15.0	7.0	6.0	2.5	1.4	20.0

Notes:

1. Even harmonics are limited to 25 percent of odd harmonics.
2. DC offset distortions not allowed.
3. Ratio = Isc/IL where:
   Isc = Maximum short circuit current at PCC.
   IL = Maximum demand load current at PCC (fundamental frequency component)

B. For each VFD unit, provide a harmonic analysis study at the point of connection to the immediate upstream distribution bus (PCC), based on pre-submittal data.

C. Each VFD unit shall be designed such that there is less than 5 percent voltage total harmonic distortion and less than 3 percent voltage distortion on each harmonic at the PCC. Current distortion to be within the limits of Table 16260-1. For the purpose of the analysis, it will be assumed that the electrical system is at a lightly loaded condition, 50 percent load. If the VFD loads exceed 50 percent system loading, assume system is loaded at VFD full load ratings.

1. At each PCC, where more than one type or size VFD unit is to be connected, provide the following:

   a. Contractor shall have the supplier of the largest drive (in Hp) provide a harmonic study for each point of common coupling based on pre-submittal information

2. The Contractor shall supply the following pre-submittal information to the largest VFD supplier to complete the harmonics study.

   a. Full load fundamental current for each variable frequency drive (VFD) unit.
   b. Harmonic currents on per unit basis of full load fundamental for each VFD unit.
   c. Available fault current information and upstream transformer data.
   d. Distribution transformer sizes and impedances, if any.
   e. VFD input line reactor and/or isolation transformer sizes and impedances from the utility source to the VFD units.
   f. Conductor information between transformer secondary terminals to the distribution buses and VFDs.

3. The results of the harmonics study shall verify that the levels of total harmonic voltage at each point of common coupling are less than 5 percent and that the voltage distortion on each harmonic is less than 3 percent. In addition, harmonic currents at the PCC will be within the limits of Table 16260-1. The study shall separately consider each VFD distribution bus as points of common connection (PCCs). The study shall specify additional equipment required (e.g., filters) at each harmonic where harmonic reduction is required to insure compliance.

D. The study shall consider the following conditions:

1. The electrical system shall be powered by the electric utility.

2. The study shall include an explanation of all assumptions, sources of data, methodologies and formulas used in the study and a summary of the study results.

3. The Contractor shall supply all equipment required as a result of the final accepted harmonics study to comply with the requirements of Paragraph 1.01 F.

2.03 PROVISIONS:

A. Service Conditions:

1. Ambient Temperature Range: 0 degrees C to 40 degrees C.

2. Operational Humidity: Up to 90 percent non-condensing.

3. Environment: As indicated on enclosure schedule.

4. Altitude: Below 3,300 feet above sea level.

5. Input Power:

a. Nominal Voltage: 480 volts (plus 10 percent or minus 10 percent), 3-phase, 3 wire
b. Nominal Frequency: 60 Hertz (plus or minus 2 Hertz.)
c. Service provided from feeder breaker on distribution bus.

B. Drive System: 0-500 HP Units

1. General:

a. Furnish solid state variable frequency, microprocessor type with Pulse Width Modulated (PWM) output wave form converter. The VFD shall employ a full wave rectifier to prevent input line notching, a DC bus choke, DC bus capacitors and Insulated Gate Bipolar Transistors (IGBT) as the output switching device to convert nominal 480 volts, 3 phase, 60 Hertz, 3 wire input power into adjustable-frequency 3 wire system at 0 to 480 volts, 3 phase, 0 to 60 Hertz output power. Provide output speed control of required motor under variable torque load or constant torque as required by the driven equipment.
b. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings. Where not indicated, the control circuits shall be standard two-wire “start-stop” and the Contractor shall furnish wiring accordingly. Controls shall be designed to allow for automatic re-start when power is returned after a system outage, unless otherwise directed.
c. Variable frequency drive manufacturer shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all loads, torque, speed and performance

requirements from the respective sources and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.

d. The Contractor and variable frequency drive system manufacturer are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are circuit breakers, motor circuit protectors, magnetic starters, relays, timers, control and instrumentation products, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment.

e. Provide VFD control which ensures accurate zero to full load torque control at low frequencies, including zero speed, with torque repeatability accuracy of 2 percent or better and torque response time less than 20 ms.

f. Provide on drive, a disconnecting device and fixed diode input rectifier (for a constant power factor).

g. The drive unit shall be of modular design to provide for ease and speed of maintenance.

2. For units rated greater than 50 Hp, provide VFD with the following type three phase PWM rectifier section: 18-pulse full wave diode bridge. Provide multiple secondary integral transformer within enclosure at input bridge to provide appropriate phase shift.

   a. As a minimum, the transformer shall provide for the cancellation of the 5th, 7th, 17th, 19th, positive and negative sequence harmonic currents at the primary connection.

   b. The transformer shall reduce voltage and current distortion on the primary side and voltage distortion on the secondary side.

   c. The design shall be optimized for harmonic rich and high neutral current environment.

   d. Harmonic cancellation shall be by electromagnetic means only, capacitors or electronics are not acceptable.

   e. Provide a primary to secondary phase shift by use of multiple secondaries.

3. As an alternate to the VFDs specified in Paragraph 2 above, provide active converter low harmonic drives for VFDs rated 125 Horsepower or larger.

   a. High order harmonics to be controlled with line filtering.

   b. Direct torque control (DTC) AC to AC converter with IGBT technology.

   c. Operational modes of scalar or V/Hz operation.

   d. AC line reactor and DC choke shall be provided to reduce input harmonic content, and provide protection from power line transients.

4. All components of the drive shall be designed and sized for the abnormal condition of continuous operation of the driven equipment specified herein at loads up to 15 percent above rated full load.

5. RMS harmonic output of the drive not to provide more than 5 percent increase in motor heating over similar operation of the motor with zero harmonics in the current.

6. The unit shall withstand drive output terminal line-to-line and line-to-ground short circuits without component failure during start-up and during operation. Drive to safely shutdown until short is cleared.

7. For inverter rated squirrel cage motors, per NEMA Standard MG-1, Part 31.40.4.2, the following limit values at the motor terminals are to be observed:

    a. For motors with base rating voltage less than or equal to 600 volts, the peak instantaneous voltage must be limited to 1600 volts or less, with a voltage rise time greater than or equal to 0.1 micro-seconds.

8. The VFD manufacturer shall guarantee that the required voltage limits will be met with the motor installed up to 100 cable feet from the VFD drive unit. If the VFD manufacturer is not able to guarantee that the above voltage limits will be met, provide a drive output filter or reactor, appropriately rated, located within the VFD enclosure and near the VFD output terminals, which shall ensure that the limitations listed above are maintained. A device located at the motor terminals is not acceptable.

9. When controlling for non-inverter rated squirrel cage motors, provide output filters to limit peak voltage at the motor terminal to less than 1000 V, increase voltage rise time and reduce common mode current.

10. VFD shall be capable of full rated output when powered by incoming voltage with Total Harmonic Distortion (THD) in excess of 10 percent.

11. Furnish series choke and capacitors on dc bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.

12. Properly size enclosure to dissipate heat generated by VFD within limits of specified service conditions.

    a. Provide NEMA 1 enclosure.
    b. Provide integral fans or cooling systems as required by the application.
    c. Provide interior LED strip light fixture in each section of VFD enclosure. Furnish with integral switch to automatically turn off light when enclosure door is closed.
    d. Circuit breaker interlock to be able to be bypassed via lever on front door surface.
    e. NEMA 1 enclosures to have keypad controls located on exterior of enclosure.
    f. Provide visual alarm indicator on cabinet door.

g. Fans shall be located to allow quick removal and replacement without disassembly of drive components.

2.04 PERFORMANCE CHARACTERISTICS:

A. Output amps: 110 percent of rated, continuous.

B. Current limit: Range 0 to 130 percent for constant torque applications, 0 to 110 percent for variable torque applications, for 1 minute minimum.

C. Acceleration time to top speed, 1-300 seconds, minimum, adjustable.

D. Deceleration time from top speed, 1-300 seconds, minimum, adjustable.

E. Frequency stability: +/- 0.5 percent (at 25 degrees C, +10 degrees C) after reaching operating temperature.

F. Output voltage: Proportional to frequency with low speed boost.

G. Combined drive/and filtering efficiency, defined as motor shaft KW divided by VFD input KW, shall meet the following minimum requirements at the specified operating points:

1. 97 percent at 60 Hertz VFD output and 100 percent load.
2. 92 percent at 50 Hertz VFD output and 60 percent load.

H. VFD fundamental power factor shall be 0.98 or higher at all speeds and loads.

I. The VFD shall be capable of sustaining continued operation with a 30 percent dip in nominal line voltage. Output speed may decline only if current limit rating of the VFD is exceeded.

J. Losses to be utilized in drive system efficiency calculation shall include the input line reactor, phase shifting transformer and, harmonic trap filter with capacitors. Auxiliary controls such as internal VFD control boards and cooling fans shall be included in all loss calculations.

2.05 DRIVE PROTECTION:

A. General:

1. Fault detection and trip circuits shall protect VFD and connected motor against line voltage transients, single-phase, power line overvoltage and undervoltage, output overvoltage and overcurrent, and VFD overtemperature.

a. The VFD shall employ three current limit circuits to provide trip free operation.

b. The slow current regulation limit circuit shall be adjustable to a minimum 125 percent of the VFD's variable torque current rating.
c. The rapid current regulation limit shall be adjustable to a minimum 170 percent of the VFD's variable torque current rating.
d. The current switch off limit shall be fixed at a minimum 225 percent of the VFD's variable torque current rating.

2. Internal Protection: Minimum circuitry as follows:

a. Current limiting, fast acting, semiconductor input fuses for protection of internal power semiconductors.
b. Instantaneous output overcurrent trip maximum: 200 percent.
c. DC bus and control circuit transformer fusing.
d. Grounded control chassis.
e. Under and over voltage trip, 3 phases.
f. Motor overload protection, with solid state relays.
g. Circuit breaker, with door interlocked handle. Provide means to allow entry into panel where required by authorized personnel. Circuit breaker to be rated 65,000 AIC minimum. Where indicated, furnish circuit breakers with shunt trip.
h. Fault reset push button.
i. Line to ground faults.
j. Input metal oxide varistor and input line reactor for transient protection.
k. VFD overtemperature.

3. Troubleshooting: Diagnostic aids to indicate cause of fault; used to assist in troubleshooting circuit problems. Isolated Form C contacts for remote indication of alarms to include the following:

a. Over/under voltage indication.
b. Overcurrent trip indication.
c. DC bus charged indication.
d. Fault detection indication.
e. Recycle start indication (to indicate that the unit tried to pick up load for three previous tries and failed).

4. Provide power loss ride through capability which will allow the logic to maintain control due to load inertia without faulting.

5. Provide a programmable automatic restart function which will provide a minimum with time delays between restarts of 3 restarts following a fault condition other than a ground fault, short circuit, internal fault, or user programmable fault condition. Restart type to be programmable for time delay or coasting motor restart.

6. For drives units rated 200 hp or more, provide uninterruptable power supply (UPS) to power control circuits and prevent inadvertent trip due to voltage sag conditions.

a. The UPS shall be installed within the drive enclosure.
b. The battery backup time of the UPS shall be a minimum of 5 minutes or as recommended by the VFD manufacturer.
c. UPS shall be American Power Conversion Smart-UPS 1400 X LT or equivalent by MGE or Eaton Powerware.

2.06 CONTROL INTERFACE:

A. Provide variable frequency drive unit with appropriate power circuitry and auxiliary contacts for energizing and controlling the following devices associated with the motor, if required:

1. Space heaters
2. Remote indication of motor start and stop (isolated contacts)

B. Minimum Control Features:

1. LOCAL/REMOTE selection of Start/Stop control.
2. LOCAL/REMOTE selection of Speed Control.
3. Accept a grounded, isolated, 4-20 mA input remote speed control signal from an external device.
4. Provide a 4-20 mA output signal proportion to VFD output frequency for remote speed indication.

C. Control Devices:

1. Provide operating, monitoring or alarm indicating devices, door mounted, with minimum as follows:
   a. Drive System Disconnect Operator.
   b. System control selector switch (RUN/OFF/REMOTE) (When in RUN position drive will run). Control switch shall be oil-tight, 30 mm units.
   c. System speed control selector switch (LOCAL/REMOTE) (When in LOCAL position, speed controlled by manual speed potentiometer). Control switch shall be oil tight, 30 mm units.
   d. Manual keypad controls to set speed in manual mode.
   e. Speed indicating meter in percent speed to indicate speed of the converter powered motor.
   f. Alarm and status lights. Provide LED cluster type, heavy duty, 30 mm oil tight units.
2. Control circuits shall be isolated from power circuits.
   a. Unit to accept a 4-20 mA DC speed control signal from an isolated, ungrounded transmitter with unit in remote mode and from local door-mounted micro-processor type keypad with unit in local mode.

b. The input 4-20 mA signal to be optically isolated from the drive run control circuit.
c. Furnish door-mounted switch on the enclosure for local/remote mode.
d. Keypad controls to have adjustable minimum speed setting of 10 to 80 percent of full speed and maximum speed setting of 50 to 100 percent of full speed. The total speed setting to follow a linear time ramp, adjustable from 1-300 seconds for acceleration and deceleration control.

D. VFD shall have native Profibus/Profinet communications capabilities.

1. Network to allow a selection of standard and custom register values to communicate drive parameters, including:

a. Drive fault
b. Overload
c. Trip
d. Loss of control power
e. Speed
f. Power (kW)
g. Amps (Phase A, B and C)
h. Voltage (Phase A-B, B-C, C-A)

2. Provide all components and drive programming to allow network interface with control system.

2.07 REDUCED VOLTAGE SOLID STATE STARTER VFD BYPASS:

A. The reduced voltage solid state starter shall be full wave, 6-SCR power bridge type, rated for 480 VAC, +10 percent/-10 percent, 3 phase, 60 Hertz., +3 Hz. SCRs shall be PRV rated for at least 2.5 times rated line voltage.

B. The following control adjustments shall be provided:

1. Current Limit: 50 percent - 500 percent of FLA.
2. Voltage Ramp During Start: Adjustable up to 60 seconds.
3. Voltage Ramp During Soft Stop: Adjustable up to 15 seconds.

C. Transient voltage suppression shall be supplied to protect against high potential transient voltage spikes.

D. Overload capacity shall be as follows:

1. Continuous: 115 percent of FLA.
2. 1 Minute: 450 percent of FLA.
3. 30 Seconds: 500 percent of FLA.
4. 5 Seconds: 600 percent of FLA.

E. One reduced voltage solid state soft start starter bypass shall be provided for each motor, where indicated in the drawings, to allow the motor to run across-the-line in the event of VFD shutdown. The transfer from the VFD to the line shall be accomplished manually by means of a selector switch. The bypass circuitry shall be mounted and wired in a free-standing, force ventilated, filtered, gasketed cabinet.

F. The reduced voltage solid state starter cabinets shall each include a door-interlocked input circuit breaker, starting contactor and running contactor (all contactors electrically interlocked), a thermal overload relay to provide motor protection and a control power transformer. Mounted on the cabinet door shall be the bypass selector switch, motor fault light, power "ON" light, motor "ON VFD" light and motor "ON LINE" light.

2.08 SHOP TESTING:

A. Provide in accordance with Section 01400.

B. Provide a factory performance test for each variable frequency drive unit. The test to consist of simulating the expected load to be driven. The drive to operate the actual motor load through the expected speed ranges. Test length to be a minimum of two hours.

C. Provide a factory burn-in test for 24 hours minimum and a control and alarm test on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.

D. Provide typical prototype factory test data for short circuit testing of each type of drive supplied. Data to verify that each drive can be started into a line-to-line fault and line-to-ground fault on the drive terminals. Each drive can be operating at full load and be subjected to a line-to-line fault and line-to-ground fault on the drive terminals. All phases (A, B & C) to be included in test data.

E. Provide certified documentation of all tests performed.

F. Provide above stated tests in addition to routine factory tests.

G. Owner to have option to witness all factory tests. Notify Owner two weeks before all tests.

2.09 SPARE PARTS:

A. Provide in accordance with Section 01730 and as specified.

B. Provide one complete spare VFD of each amp rating.

C. Provide one spare board or card, three diodes, for each horsepower size drive. Spares will be color-coded or otherwise keyed to their original counterpart such that

improper installation of spare cards is impossible. In addition to the cards, the manufacturer shall provide six spares of each type and amp rating for all expendable items such as pilot lamps, power fuses, and control fuses. Provide three spare keypads.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine VFD location for satisfactory preparation. Check conduits and raceway location for connection to units.

B. Visually inspect delivered unit(s) and accessories for conformance with specification and drawings.

C. Verify availability of appropriate pacing signal.

D. Maintain variable frequency drive in upright position at all times.

E. Protect variable frequency drive against damage. Store drive in clean, dry environment with temperature and humidity within range as specified by drive manufacturer. Energize space heaters during storage as recommended by manufacturer.

3.02 INSTALLATION:

3.03 ERECT, INSTALL, AND START-UP EQUIPMENT.

A. The VFDs shall be installed as shown on the drawings, in accordance with the manufacturer's installation instructions, and accepted shop drawings.

B. Install VFDs to allow complete door swing required for component removal. This is specifically required where a VFD is set in the corner of a room.

C. Install "DANGER HIGH VOLTAGE" warning sign on front door of each VFD enclosure as specified in Section 16075.

D. Factory-trained service personnel, other than sales representatives, shall supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested.

3.04 FIELD TESTING:

A. Provide in accordance with Section 01400.

B. Perform testing checkout, and start-up for variable frequency drive equipment under technical direction of manufacturer's service engineer. Under no circumstances energize any portion of the drive system without authorization from manufacturer's technical representative.

C. Field Tests:

1. Test each drive over the total speed range that it will be required to operate through for the load being driven for a minimum of two hours. Determine for each drive, motor, and load combination the following at minimum speed, maximum speed, and at 1/3 and 2/3 points between the minimum and maximum speeds:

   a. Input power (kW), voltage, current and RMS power factor on the line side of the drive isolation device.
   b. Output to the driven load in kilowatts.
   c. For each drive, measure the harmonic voltage distortion and harmonic current distortion for each harmonic at the main distribution bus for maximum and minimum load conditions.
   d. Measure the total harmonic voltage distortion and total harmonic current distortion at each PCC for maximum and minimum load conditions.

2. Test each drive by using the actual control signal for remote and local operation.

3. Test each drive’s alarm functions.

4. Perform all tests in the presence of the Owner's representative.

5. Perform the above test in addition to the manufacturer's normal field tests.

6. Submit final test report with summary comparing field test data with harmonic analysis design calculated values for each drive.

7. Testing determined not in compliance with Contract documents shall be repeated by the Contractor at no additional cost to the Owner.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16272
PAD-MOUNTED TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section describes materials, installation, and testing of outdoor pad-mounted transformers.

1.02 REFERENCES:

A. American National Standards Institute, (ANSI):

1. Z55.1: Gray Finishes for Industrial Apparatus and Equipment

B. ASTM International (ASTM):

1. B117: Standard Practice for Operating Salt Spray (Fog) Apparatus.
2. D117: Standard Guide for Sampling, Test Methods, and Specifications for Electrical Insulating Oils of Petroleum Origin.

C. U.S. Department of Energy (DOE):

1. Distribution Transformers Energy Conservation Standard (10 CFR Part 431).

D. Institute of Electrical and Electronics Engineers (IEEE):

1. 386: Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
2. C57.12.00: Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
3. C57.12.26: Standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors (34 500 Grd Y/19 920 V and Below; 2500 kVA and Smaller).
4. C57.12.28: Pad-Mounted Equipment Enclosure Integrity

E. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

F. Occupational Safety & Health Act (OSHA):

1. Regulation 1910.7

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Submit shop drawings giving equipment dimensions, anchoring information, and weights for each rating shown in the drawings and giving ratings of transformers, switches, fuses, and breakers. Provide data on pressure-relief valves, oil sampling valves, gauges, and separable connectors.

C. Submit catalog cuts for transformer pads.

D. Factory Tests: Furnish manufacturer's certified standard test reports for the transformer ratings shown in the drawings and for the tests specified herein.

E. Instruction Manuals: Furnish manufacturer's installation and maintenance manuals on the transformers and accessories.

1.04 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Single source manufacturer regularly engaged in manufacturing pad-mounted transformers complying with requirements of these Specifications and experienced with at least 5 projects of similar size and scope

B. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms “NRTL” shall be as defined in OSHA Regulation 1910.7.

2. Terms “listed” and “labeled” shall be as defined in National Electrical Code, Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

D. ANSI/IEEE Compliance: Comply with applicable requirements of ANSI/IEEE standards, including IEEE C2.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Handle pad-mounted transformers components in accordance with manufacturer’s instructions. Use factory installed lifting provisions.

1.06 SEQUENCING AND SCHEDULING:

A. Coordinate size and location of concrete bases and pads. Cast anchor bolt inserts into pad.

1.07 MAINTENANCE:

A. Extra Materials:

1. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

2. Touch-Up Paint: 3 half-pint containers of paint matching enclosure exterior finish.

3. Contact Lubricant: 1 container.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Cooper Power Systems

B. ABB

2.02 TRANSFORMER:

A. General: Liquid-filled, pad-mounted transformer, copper windings, complying with IEEE C57.12.26 and C57.12.28, with primary gang-operated load break disconnect switch(es), tap changer, fuse provisions, secondary terminals in separate compartments, and accessories in a weather-resistant, tamper-proof enclosure. Isolate and interlock high- and low-voltage compartments. Doors shall be provided with padlockable three-point latch and pentahead bolt.

B. Transformers shall comply with the 2010 Department of Energy Efficiency Standards for Distribution Transformers.

C. Enclosure: Enclosure base shall have a 4 mil thick tar-mastic undercoat.

D. Transformer: Unit shall be dead front, 3-phase, two winding, 60 Hertz, 117 degrees F (65 degrees C) rise above a 104 degrees F (40 degrees C) ambient. Self-cooled kVA ratings shall be as noted in the drawings. High voltage shall be 12.47-kV delta with two 2-1/2 percent taps above and below normal. BIL shall be 95 kV. Low voltage shall be as indicated in the drawings. Insulating liquid shall be mineral oil. Insulating liquid shall contain less than 1-ppm PCB chemicals.

E. Percent Impedance Voltage: Provide the following impedances subject to a +/- 7.5 percent impedance variation:

kVA	Percent IZ
750 and larger	5.75

F. Primary Compartment: Provide the following equipment as a minimum:

1. Dead-front construction.
2. Loop feed construction.
3. Three dead-front elbow-type metal oxide varister [9/10-kV] lightning arresters.
4. Load-break switches.
5. Draw-out dry well mounted current-limiting fuses.
6. Medium-voltage bushing inserts and bushings for separable elbow connectors conforming to IEEE 386 and rated for 15 kV, 95 kV BIL, 200 amperes continuous, 10,000-ampere rms symmetrical for a time duration of 0.17 second. Provide a parking stand for each elbow connector. Equip connector with steel-reinforced hook-stick eye, grounding eye, test point, and arc-quenching material.
7. External tap changing handle operable only when the transformer is de-energized.

G. Low-Voltage Compartment: Provide the following equipment as a minimum:

1. Secondary low-voltage bushings with spade terminals designed for copper conductors.
2. Liquid level gauge, dial type.
3. Thermometer, dial type.
4. Oil filling connection.
5. Drainage and oil sample valves.
6. Neutral ground strap, removable.
7. Corrosion-resistant nameplate and connection diagram in conformance with IEEE C57.12.26 except that the number of gallons of coolant shall be shown.
8. Transformer case grounding pad.
9. Non-PCB and UL label.

2.03 FACTORY FINISH:

A. Provide with a factory-applied, corrosion-resistant finish which shall withstand 3,000 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of paint primer coat to the metal surface in excess of 1/16 inch from the scribed test mark. Finish color shall be Munsell green.

B. Cut edges or otherwise damaged surfaces of galvanized steel shall be coated with a zinc-rich paint conforming to Section 09800, System No. 55.

2.04 TRANSFORMER PADS:

A. Provide precast concrete transformer pads sized per transformer manufacturer requirements. Provide reinforcement for parkway (nontraffic) loading.

2.05 FACTORY TEST:

A. Perform the following factory tests:

1. Routine factory tests, IEEE C57.12.00 Section 8.1.
2. ANSI full wave impulse test, observed by oscilloscope.
3. ANSI reduced full wave, chopped wave impulse test with oscillograph record.
4. Complete ANSI temperature tests.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install pad-mounted transformer in conformance to the manufacturer's mounting instructions including securing it to the concrete slab by at least four anchor bolts.

3.02 GROUNDING:

A. Pad-mounted transformer shall have all noncurrent-carrying metal parts connected to a solid earth ground electrode.

3.03 SIGNS:

A. Install "DANGER--HIGH VOLTAGE--KEEP OUT" signs with tamper-proof stainless steel screws on each accessible side of pad-mounted transformers.

3.04 FIELD TESTS:

A. After the installation has been completed, conduct an operating test demonstrating that all equipment devices operate in accordance with the requirements of the drawings and specifications.

B. Operating Test: Energize the transformer and adjust the output voltage to the specified value. Further readjust tap settings, if necessary, after the facility being served is in normal operation.

3.05 CLOSEOUT:ACTIVITIES::

A. Provide in accordance with Section 01700.

B. Adjusting: Adjust primary taps so secondary voltage is above and within 2 percent of rated voltage.

END OF SECTION

SECTION 16320
DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide copper-wound, dry-type transformers as indicated and specified.

B. Provide transformer windings and enclosures rated for the installation location and in accordance with the requirements herein.

C. Transformers shall be “Energy Star” rated.

1.02 REFERENCES:

A. American National Standards Institute (ANSI):

1. Z55.1: Gray Finishes for Industrial Apparatus and Equipment

B. ASTM International (ASTM):

1. D635: Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

C. National Electrical Manufacturers Association (NEMA):

1. ST 20: Dry-Type Transformers for General Applications (ANSI C89.2). - withdrawn

D. International Electrical Testing Association (NETA):

1. ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
2. National Fire Protection Association (NFPA):
3. 70: National Electrical Code (NEC).

E. Underwriters' Laboratories, Inc. (UL):

1. 506: Standard for Specialty Transformers.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Submit shop drawings and manufacturer's product data of the transformer. Information to include:

1. Outline drawings including dimensions.
2. Weight.
3. Ratings and tap configuration.
4. Core and coil material.
5. Insulation system description.
6. Loss data and efficiency.
7. Accessories.
8. Mounting requirements.
9. Nameplate data.
10. Testing data.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610.

B. Deliver transformers individually wrapped for protection and mounted on shipping skids.

C. Accept transformers on site. Inspect for damage.

D. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle and stored in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.06 REQUIREMENTS OF REGULATORY AGENCIES:

A. Furnish transformers in accordance with NEMA ST 20 and UL 506.

B. Furnish transformers with UL listing mark.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Square D Co.

B. Eaton-Cutler-Hammer Corp.

C. Siemens Inc.

D. General Electric Company.

2.02 TRANSFORMERS:

A. In NEMA 1 and NEMA 12 designated areas, furnish general purpose, ventilated, dry-type transformers in indoor-style enclosure. On single-phase transformers and three-phase transformers above 9 KVA, provide not less than two windings per phase.

1. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.

2. Ventilation openings shall prevent accidental access to live components.

3. Thoroughly clean and paint enclosure at the factory with manufacturer's prime coat and standard finish.

B. Auto transformers shall not be used in place of general purpose dry-type transformers.

C. Furnish at least two 2-1/2 percent full capacity taps above and below nominal in high voltage winding for transformers rated above 15 kVA.

D. Furnish transformers, single-phase or three-phase, as indicated. Furnish transformers with kVA ratings as indicated.

E. Furnish three-phase transformers, Delta-Wye connected as indicated, and conforming to latest NEMA standards. Scott Tee connected transformers are not acceptable above 9 kVA.

F. Isolate core and coil from enclosure using vibration-absorbing mounts.

G. Furnish transformers with primary and secondary voltages and frequency, wye connected, as indicated for secondary windings, with neutral brought out for cable termination.

H. Furnish transformers designed for continuous operation at rated kVA with normal life expectancy as defined in NEMA ST 20.

I. For transformers rated 30 kVA or less, ensure that performance is obtained without exceeding 115 degrees C average temperature rise by resistance or 145 degrees C hot spot temperature rise in 40 degrees C maximum ambient and 30 degrees C average ambient. Do not allow maximum coil hot spot temperature to exceed 185 degrees C.

J. Furnish transformers with 220 degrees C insulation materials with proven reliability for 15 kVA transformers and above. Furnish 185 degrees C insulation on transformers below 15 kVA.

K. Transformers rated greater than 30 kVA shall be provided with low-loss 80 degrees C full load operating temperature rise rating.

L. Furnish transformers made of flame retardant materials that will not support combustion as defined in ASTM D635.

M. Furnish core mounting frames and enclosures of welded and bolted construction with mechanical rigidity and strength to withstand shipping, erection and short circuit stresses.

1. Cores shall be grain oriented, non-aging, and silicon steel.
2. Coils shall be continuous windings without splices except for tapes.
3. Coil loss and core loss shall be minimum for efficient operation.
4. Primary and secondary tap connections shall be razed or pressure type.
5. Coil windings shall have end fillers or tie downs for maximum strength.

N. Furnish transformers designed to meet UL thermal overload test of 200 percent of rated current for one half hour.

O. Furnish transformers not to exceed the 65 degrees C rise established by UL as safe limit for maximum surface enclosure temperature.

P. Furnish transformers with sound level not exceeding:

Average Sound Level in dB

kVA	NEMA ST 20
0-09	40
10-50	45

Q. Transformers rated 15 kVA and larger to be provided with rubber washer anti-vibration pads and molded neoprene assemblies to isolate noise from the transformer to the mounting surface.

2.03 SHOP TESTING:

A. Submit results of audible-sound-levels tests in accordance with NEMA ST 20 of similar size transformer.

B. Production test each unit in accordance with NEMA ST 20.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Set transformer plumb and level. Install and guard transformers as specified by latest NEC and ANSI standards, and in accordance with manufacturer's printed instructions.

B. Furnish adequate space around transformer to dispose of transformer full load losses by ventilation without creating excessive ambient temperature. Verify working clearances as required by the NEC are met.

C. Floor mount transformers rated above 15 kVA unless otherwise indicated on the drawings.

D. Provide lifting lugs and jacking plates on transformer enclosure.

E. Provide concrete pad for all floor mounted transformers.

F. Clean metal parts, excepting cores and core mounting frames, then rust-proof and apply heavy coating of inert primer. Paint coverplates and external metal parts with two finish coats of ANSI Z55.1 No. 61 or 49 Gray.

G. Verify mounting pads are in place to reduce noise.

H. Install grounding and bonding in accordance with the drawings and Section 16450.

3.02 FIELD TESTING:

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16361
LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide indoor-type metal enclosed low-voltage power switchgear as indicated and in compliance with Contract Documents.

B. Complete low-voltage switchgear assembly to be designed, assembled, wired, and tested at the point of manufacture in accordance with the latest NEMA, UL, and ANSI standards.

C. Use manufacturer's standard when data is not specified.

D. Provide Surge Protective Devices (SPD) as indicated and as specified in Section 16400.

E. Low-voltage switchgear to be provided with labels incorporating the results of the arc flash studies provided under Section 16990.

1.02 REFERENCES:

A. American National Standards Institute (ANSI):

1. C39.1: Electrical Analog Indicating Instruments
2. Z55.1: Gray Finishes for Industrial Apparatus and Equipment

B. Institute of Electrical and Electronics Engineers (IEEE):

1. C37.13: Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
2. C37.16: Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC (3200 V and below) Power Circuit Breakers
3. C37.17: Trip devices for AC and General Purpose DC Low Voltage Power Circuit Breakers
4. C37.20.1: Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
5. C57.13: Standard Requirements for Instrument Transformers

C. National Electrical Manufactures Association (NEMA):

1. C37.50: Switchgear Low Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures
2. C37.51: For Switchgear - Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedure
3. SG-3: Low Voltage Power Circuit Breakers
4. SG-5: Switchgear Assemblies.

D. National Fire Protection Association (NEPA):

1. 70: National Electrical Code (NEC).

E. Occupational Safety & Health Act (OSHA).

1. Regulation 1910.7

F. Underwriters' Laboratories Inc. (UL):

1. 1066: UL Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
2. 1558: Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, installation instructions.

C. Complete wiring and schematic diagrams for the equipment furnished. Each wiring diagram shall be legible and not reduced from the original design drafted format. Provide a list of equipment on each wiring diagram for which it is applicable.

D. Equipment layout.

E. Time versus current curves for protective devices.

F. Data sheets for all devices provided as part of the assembly.

G. All other details required to demonstrate that system has been coordinated and will properly function as a unit.

H. Spare Parts Data: Provide a list of recommended spare parts for the material and equipment to be provided, including current unit prices and source of supply (indicate which supplies are furnished at no extra cost with purchase of equipment) and in accordance with Section 01730.

I. Operating and Maintenance Instruction Manuals:

1. Furnish:

   a. Operating instruction manuals outlining step-by-step procedures required for system startup and operation and in accordance with Section 01730.
   b. Manufacturer's name, model number, service manual parts list.
   c. Brief description of equipment and basic operating features.
   d. Maintenance instruction manuals outlining maintenance procedures, for all devices, including compartment installation, circuit breakers, motor starters and fuses.
   e. Troubleshooting guide listing possible breakdown and repairs.
   f. As-built wiring diagrams for the system.

J. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed to prove compliance with specified performance criteria including final position of controls.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier prior to installation.

C. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment and field erection:

   a. 1 person-day.

3. Functional Testing: Check alignment and perform a functional test. Tests to include all items specified.

   a. 1 person-day.

4. Testing: Field performance test equipment specified.

   a. 3 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-day.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

D. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

E. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

F. ANSI/IEEE Compliance: Comply with applicable requirements of ANSI/IEEE standards, including IEEE C2 and C57.12.80.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Shipping:

1. Ship equipment, and materials, except where partial disassembly is required by transportation regulations or for protection, complete with identification and quantity of items.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. Switchgear shall be separated into shipping blocks with wiring harnesses labeled for re-termination at the Project Site. Each shipping block shall include a removable lifting angle, to allow attachment by suitable lifting equipment.

4. Deliver spare parts at same time as pertaining equipment. Delivery to Owner after completion of work.

5. Channel bases:

a. For front and rear, minimum of 1-1/2 inch by 3 inch standard channel with suitable holes for mounting switchgear, and holes for grouting and flow of concrete.

b. Shipped in advance with accurate template of switchgear mounting holes or dimension layout drawing for embedding in concrete pad, floor slab, or securing to floor.

6. Attach lifting angles to main frame of structure to distribute weight equally. Deflection or distortion is cause for rejection.

C. Storage:

1. Inspection and inventory items upon delivery to site.

2. If the equipment cannot be placed into service after its receipt, store in a closed building or structure, in a clean, dry and ventilated area free from temperature, dirt and moisture extremes. Acceptable storage temperatures are from 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) with temporary heaters provided within enclosures to prevent condensation. Provide heavy plastic envelope directly over switchgear to protect against dust, dirt, and moisture. Provide lifting angles outside of envelope.

3. Store and safeguard equipment, material and spare parts.

1.06 WARRANTY AND SERVICE:

A. Provide in accordance with Section 01740 and as specified.

B. Guarantee components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a period of 5 years.

C. Ensure that equipment manufacturer has local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

1.07 MAINTENANCE:

A. Extra Materials:

1. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

2. Provide spare parts as recommended by manufacturer.

3. Package spare equipment in suitable containers bearing labels clearly indicating contents and in what equipment used.

4. Deliver spare parts at same time as equipment. Properly store and safeguard such spare parts until completion of work, at which time deliver to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Siemens Corporation.

B. Square D Company.

2.02 EQUIPMENT:

A. Furnish switchgear rated 480 volt, 3 phase, 3-wire, 60 Hertz. Brace buses and bus structures for the rms symmetrical amperes, short circuit indicated.

B. Coordinate all primary parts of the metal enclosed equipment, including circuit breakers, fuses, buses, connections and insulators to withstand mechanical and thermal stresses for use on the proposed system.

C. Furnish steel channel sills with suitable drilled holes for mounting, aligning and bolting switchgear in place. Method of mounting as indicated. Provide size recommended by switchgear manufacturer and acceptable to Engineer and Owner. Paint completed sills with two coats of aluminum paint or other acceptable corrosion-resistant finish before setting in place.

D. If switchgear equipment pads are located on concrete floor slabs, furnish painted steel channel mounting sills and anchor bolts, including location instruction for setting in place during construction of the concrete equipment pads.

2.03 RATINGS:

A. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum ac service.

B. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage and as shown on the drawings.

C. The bus system shall have a minimum ANSI short-circuit withstand rating of 65,000 amperes symmetrical tested in accordance with IEEE C37.20.1 and UL1558.

D. All circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000 amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.

E. All ratings shall be tested to the requirements of IEEE C37.20.1, NEMA C37.50 and NEMA C37.51 and UL witnessed and approved.

2.04 CONSTRUCTION:

A. Switchgear completely self-supporting structure of required number of vertical sections bolted together to form one metal-enclosed switchgear 90 inches high minimum. Sides, top and rear covers are code gauge steel, bolted to switchgear structure. Frame structure members die-formed 11 gage steel bolted together and reinforced at external corners with rugged gussets internal and external to structure members. Switchgear frame suitable for use as floor sills in indoor installations. Switchgear assemblies conforming to NEMA Std. SG-5.

B. Provide switchgear with incoming line main devices in individually mounted construction, and feeder devices in group mounted construction. Incoming line main devices side or rear accessible through bolted-on covers. Group mounted devices, front accessible per NEMA standards, furnished with wiring gutters on front of distribution vertical sections of switchgear. Provide gutters with code gauge steel formed covers bolted to structure frame. Cover unused device space with blank code gauge steel formed covers.

C. Construct metal-enclosed switchgear structure from formed sections of specially smoothed and leveled steel, not less than 11 gage, welded together and reinforced, where necessary, with formed steel members. Resulting structure totally enclosed, self-supporting and free-standing.

D. Make provision for conduit and cable entrance from bottom as indicated.

E. Enclose bus compartments and the instrument and control power transformer compartments completely with sheet steel and separate from each other by means of tightly fitted steel barriers.

F. Where future breakers are indicated, compartment complete with buses, bus supports, insulators, primary and secondary disconnects, rails and other accessories to require only insertion of breaker removable element. Provide insulating barriers in switchgear units to cover all live parts.

G. Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment.

1. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by means of steel barriers to the maximum extent possible. It shall be equipped with drawout rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges.

2. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells and be front accessible and removable.

H. The stationary part of the primary disconnecting devices for each power circuit breaker shall be breaker mounted and consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts, suitably spaced, shall be furnished on the power circuit breaker studs which engage in only the connected position.

1. The assembly shall provide multiple silver-to-silver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs.

2. Load studs shall be equipped with insulated copper load extension buses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be tin-plated where outgoing terminals are attached.

I. The circuit breaker door design shall be such that the following functions may be performed without the need to open the circuit breaker door: lever circuit breaker between positions, operate manual charging system, close and open circuit breaker, examine and adjust trip unit, and read circuit breaker rating nameplate.

J. The secondary disconnecting devices shall consist of floating terminals mounted on the stationary unit and engaging mating contacts at the front of the breaker. The secondary disconnecting devices shall be gold-plated and engagement shall be maintained in the “connected” and “test” positions.

1. The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, “connected,” “test,” “disconnected” and “removed.”

2. The breaker drawout element shall contain a worm gear levering “in” and “out” mechanism with removable lever crank.

3. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering “in” or “out” of the cell. Interlocking that trips the breaker will not be accepted.

4. The breaker shall include an optional provision for key locking open to prevent manual or electric closing.

5. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering.

6. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

K. The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

L. Provide a rear compartment barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.

M. Provide in the cell when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against incidental contact.

N. Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.

O. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

2.05 BUS BARS:

A. Main bus and riser bus tin plated copper supported with high impact, non-tracking insulating material, and braced to withstand mechanical forces exerted during short circuit conditions, to rating of protective devices as indicated.

B. Contact surfaces of main bus joints and all tap connections silver plated.

C. Bus sizing shall be based on ANSI standard temperature rise of 65 degrees C over a 40 degrees C ambient. If main circuit protective device is provided, continuous current rating of bus equivalent to frame size rating of that device.

D. Furnish a ground bus and secure to each vertical section structure. Extend ground bus for entire length of switchgear.

E. Furnish ground bus of at least 2 inch by 1/4-inch copper bar for length of switchgear structure. Each unit frame effectively grounded. Provisions furnished for external ground connections.

2.06 DRAWOUT CIRCUIT BREAKER UNITS:

A. Circuit breaker units composed of metal-enclosed unit complete with stationary and removable elements, including primary disconnecting devices, mechanical interlocks, and hinged front door.

B. All power circuit breakers shall be constructed and tested in accordance with IEEE C37.13, C37.16, C37.17, NEMA C37.50, UL 1066 and NEMA SG-3 standard. The breaker shall carry a UL label.

C. Breakers shall be provided in drawout configuration. The 800, 1600, and 2000 ampere frame power circuit breakers shall be provided in the same physical frame

size, while 4000 ampere frame power circuit breakers shall be provided in a second physical frame size. Both physical frame sizes shall have a common height and depth.

D. Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation.

E. Breakers shall be manually operated (MO).

F. Where indicated, furnish circuit breakers with shunt trip.

G. To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker. Provide breaker lifting device and transfer truck for breaker withdrawal.

H. The power circuit breaker shall have a closing time of not more than 3 cycles.

I. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

J. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

K. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions, as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a “Positive On” feature. The breaker flag will read “Closed” if the contacts are welded and the breaker is tripped or opened.

L. The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit.

M. A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

N. Provide a portable remote racking device to allow personnel to rack a low voltage drawout circuit breaker from a remote location up to 30 feet away, clear of the arc flash boundary. Device shall include following features:

1. Self-check indicator.

2. Stop release pushbutton.

3. Operate motor pushbutton.

4. Racking direction selector switch.

5. Power On/Off indicating light.

6. Insert circuit breaker indicating light.

7. Withdraw circuit breaker indicating light.

8. Over-torque indicating light/reset pushbutton.

2.07 TRIP UNITS:

A. Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.

B. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

E. Trip unit shall have selectable powered and unpowered thermal memory for enhanced circuit protection.

F. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state element

1. All circuit breakers shall have adjustments for long delay pickup and time.

2. All circuit breakers shall have individual adjustments for short delay pickup and time, and include I squared t setting.

3. All circuit breakers shall have an adjustable instantaneous pickup.

4. Main and tie circuit breakers shall have individually adjustable ground fault current pickup and time, and include I2t settings or ground alarm only.

G. The trip unit shall have provisions for a single test kit to test each of the trip functions.

H. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the preset time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

I. Each circuit breaker and shall transmit the following parameters to the central control station using Profibus:

1. Breaker position (open, close, trip).

2. Current.

2.08 WIRING:

A. Switchgear completely wired at factory. All secondary and control wiring made with standard switchgear wire and cable.

B. Provide acceptable terminal blocks with marking strips for all secondary and control circuits leaving metal enclosed structure and for interconnecting separate compartments.

C. Enclose all wiring between stationary units in metal raceway or compartments with removable covers.

D. Where wiring connections are made to equipment mounted on hinged doors, provide terminal blocks or wire cleats for all secondary and control circuits leaving metal enclosed structure and for connecting separate compartments.

2.09 MONITORING AND PROTECTIVE DEVICE

A. Provide a microprocessor-based monitoring and protective device where shown in the drawings for electrical metering and system voltage protection. Provide current and control power transformers as required. Protect control power transformer with fuses on the primary and secondary sides. Device shall have the following features:

1. Continuous metering of the three phases of the electrical system.

2. It shall be possible to view on the LCD module display the current, voltage, active power, reactive power, power factor, watt-hours, frequency, and demand values.

3. A multi-position keypad to give full front panel programmability.

4. Set points shall be stored in EEPROM for permanent storage.

5. A minimum 32-character liquid crystal display to provide English language description of set points and metered values.

6. An alarm indication via a front panel LED indicator and the change in state of dedicated on-board output relays (a minimum of two relays), with Form C contacts. These contacts shall be used to open and close breakers and/or initiate alarm signals to remote equipment.

B. The unit shall be capable of transmitting data utilizing Profibus. Provide converter, if required, to convert serial communication protocols to Ethernet.

C. Device shall be Schneider Electric PowerLogic or equivalent by Siemens.

2.10 ACCESSORY DEVICES:

A. Control power transformers rated 480-120/240 volts, single-phase, 3-wire, 60 Hertz, with kva rating as required by switchgear, but not less than 5 kVA. Mount current limiting primary fuses for control power transformer on disconnecting or drawout fuse mounts. Provide secondary fuses.

B. Instruments, Relays and Control Equipment:

1. All instruments and relays with semiflush mounted cases and dusttight. All relays, instruments and meters accurately calibrated for satisfactory operation after installation. Instrument relays conforming to ANSI C39.1.

2. In general, all indicating instruments rectangular type with 250 degree scales with one percent accuracy. Moving elements provided with zero adjustments. Indicating instruments conforming to ANSI C39.1.

3. Control and selector switches heavy duty oiltight units rated 20 amperes at 600 volts, of rotary-type with positive means for maintaining contact. Provide enclosed contacts, silver-to-silver, with easily removable protective covers.

4. Fuse blocks and fuses provided as required, for the protection of the instruments.

5. Suitable rated current and potential test blocks furnished with matching plugs, for connecting external instruments installed as indicated. Test blocks 6- or 8-point, suitably marked and connected for inserting both current and potential test leads.

A. Nameplates:

6. Provide engraved nameplates for switchboards and panel mounted devices laminated plastic with white lettering on black background.

2.11 PAINTING:

A. All steel surfaces of switchgear assembly chemically cleaned and finished with ANSI Z55.1 No. 61 gray enamel over rust resistant undercoat. Exterior of outdoor enclosures finished in ANSI Z55.1 No. 24 blue gray.

B. All meters, instruments and relays with dull black finish.

2.12 FACTORY TESTS:

A. The entire Switchgear assembly shall go throught a quality inspection before shipment, verifying the equipment to the factory shop drawings. This inspection will include:

1. Physical inspection and verification of:

a. Structure including verification of all bolted connections,
b. Electrical conductors, including:

i. Bussing including verification of all bolted connections.
ii. Wiring.
iii. Unit compartments.

2. Electrical Tests:

a. Electrical tests include:

i. Power circuit phasing.
ii. Control circuit wiring and verification of satisfactory operation of all relays and other devices.
iii. Instrument transformers.
iv. Meters.
v. Ground fault system.
vi. Device electrical operation.

b. AC dielectric tests shall be performed on the power circuit.

3. Markings/Labels, include:

a. Instructional and warning type labels.
b. Underwriters Laboratory (UL).
c. Inspector’s stamps.

4. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the switchgear meets operating specifications.

B. Equipment that is shipped without evidence of the required tests being performed to verify satisfactory operation will be subject to non-acceptance.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Properly set and level channel sills.

B. Attention is directed to requirements of Section 01730, with regard to services of manufacturer's representative.

C. Furnish complete, clear, and concise instructions for installation, operation, and maintenance of the equipment.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16400
SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide Surge Protection Devices (SPDs) components in combination with the electrical distribution system equipment including switchboards, motor control centers, 480V distribution panels and 120V panelboards.

B. The components shall provide protection for electrical and electronic devices against the damaging effects of surges, transients and electrical line noise.

C. Where indicated on the electrical contract drawings, provide separate, modular components from the electrical distribution equipment enclosures. Provide conduit, cable and all associated components for a complete SPD system installation. It shall be the Electrical Contractor's responsibility to verify adequate space for locating modular SPD equipment adjacent to associated electrical distribution equipment.

1.02 REFERENCES:

A. American National Standard Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits
2. C62.45: Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

B. Military Standard (MIL):

1. 220A: Radio Frequency Interference and Electromagnetic Interference

C. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum)
2. LS 1: Low Voltage Surge Protection Devices

D. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

E. Underwriters Laboratory (UL):

1. 1449: Standard for Safety, Surge Protective Devices - Third Edition.

2. 1283: Standard for Safety, Electromagnetic Interference Filters

1.03 SUBMITTALS:

A. Submit shop drawings, manufacturer's product data, and component ratings in accordance with this section and the requirements of Sections 01300 and 16050.

B. SPD type, model number, system voltage, phases, modes of protection, Maximum Continuous Operating Voltage (MCOV) Voltage Protection Rating (VPR), Short Circuit Current Rating (SCCR), and Nominal Discharge Current (In).

C. Provide outline drawings and internal wiring diagrams.

D. List all required installation criteria including circuit breaker trip rating to meet UL 1449, Third Edition.

E. Identify all cable sizes, distance limits and accessory devices when SPD units are to be provided in separate enclosures, where applicable.

F. For informational/purposes only, submit installation instructions and separate from all other submittals.

G. UL 1449 listing and summary of factory test data.

1.04 QUALITY ASSURANCE:

A. SPD units and all components shall be designed manufactured and tested in accordance with the latest applicable UL Standard ANSI/UL 1449 Third Edition.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 16050 and as specified.

B. Shipping:

1. Ship equipment and materials, except where partial disassembly is required by transportation regulations or for protection, complete with identification and quantity of items.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. Deliver spare parts after installation but before start-up of system as specified. Deliver to Owner after completion of work.

C. Storage:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts.

1.06 WARRANTY AND SERVICE:

A. Provide in accordance with Section 01740 and as specified.

B. The Surge Protection Device (SPD) manufacturer is to warranty the components against defective materials and workmanship for a period of five years following delivery from the manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Surge Protection Device components.

1. Phoenix Contact.
2. Siemens.
3. Advanced Protection Technologies, Inc.

2.02 PROVISIONS:

A. Environmental Requirements:

1. Operating Temperature: minus 40 degrees C to 60 degrees C.
2. Relative Humidity: 5 to 95 percent.
3. Operating Altitude: 0 to 12,000 Feet.
4. Audible Noise: Less than 35 dBA at 3 feet.

B. Electrical Requirements:

1. The maximum continuous operating voltage of all suppression components utilized is not to be less than 115 percent of the nominal operating voltage at the installed location.
2. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Volts	L-N	L-L	N-G
208Y/120	460V	1000V	700V
480Y/277	1100V	1800V	1000V

3. The ANSI/IEEE C62.41.1-1991 Category C3 let through voltages shall not exceed the following

Volts	L-N	N-G
208Y/120	550V	470V
480Y/277	900V	920V

4. The SPD components are to be rated as follows:

480V Service Entrance at each structure	250 kA per phase 125 kA per mode
480V Distribution Panels	160 kA per phase 80 kA per mode
120/208V Panelboards	120 kA per phase 60 kA per mode

5. The mode of operation is to protect against surges and transients as follows:

System Configuration	Protection Mode
Single Phase, Two Wire (L,N) + Ground	L to G,L to N, and N to G
Single Phase, Two Wire (L,L) + Ground	L to L, and L to G
Three Phase, Three Wire (Delta) + Ground	L to L, and L to G
Three Phase, Four Wire (Wye) + Ground	L to L, L to G,L to N, and N to G

2.03 OPERATION:

A. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor. The system shall not use silicone avalanche diodes, air gaps or other methods of suppression.

B. Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHZ.

C. SPD shall provide surge current diversion between each phase conductor and the neutral conductor, between each phase conductor and ground and between the neutral conductor and ground. For delta systems, the SPD shall have components directly connected between each phase conductor and between each phase conductor and ground.

D. The SPD shall provide a low impedance path for surge current using over sized conductors with equal impedance paths to each suppression element. Plug-in style connections or printed circuit boards for use in the path of surge current shall not be used.

E. Operating Parameters:

1. The maximum response time shall not exceed 1 nanosecond.

2. Provide with a noise filtering system capable of managing noise levels produced by electro-magnetic interference and radio frequency interference. The noise filtering system shall reject a minimum of 50db at 100 kHz as measured by the 50 Ohm Insertion Loss Method (Military Standard 220A).

3. The parallel system components shall operate over a minimum frequency range of 47 Hertz to 63 Hertz.

4. The SPD components shall limit total harmonic distortion produced to less than one percent.

5. SPD component ratings to be per UL 1449, Third Edition.

6. Each unit shall be factory tested at the maximum continuous operating voltage and short circuit tested, prior to delivery.

F. Product Components:

1. Protection and Filtering Elements:

a. The SPD components shall consist of replaceable protection modules designed to suppress and divert transient voltages and surge currents. Each protection module shall contain one or more individually fused metal oxide varisters capable of withstanding over 1000 surges of Category C (IEEE/ANSI C62.41.1) current rated at 10,000 amperes.

b. Each protection module shall contain filtering elements capable of providing noise attenuation.

c. The SPD components shall substantially limit transient waveform rise-time characteristics. The components are to be configured as parallel connected, current carrying elements designed to enhance the surge suppression and diversion performance of the protection modules.

2. Provide individual fusing to allow the SPD to be isolated during fault conditions.

3. Provide red and green solid-state status lights which indicate operational status of each unit and visual diagnostic monitoring of each component and module. Provide audible alarm to activate on fault condition, with a silence switch and push-to-test alarm switch.

4. Provide surge counter with battery backup to retain memory upon loss of AC power.

5. Provide remote status monitoring with form C dry contacts monitoring all phases.

2.04 SHOP TESTING:

A. Perform factory performance testing on each unit. The test to consist of the following:

1. High voltage impedance test.

2. Current test.

B. Tests shall be in accordance with the following standards:

1. ANSI/IEEE C62.41.1 Cat. A, B, & C.

2. ANSI/IEEE C62.45.

3. Military Standard 220A.

4. Underwriters Laboratory UL 1449.

C. Submit certified documentation of all factory tests performed.

D. Perform above tests in addition to standard factory tests.

2.05 SPARE PARTS:

A. Provide in accordance with Section 01730 and as specified.

B. Provide one spare protection module of each type for on-site spare parts purposes.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Visually inspect delivered unit(s) and accessories for conformance with drawings and specifications. Replace all components found to exhibit defects.

3.02 INSTALLATION:

A. Install unit in compliance with the manufacturers printed instructions. All electrical installation work shall be in accordance with UL Listing Requirements and applicable National or Local Electrical Codes.

B. For units mounted adjacent to electrical distribution equipment, verify conduit and wire for the SPD components are as specified by the SPD manufacturer and installed in strict accordance with the National Electrical Code.

C. Verify UL 1449, third edition, label is provided on each unit.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16402
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete underground distribution system as indicated and specified.

B. Conform to lines, grades, elevations, and dimensions. Resolve interferences with other underground conduit, piping or equipment, either new or existing with the Engineer and Owner. Match components suitable for proper installation.

C. Provide concrete encasement of duct system where indicated. Include forms and reinforcing in installation. Perform work in accordance with Section 16050.

D. Provide manholes and handholes complete with ground rods, windows, ladders, frames, covers, cable racks, supports, pulling irons, and other inserts. Use reinforced concrete. Perform work in accordance with Section 16050.

E. Provide Schedule 80 polyvinylchloride (PVC) conduit for power and control circuits.

F. Provide PVC-coated rigid steel conduit for variable frequency drive (VFD) output power circuits and in Class I, Division 1 locations.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with requirements of Sections 01300 and 16050.

B. Provide "Record" drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S COMPLIANCE:

A. Manufacturer's acceptance contingent upon products' compliance with specifications.

2.02 MANUFACTURERS:

A. Polyvinylchloride (PVC) Conduit:

1. Specified in Section 16110.

B. PVC-Coated Rigid Steel:

1. Specified in Section 16110.

C. Manhole Waterproofing Material:

1. Heavy Duty Black, No. 46-449, by Tnemec Company, Inc., No. Kansas City MO.
2. Hi-Build Bituminous Coating, No. 64-J-5, by Valspar Corporation, Baltimore, MD.
3. Bitumastic Super Service Black, by Kop-Coat, Inc., Pittsburgh, PA.

2.03 MATERIALS AND COMPONENTS:

A. Conduit Spacers: Furnish conduit spacers made of plastic to maintain spacing between conduits.

B. Concrete: Minimum compressive strength, 3,000 psi.

C. Above Grade Aluminum Pull Boxes:

1. Provide NEMA 3R pull boxes for pulling and terminating low voltage conductors, in types and sizes indicated.
2. Construct of 0.125” thick 5052-H32 aluminum with mill finish.
3. Hardware, padlockable door handle, door cam, and hinge to be Type 316 stainless steel.
4. Roof sloped toward rear.
5. Perforated screen vent slots on underside of overhang.
6. Single latching three-point front door with double flanged door opening and neoprene door gasket.

D. Precast Manholes and Handholes:

1. Provide handholes and manholes for pulling and terminating medium voltage conductors, in types and sizes indicated.
2. Handholes: Precast concrete, open bottom, with traffic-rated cast-iron covers.
3. Manholes: Precast concrete, closed bottom with sump and hot-dipped galvanized steel traffic-rated covers, designed to AASHTO HS20-44 loading. Provide with pulling irons and cable racks.

4. Provide access knockout entrance panels for entry of ducts. Install one knockout panel in each wall, a minimum of 12-inch-high by 24-inch-wide for future ducts.

5. Sump: Cast in bottom of manholes with cover and discharge pipe.

E. Manhole and Handhole Frames and Covers:

1. Conform to details indicated on the drawings and as specified.

2. Mark "ELECTRICAL" on cover of manhole.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUITS:

A. Concrete encase all conduits below grade. Dig trenches to depth and location indicated.

B. Provide minimum separation of power and control conduits of 3 inch both vertically and horizontally. Build ductbank layer by layer, backfill and compact each layer to provide support for next layer.

C. Separate power and control ducts from instrument ducts by a minimum of 12 inches.

D. Backfill ductbank in layers and tamp as directed by the Engineer. Provide magnetically detectable yellow ductbank marker tapes, reading "Caution - Electrical Lines Below", over entire length of ductline. Locate tapes 12 inches below grade. Provide a tape for every 12 inches of width of ductline.

E. Install conduit encased in concrete with spacers and reinforcing as specified and as indicated in the drawing details.

F. Install conduit runs following routing on drawing and running in straight lines. Where deviation from a straight line becomes necessary, install bends of radius which allow for rodding and installation of cable.

G. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep bends having minimum radius of curvature of 25 feet. Manufactured bends can be used at ends of short runs of 100 feet or less, and then only at or close to the end of run. Provide long sweep bends made up of one or more curved or straight sections and/or combinations thereof. Install manufactured bends with minimum radius of 36 inch where larger radius cannot be used.

H. Lay ductlines to minimum slope of 4 inch per 100 feet and slope to manholes and handholes, as indicated. Ductlines are to slope away from buildings.

I. Install spacers at intervals of approximately 4 feet and stagger between tiers of ducts to provide not less than 12 inches of longitudinal separation. Install base spacers to

provide at least 3 inches between bottom of trench and underside of bottom conduits. Completely fill space with concrete. Firmly wire conduits and spacers together before concrete is placed.

J. Ductbanks are to be formed, unless trench conditions allow for neat placement of concrete with specified clearances.

K. Prior to placing of concrete, remove all dirt, sand, and any other debris from between conduits and from trench bottoms. Hold conduits in place to prevent floating or accidental movement.

L. Stagger joints in conduits at least 6 inches. Do not allow couplings to rest on bottom of trench. Install couplings for plastic conduit in accordance with manufacturer's recommendations.

M. Install concrete encasements so minimum clearance of 12 inches from concrete to parallel pipes, lines, structures, etc., is maintained. Where ducts cross, minimum clearance of 6 inches is required. Do not allow the top of concrete to be less than 30 inches below finished grade or paving. Submit special conditions which may require lesser clearances or special conditions which may require greater than 30 inches depth to Engineer for acceptance.

N. Where a connection is made to existing ductline, bond or dowel concrete encasement to existing encasement. Use waterstop between ductpours and between manholes or buildings and ductwork as indicated.

O. Do not use power-driven vibrators for spading of concrete around ducts.

P. Roll and grade backfill, and restore surface to condition equal to the site finish grade, or as otherwise indicated.

Q. Locate ductbank markers at ends of all ductbanks except at manholes or handholes, at approximately every 200 feet along duct run, and at each change in direction of duct run. Place markers approximately on ductbank. Install markers 6 inches square or round section by 3 feet long made of Class B concrete. Imprint the letter "D" or cast it on top of the marker. Install top of duct markers flush in paved areas, protruding no more 2-inches above finished grade in unpaved areas. In finished lawns, allow marker to protrude 1/2-inch.

R. Keep conduits clean of concrete, dirt, and other substances during the course of construction. After the ductlines have been completed, pull a standard flexible mandrel not less than 12 inches long, having a diameter approximately 1/4-inch less than the inside diameter of the conduit, through each conduit, after which pull a brush with stiff bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Replace conduit runs that do not allow the passage of the mandrel at no additional cost to the Owner. Pneumatic rodding may be used to draw in the lead wire. Install in spare conduits a pull wire or rope, and plug and seal spare conduits after cleaning.

3.02 MANHOLES AND HANDHOLES:

A. Install manholes with cable racks, hooks, insulators, and other features, as indicated.

B. Place a 6 inch crushed-stone base under each manhole and handhole.

C. At convenient point close to wall, drive a ground rod into earth as indicated. Extend ground rod approximately 6 inches above finished manhole floor. After completion of manhole or handhole installation, connect 6 foot length of No. 4 bare copper ground wire to ground rod and coil it within manhole or handhole for connection to steel supports and cover.

D. Set manhole and handhole frames to the required grade and make watertight connection.

E. Install tops of manhole and handhole covers in unpaved areas approximately 1/2-inch above finished grade, and in paved areas install flush with finished surface of paving.

F. Install galvanized corrosion-resistant channel support, with continuous slot and required fittings designed for concrete encasement.

G. Manhole shall be provided with two cable pulling irons in wall opposite each ductbank entrance, one 6 inch above floor and one 6 inch below the roof of manhole. Where indicated on drawings, install additional features such as openings in manhole walls for future conduit entrances. Seal future entrances with required courses of brick.

H. Where ductlines enter manholes, terminate conduits in end bells. Terminate steel conduit entering manholes and handholes in grounding bushing.

3.03 MANHOLE AND HANDHOLE WATERPROOFING:

A. Apply two coats of bituminous waterproofing material to exterior surfaces of manholes and handholes. Apply by brush or spray, in accordance with manufacturer's printed instructions. Allow time between coats to permit sufficient drying.

1. Two coats applied with a minimum dry film thickness of 12 to 14 mils per coat.

3.04 RECORD DRAWINGS OF UNDERGROUND WORK:

A. Furnish one set of marked copies of contract drawings, showing exact routing and depths of all underground conduit, duct handholes and manholes. Furnish scaled plot plans, showing principal outline of buildings and structures. Reference conduits, ducts, and manholes, and all bends deviating from straight line, dimensionally from fixed objects or structures.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16415
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section includes materials and installation of automatic transfer switches.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

B. National Electrical Manufacturers Association (NEMA):

1. ICS 2: Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.

C. Underwriters Laboratories (UL):

1. 1008: Automatic Transfer Switches.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

B. Submit shop drawings and manufacturers' product data in accordance with the requirements of Section 16050.

C. Submit manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and a list of accessories.

1.04 OPERATION AND MAINTENANCE MANUALS:

A. Submit operation and maintenance manuals in accordance with Section 16050.

1.05 MANUFACTURER'S SERVICES:

A. Provide manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One labor day to check the installation and advise during start-up, testing, and adjustment of the transfer switch.

PART 2 - PRODUCTS

2.01 TRANSFER SWITCH:

A. Transfer switch shall be mounted in a wall-mounted NEMA 1 enclosure. Transfer switch shall have number of poles, amperage, and voltage ratings as shown in the drawings. Withstand current rating shall not be less than 14,000 ampere rms symmetrical.

B. Switch shall be listed per UL 1008 as a recognized component for emergency systems and be rated for all classes of loads.

C. Transfer switch shall be electrically operated and mechanically held in each direction by a single operating mechanism momentarily energized from the source to which the load shall be transferred. Accomplish mechanical locking in each direction without the aid of latching solenoids, toggle mechanisms, or gear arrangements. Total operating transfer time shall not exceed one-sixth of a second.

D. Operation shall be inherently double throw where normal and emergency contacts operate simultaneously with no momentary delay in a mid-position. An overload or short circuit shall not cause the switch to go to a neutral position. Do not use main contact structures not originally manufactured for transfer switch service (molded case circuit breakers or contactors). Inspection and replacement of all contacts (stationary and arcing) shall be possible from the front of the switch without any disassembly of operating linkages or power conductors. Provide a handle to permit no-load manual operation.

2.02 ACCESSORIES:

A. Provide a solid-state sensing and control logic panel. Include the following operational characteristics:

1. Full phase voltage relay supervision of the normal source with at least one close differential relay to detect "brownout" condition, set at 70 percent dropout and 90 percent pickup.
2. Voltage/frequency lockout relay to prevent premature transfer, set at 90 percent voltage and 90 percent frequency.
3. Adjustable (2 to 25 minutes) time delay on retransfer to normal, set at 20 minutes.
4. Transfer to emergency time delay (adjustable 1 to 300 seconds), set at 1 second.

B. Provide a system test switch (momentary type) on the front of the enclosure.

C. Manual push button to bypass the time delay on retransfer.

D. Indicating lights to indicate source to which the load is connected.

E. Indicating light to indicate presence of normal power source.

F. Auxiliary contacts for remote indication of switch position, one normally open and one normally closed contact for normal and emergency position.

G. Transfer switch shall be configurable for connectivity to Profinet for communications.

2.03 MANUFACTURERS:

A. The transfer switch shall be as manufactured by:

1. Automatic Switch Company.
2. Russelectric Co.
3. Zenith (ZTS).

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Secure transfer switch rigidly to wall with anchor bolts or Phillips Drill Company concrete anchors. Anchor bolts or concrete anchors shall be carbon steel per ASTM A307, Grade B.

3.02 FIELD TESTING:

A. Field test per manufacturer's recommended standard test procedure.

B. Field test and calibrate timing and monitoring logic. All adjustments shall be within 5 percent of the previously specified set points.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16450
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide a single, complete, integrated grounding system, including conductors, raceways, and connections, indicated and specified, and in accordance with the National Electrical Code Article 250.

B. Include grounding of switchgear, motor control centers, electric equipment enclosures etc., transformers, switch structures, etc.; ground grid systems with ground rod and water pipe connections; structural steel, and lightning protection system.

C. Include grounding conductors completely inter-connecting water supply pipe, ground rods, ground grid, switchgear and motor control center ground buses, other distribution equipment, and other groundable equipment.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. B3: Standard Specification for Soft or Annealed Copper Wire.
2. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. B33: Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Institute of Electrical and Electronics Engineers (IEEE):

1. Standard 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code.
2. 780: Lightning Protection Code.

D. Underwriters Laboratories (UL):

1. 467: Standard for Grounding and Bonding Equipment.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with requirements of Sections 01300 and 16050.

B. Submit catalog and dimensional data for the following:

1. Ground rods
2. Exothermic welding
3. Connecting hardware

C. Submit grounding system test results.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S COMPLIANCE:

A. Manufacturer's acceptance contingent upon products' compliance with the specifications.

2.02 MANUFACTURERS:

A. Ground Rods:

1. ERICO Products Inc.
2. Galvan Electrical Products.
3. Nehring Electrical Works.

B. Exothermic Welding:

1. ERICO Products, Inc.
2. American Brass Mfg. Co.
3. Orgo-Thermit, Inc.

C. Connecting Hardware:

1. American Brass Mfg. Co.
2. Thomas and Betts
3. Anderson Electric Corp.

2.03 MATERIALS AND COMPONENTS:

A. Conductors:

1. Provide copper grounding conductors bare or insulated, sized as indicated. When not indicated on the drawing provide in accordance with the NEC. Provide protection of conductors in locations where physical damage would result from direct exposure.

2. Ground and bond wires for substations, main panels and distribution points, and ground rod connections shall be annealed bare copper conforming to ASTM B3, stranded, with 98 percent conductivity.

3. Equipment grounding conductors run with circuit conductors and grounding electrode conductor shall be 600 volt with green insulation, unless noted otherwise on the Contract documents.

4. Unless noted otherwise, all conductors No. 8 AWG and larger shall be stranded, Class B in accordance with ASTM B8.

    a. Uninsulated conductors shall be bare copper in accordance with ASTM B3, tinned in accordance with ASTM B33.
    b. Use tinned-coated in corrosive environments including when buried in earth or embedded in concrete.

B. Connectors and Fasteners:

1. Provide ground clamps which are UL listed for use on copper or brass pipes.

2. Provide ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material for use on iron pipes.

3. Provide ground clamps, for use on pipes, with rigid metal base providing good contact by proper seating on the pipe. Do not use strap type clamps.

C. Ground Rods:

1. Ground rods shall conform to the requirements of NFPA 70 and UL Standard 467.

2. Ground rods shall be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10 feet long per section.

3. Ground rods shall be clean and smooth with the following characteristics:

    a. Cone-shaped point on the first section.
    b. Die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in feet.

PART 3 - EXECUTION

3.01 EXOTHERMIC WELDING:

A. Welding shall be by the exothermic process.

B. Within the welding procedure, include the proper mold and powder charge and conform to the manufacturer's recommendations.

C. Welding processes shall be the exothermic fusion type that will make a connection without corroding or loosening.

D. The welding process shall join all strands and not cause the parts to be damaged or weakened.

E. Completed connection or joint shall be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor.

F. Paint buried ground connection with a bitumastic paint.

3.02 INSTALLATION OF GROUNDING CONDUCTORS:

A. Install grounding conductors so that they will not be exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

B. Bury equipment grounding conductors at depth indicated in the drawings. Bring loops or taps up for connection to equipment or other items to be grounded.

C. Where raceways are used to contain and protect grounding conductors, install in accordance with Sections 16110 and 16402.

D. Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors.

E. Install loop type, low impedance, grounding system interconnecting all components so at least two grounding connections are provided for each major item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

F. Connect structural steel to the external perimeter loop of grounding conductors installed around all sides of building foundation, buried at least 30 inches below grade. Connect to each vertical column by loop or tap. Connect two opposite points on external loop to two different points on grounding system.

G. Buried and concealed ground connections shall use exothermic welding.

H. Make accessible connections to structural members by exothermic welding process or by bolted connector. Connections to equipment or ground bus by bolted connectors.

3.03 INSTALLATION OF GROUND RODS:

A. Install ground rods in manholes in accordance with requirements specified under the section Underground Distribution Systems. Connect each grounding conductor entering a manhole to ground rod by exothermic weld.

B. Install ground rods where indicated. Install the top of the rod 12 inch below the ground surface.

C. Make connection to overall grounding system as indicated.

D. Ensure that final resistance of interconnected ground system is 5 ohms, or less. Measure ground resistance in normally dry conditions, and not less than 48 hours after rainfall.

3.04 EQUIPMENT GROUNDING:

A. Ground each piece of electrical equipment by means of a grounding conductor installed in raceway feeding that piece of equipment. Grounding conductors installed in conduit with insulated conductors to be furnished with green, 600 volt insulation. Grounding conductors are in addition to and not to be considered as the neutral wire of the system.

B. Connect power transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

C. Connect two separate ground connections from ground grid to ground bus of switchgear assemblies, motor control centers, and all outdoor transformer equipment. Ensure that each connection for item of equipment is from different section of ground grid.

D. Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

E. Conduits entering metal enclosures shall utilize bonding type locknuts and grounding bushings. Locknuts that gouge into the metal enclosures are not acceptable.

F. Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on at least one end of conduit run. Conduit connections shall be wrench tight.

G. Install a separate grounding conductor from ground system to motors of 100 horsepower and larger, in addition to raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.

H. Connect lightning arresters to ground system by suitable conductors. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, ensure that suitable separate grounding conductor connects lightning arresters with system ground.

I. Ground each area lighting standard by ground rod driven near base of standard. Connect ground rods to grounding conductor brought with area lighting feeder cable.

J. Connect individual ground rods to the grounding loop using the direct burial grounding cable.

3.05 SIGNAL GROUNDING:

A. Ground signal surge protection and shields of twisted, shielded cable using a signal bonding conductor. The signal bonding conductor shall be a continuous path from the instrument surge protection or shield to the grounding electrode conductor. The signal bonding conductor shall be isolated from the equipment grounding conductor for its entire path.

B. Where convenient several signal bonding conductors may be conbined, providing that all the following conditions are met:

1. The combined signal bonding conductor shall have the equivalent cross section of the conductors that it was combined from or three times the cross section of the largest conductor that it was combined from, whichever is less.
2. The combined signal bonding conductor shall be isolated from the equipment grounding conductor.
3. Where two signal bonding conductors are combined use a three port insulated splice.
4. Where three or more signal bonding conductors are combined, use a copper bus mounted on 600 volt insulators. Attach each conductor to the bus using an insulated ring tongue lug and screw terminal.

3.06 FIELD TESTING:

A. Test grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise must not exceed 50 milliohms.

B. Ground resistance and counterpoise tests must be made during dry weather and no sooner than 48 hours after rainfall. Conditions of soil and weather shall be documented on test forms.

C. Conduct tests using the ratio method that measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE Standard 81.

D. Indicating instrument must be self-contained and include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Calibrate direct-reading ohmmeter for ranges of 0 to 20 ohms and 0 to 200 ohms.

E. Place auxiliary grounding electrodes in accordance with instrument manufacturer's recommendations but not less than 50 feet apart, in accordance with IEEE Standard 81.

F. Perform continuity test on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

G. Furnish copies of test reports on ground system.

3.07 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16500
INTERIOR LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete indoor lighting systems as indicated and in compliance with Contract Documents.

B. Light fixture schedules are provided on the Contract Drawings. These Specifications are to be considered supplementary to the information contained in the light fixture schedule. In areas of conflict the scheduled items shall be provided.

C. Fixtures shall be “Energy Star” rated.

1.02 DEFINITIONS

A. Emergency Lighting Unit: Fixture with integral emergency battery-powered supply and means for controlling and charging battery. Also known as an emergency light set.

B. Fixture: Complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply. Internal battery-powered exit signs and emergency lighting units also include battery and means for controlling and recharging battery. Emergency lighting units include ones with and without integral lamp heads.

1.03 REFERENCES:

A. American National Standards Institute (ANSI):

1. C78.377: Chromaticity of Solid State Lighting Products.

B. Design Lights Consortium (DLC)

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).
2. 101: Life Safety Code.

D. Underwriters' Laboratories, Inc., (UL):

1. 773: Standard for Plug-In Locking Type Photo Controls for use with Area Lighting.

2. 773A: Nonindustrial Photo Electric Switches for Lighting Control.

3. 924: Standard for Emergency Lighting and Power Equipment.

4. 1598: UL Standard for Safety Luminaires

5. 8750: Light Emitting Diode (LED) Equipment for Use in Lighting Products.

E. Illuminating Engineering Society of North America (IESNA or IES):

1. LM-79: IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

2. LM-80: IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources

1.04 SUBMITTALS:

A. Submit shop drawings and manufacturer's product data with installation instructions in accordance with the requirements of Sections 01300 and 16050.

B. Submit manufacturer's shop drawings including photometric laboratory test data to show that luminaires proposed are of same type, construction and quality as those indicated. Luminaires are to be listed and labeled by Underwriters' Laboratories.

C. Submit photometric calculations based on maintained lighting foot candle levels for areas where lighting fixtures are substituted. Substituted fixtures must provide similar lighting performance and energy usage as those scheduled, and must be constructed of similar quality and materials.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Lighting fixtures to be provided with dedicated supporting systems.

C. Comply with the Code for Buildings and all local and State energy laws and regulations.

1.06 EXTRA MATERIALS:

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Lamps: 10 lamps for every 100 of each type and rating installed. Furnish at least 1 of each type.

2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least 1of each type.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, except as indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: 0.125 inches minimum; except where greater thickness is indicated.

F. Fixture Support Components:

1. Single Stem Hangers: 1/2 inches steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
2. Twin Stem Hangers: Two, 1/2 inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
3. Rod Hangers: 3/8 inch minimum diameter, zinc plated, threaded steel rod.
4. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking type plug.

2.02 LAMPS:

A. Furnish lamps of types and wattages shown in luminaire schedule.

2.03 LED FIXTURES:

A. Provide fixtures on the DesignLights Consortium (DLC) Qualified Products List.

B. Thermal Management: Liquids or other moving parts shall be clearly indicated in submittals, and shall be consistent with product testing.

C. Color Rendering Index (CRI): >70.

D. Correlated Color Temperature: 4000K.

E. Minimum luminaire efficacies: 85 lumens per watt. Nominal input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.

F. Fully enclosed wiring and LED diodes enclosed to prevent penetration of dust, insects, and other debris into the lamp and driver compartment.

G. Driver/LED combined system shall have rated life based on IESNA LM-80-2008 (or latest) of 50,000 hrs at 70% lumen maintenance.

H. Driver is high efficiency type with THD < 20 percent and power factor > 0.90.

2.04 EMERGENCY LIGHTING AND EXIT LIGHTING UNITS:

A. Exit Signs: Conform to UL 924 and following:

1. Sign Colors: Conform to local code.
2. Minimum Height of Letters: Conform to local code.
3. Arrows: Include as indicated.

B. Emergency Lighting Units: Conform to UL 924. Provide self contained units with following features:

1. Battery: Sealed, maintenance free, lead acid type with minimum 10 yr nominal life and special warranty.
2. Charger: Minimum 2 rate, fully automatic, solid state type, with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80% of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep discharge level. Relay disconnects lamps and battery and automatically recharges and floats on trickle charger when normal voltage is restored.

PART 3 - EXECUTION

3.01 LUMINAIRES AND LAMPS:

A. Install types and sizes indicated, complete. Deliver lamps of proper type, wattage and voltage rating to site and install in luminaires prior to completion of project.

B. Install all luminaires to comply with applicable provisions of National Electrical Code. Suspend pendant luminaires by means of suitable outlet box cover-type aligners, each having flexible joint permitting unit to hang plumb.

1. Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers.
2. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated.
3. Brace pendants 4 feet or longer to limit swinging.
4. Single-unit suspended fixtures shall have twin-stem hangers.
5. Multiple-unit or continuous row fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end.
6. Rods shall be a minimum 3/8-inch diameter.

C. Use aligners of shock absorbing type, where indicated.

D. Install luminaires with adjustable fittings to permit alignment with ceiling panels. Install luminaires in fire-resistive type of suspended ceiling construction, equipped with fireproofing boxes constructed of materials of same fire rating as ceiling panels. Materials in conformance with UL approved building materials list.

E. Support for Recessed and Semi-recessed Grid Type Fixtures: Support Units from suspended ceiling support system. Install ceiling support system rods or wires at minimum of 4 rods or wires for each fixture, located not more than 6 inches from fixture corners.

1. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corner.
2. Fixtures Smaller than Ceiling Grid: Install minimum of 4 rods or wires for each fixture and locate at corner of ceiling grid where fixture is located. Do not support fixtures by ceiling acoustical panels.
3. Fixtures of Sizes Less than Ceiling Grid: Center in acoustical panel. Support fixtures independently with at least two 3/4 inch metal channels spanning and secured to ceiling tees.

F. Install accessories such as straps, mounting plates, nipples, or brackets necessary for proper installation.

G. Connect emergency light units to the unswitched branch circuit powering the luminaires in the same space.

3.02 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16520
EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete outdoor lighting systems as indicated and in compliance with Contract Documents.

B. Light fixture schedules are provided on the Contract Drawings. These Specifications are to be considered supplementary to the information contained in the light fixture schedule. In areas of conflict the scheduled items shall be provided.

C. Fixtures shall be “Energy Star” rated.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. A500/A500M: Cold Formed Welded and Seamless Carbon Steel Structural Tubing.

2. B429/B429M: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

B. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits

2. C62.41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. Underwriters' Laboratories, Inc. (UL):

1. 773: UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting-Fourth Edition

2. 1598: UL Standard for Safety Luminaires

1.03 DEFINITIONS:

A. Fixture: Complete lighting device. Fixtures include lamp or lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.

B. Lighting Unit: Fixture or assembly of fixtures with common support, including pole or bracket plus mounting and support accessories.

C. Luminaire: Fixture.

1.04 SUBMITTALS:

A. Submit shop drawings and manufacturer's product data with installation instructions in accordance with the requirements of Sections 01300 and 16050.

B. Submit manufacturer's shop drawings including photometric laboratory test data to show that luminaires proposed are of same type, construction and quality as those indicated. Luminaires are to be listed and labeled by Underwriters' Laboratories.

C. Submit photometric calculations based on maintained lighting foot candle levels for areas where lighting fixtures are substituted. Substituted fixtures must provide similar lighting performance and energy usage as those scheduled, and must be constructed of similar quality and materials.

D. Product Data:

1. Describe fixtures, lamps, poles, and accessories. Arrange Product Data for fixtures in order of fixture designation. Include data on features, poles, accessories, finishes, and following:

a. Outline drawings indicating dimensions and principal features of fixtures and poles.
b. Electrical Ratings and Photometric Data: Certified results of laboratory tests for fixtures and lamps.

E. Operating and Maintenance Data (O&M): Maintenance data for products to include operation and maintenance information.

1.05 QUALITY ASSURANCE:

A. Comply with IEEE C2.

B. Items provided under this section shall be listed or labeled labelled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term “NRTL” shall be as defined in OSHA Regulation 1910.7.

2. Terms “listed” and “labeled” shall be as defined in National Electrical Code (NEC), Article 100.

C. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.06 STORAGE AND HANDLING OF POLES:

A. Store poles on decay-resistant treated skids at least 12 inches above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.

B. Metal Poles: Retain factory applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.07 EXTRA MATERIALS:

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Lamps: 2 lamps of each type and rating installed.

2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 of each type and rating installed.

PART 2 - PRODUCTS

2.01 FIXTURES AND FIXTURE COMPONENTS:

A. Metal Parts: Free from burrs, sharp edges, and corners.

B. Sheet Metal Components: Corrosion resistant aluminum, except as otherwise indicated. Form and support to prevent warping and sagging.

C. Housings: Rigidly formed, weather and light tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed fixtures.

D. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect ballast.

E. Exposed Hardware Material: Stainless steel.

F. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:

1. White Surfaces: 85 percent

2. Specular Surfaces: 83 percent

3. Diffusing Specular Surfaces: 75 percent

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

H. Lenses and Refractors: Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.

I. Photoelectric Relays: Conform to UL 773.

1. Contact Relays: Single throw, arranged to fail in ON position and factory set to turn light unit on at 1.5 to 3 foot-candles and off at 4.5 to 10 foot-candles with 15 sec minimum time delay.

2. Relay Mounting: In fixture housing.

2.02 LAMPS

A. Furnish lamps of types and wattages shown in luminaire schedule.

2.03 LED FIXTURES

A. Provide fixtures on the DesignLights Consortium (DLC) Qualified Products List.

B. Thermal Management: Liquids or other moving parts shall be clearly indicated in submittals, and shall be consistent with product testing.

C. Color Rendering Index (CRI): >70.

D. Correlated Color Temperature: 4000K.

E. Minimum luminaire efficacies: 85 lumens per watt. Nominal input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.

F. Fully enclosed wiring and LED diodes enclosed to prevent penetration of dust, insects, and other debris into the lamp and driver compartment.

G. Driver/LED combined system shall have rated life based on IESNA LM-80-2008 (or latest) of 50,000 hrs at 70 percent lumen maintenance.

H. Driver is high efficiency type with THD < 20 percent and power factor > 0.90.

I. Outdoor fixtures capable of reliable operation in temperature range of -30 degrees C to +40 degrees C minimum.

2.04 FIXTURE SUPPORT COMPONENTS:

A. Wind-load strength of total support assembly, including pole, arms, appurtenances, base, and anchorage, is adequate to carry itself plus fixtures indicated at indicated

heights above grade without failure, permanent deflection, or whipping in steady winds of 100 mi./h with gust factor of 1.3.

B. Arm, Bracket, and Tenon Mount Materials: Match poles' finish.

C. Mountings, Fastenings, and Appurtenances: Corrosion-resistant items compatible with support components. Use materials that will not cause galvanic action at contact points. Use mountings that correctly position luminaire to provide indicated light distribution.

D. Pole Shafts: Square, straight.

E. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.

F. Aluminum Poles: ASTM B429/B429M, 6063-T6 alloy. Provide access handhole in pole wall.

G. Metal Pole Grounding Provisions: Welded 1/2 inch threaded lug, accessible through handhole.

H. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without under-brace, in sizes and styles indicated, with straight tubular end section to accommodate fixture.

I. Pole Top Tenons: Fabricated to support fixture or fixtures and brackets indicated and securely fastened to pole top.

J. Concrete for Pole Foundations:

1. Comply with Section 03300.
2. Use 3000 psig strength, 28 day concrete.

2.05 FINISHES:

A. Metal Parts: Manufacturer's standard finish, except as otherwise indicated, applied over corrosion resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects.

B. Other Parts: Manufacturer's standard finish, except as otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Set units plumb, square, level, and secure according to manufacturer's written instructions and accepted submittals.

B. Concrete Foundations: Construct according to Section 03300.

1. Comply with details and manufacturer's recommendations for reinforcing, anchor bolts, nuts, and washers. Verify anchor bolt templates by comparing with actual pole bases furnished.

2. Finish: Trowel and rub smooth parts exposed to view.

C. Pole Installation: Use web fabric slings (not chain or cable) to raise and set poles.

D. Fixture Attachment: Fasten to indicated structural supports.

E. Lamp fixtures with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.02 GROUNDING:

A. Ground fixtures and metal poles according to Section 16450.

1. Poles: Install 20-foot driven ground rod at each pole.

3.03 FIELD QUALITY CONTROL:

A. Inspect each installed unit for damage. Replace damaged fixtures and components.

B. Tests and Observations:

1. Give advance notice of dates and times for field tests.

2. Provide instruments to make and record test results.

3. Replace or repair damaged and malfunctioning units, make necessary adjustments, and retest. Repeat procedure until units operate properly.

3.04 ADJUSTING AND CLEANING:

A. Clean units after installation. Use methods and materials recommended by manufacturer.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16900
ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and connect the electrical control equipment and miscellaneous electrical equipment, including such instruments and devices indicated and specified. Device enclosures for electrical equipment as indicated and specified.

B. Control panel enclosures and devices specified herein are provided under those specification sections which invoke this section for control panel requirements or as indicated on electrical drawings.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. D178: Standard Specification for Rubber Insulating Matting

B. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum).
2. ICS 1: Industrial Control and Systems General Requirements
3. ICS 2: Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.
4. ICS 4: Terminal Blocks for Industrial Use.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. Underwriter's Laboratories, Inc. (UL):

1. 467: Standard for Grounding and Bonding Equipment.
2. 486A: UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3. 489: Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Wiring diagrams to show control interface points provided with other equipment.

C. Shop drawings to include:

1. Outline drawings with elevations.
2. Equipment arrangement drawings.
3. Anchor bolt location drawings.
4. Electrical schematics and wiring diagrams.
5. Electrical fuse/circuit breaker characteristic.
6. Equipment performance curves and data.
7. Bill of installation/assembly materials.
8. Equipment weights.
9. Completed manufacturer's data sheets.
10. Sustainable design submittals.

1.04 SPARE PARTS:

A. Comply with the requirements specified in Section 01600.

B. Provide the following spares:

1. One safety disconnect switch.
2. Three pushbutton/selector switch control stations of each type used.
3. One lighting contactor.
4. Three relays of each type used.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 MANUFACTURERS FOR ELECTRICAL DISTRIBUTION EQUIPMENT:

A. Siemens.

B. Schneider Electric (Square D).

C. Appleton Electric Company.

D. Crouse-Hinds Company.

E. O-Z/Gedney.

2.02 SAFETY DISCONNECT SWITCHES:

A. Provide heavy duty type, safety switches, with external operating handles, 3 PST, rated 600 volt, 60 Hertz with ampere rating as indicated, and having provisions for padlocking.

B. Provide molded-case switches for safety switches as indicated.

C. Heavy duty safety switches to be UL listed, File E 2875 and 154828, and meet or exceed NEMA Standard KS1.

2.03 CONDUIT AND WIRING:

A. Provide conduit and wiring necessary to make connections between instrument panels, consoles, cabinets and external equipment and devices.

2.04 PUSHBUTTON AND SELECTOR SWITCH STATIONS:

A. Provide HAND-OFF-AUTO switches, push buttons, tumbler switches and other accessory devices as necessary for the control of motors and other electrical equipment or devices.

B. Provide pushbutton and selector switch stations designed for heavy-duty service and with momentary or maintaining contacts as indicated or as necessary for starting and stopping of equipment with 10 amp contact ratings.

C. Provide heavy duty switches and pushbuttons, Square D Company, Class 9001. Indicating lights to be led cluster type.

D. At stations provide nameplates with white letters on black background.

E. Provide Type 316 stainless steel NEMA Type 3R enclosures for stations located in exterior or highly corrosive areas. Provide gaskets and Type 316 stainless steel screws, to prevent entry of chemicals.

2.05 CONTROL PANELS AND ELECTRICAL ENCLOSURES:

A. Manufacturers:

1. Hoffman, Inc.

2. Hammond Manufacturing.

B. Provide control panels as indicated. Ensure that dimensions, NEMA rating, construction and mounting of equipment are as indicated.

C. Provide enclosures with back panels constructed of at least 14 gage steel and provided with terminal blocks for connection of external wiring. Provide door and body stiffeners in panels over 36 inches in length. NEMA 3R stainless steel panels to be provided with hand operated quick disconnects of stainless steel material.

D. Provide UL listed and NEMA rated pushbuttons, indicator lights and switches of heavy duty, oil tight types. Provide relays of industrial types, with 120 volt, 60 Hertz operating coils, and contacts rated for intended service. Power from fused control power transformers.

E. Provide nameplates for each panel and each device on panel. Nameplates of laminated plastic material, at least 3/32-inch thick, and with white letters on a black background.

F. Secure nameplates with self tapping, Type 316 stainless steel metal screws.

G. Terminal Blocks:

1. Provide terminal blocks rated for 600 volts with screw type terminals.
2. Terminal blocks to be one piece with full barriers.
3. Provide General Electric EB-25 terminal blocks.

H. Provide print pocket on inside of enclosure and include as-built drawings for Owner's use.

I. Where 480 volts AC and 120 volts AC are required within the same enclosure, install components to insure separation of wiring for the panel voltage circuits.

J. Enclosures 24 inch or larger shall be provided with light fixtures, light switch and 20 amp GFI protected receptacle. Light fixtures shall be UL listed for wet locations and provided with metal guard and LED lamp.

K. Where visual strobe or warning lamps are required, provide heavy duty beacon, Edwards Signal Catalog No. 93.

L. Where audible horn alarms are required, provide Edwards Signal 870P.

M. Where equipment and devices are to be installed in hazardous locations, provide equipment and components suitable for the environment.

N. Where intrinsically safe wiring is required within the panels, the following requirements shall be met:

1. Within enclosures, conductors or intrinsically safe (IS) circuits shall be separated at least two inches from conductors of any non-intrinsically safe circuit. Within the enclosure the conductors shall be secured.

2. Intrinsically safe wiring shall not be routed in the same conduit as non-IS wiring.

3. Terminals in panels with IS wiring shall be identified in a manner that will prevent unintentional interference with the control circuits during testing and servicing.

O. All indicating lamps to be LED cluster type.

2.06 RUBBER MATS:

A. Provide rubber mats conforming to ASTM D-178 Type I, Class I: Mats shall be at least 4 feet wide and have a length at least equal to the panelboard, motor control center, drive enclosure, or switchgear before which they are to be placed. Furnish two spare mats, each 4 feet long.

B. Place mats in front of panelboards, motor control centers, drive enclosures, and switchgear. Place mats behind electrical assemblies with rear access.

2.07 CONTACTORS AND RELAYS:

A. Provide electrically held, heavy duty type contactors (relays) for lighting control, rated 20 amps, 600 volts, with number of poles as indicated.

B. Provide contactor in the required NEMA enclosure suitable for wall mounting. Provide circuit breaker or fuse protection on each ungrounded pole. Provide contactor similar to Square D Company, Class 8903, Type LX.

C. Provide control power transformer with primary and secondary fuse protection. Control power to be 120 volts, single phase.

D. Provide timing relays by Allen Bradley, Series 700.

E. Provide industrial grade relays, NEMA rated, Square D Company, Class 8501.

PART 3 - EXECUTION

3.01 WIRING OF MISCELLANEOUS DEVICES:

A. Make electrical connections required for recording and indicating instruments, and miscellaneous devices. Provide electrical supplies to metering, instrumentation, control, and alarm systems.

B. Connect HAND-OFF-AUTO switches, safety switches, tumbler switches, and other accessory devices as indicated or necessary for control of motors and other electrical equipment or devices.

C. Install conduit and wiring and make electrical connections between all instrument panels, consoles, cabinets, and external equipment and devices. Panels, cabinets, etc., are indicated.

3.02 WIRING OF EQUIPMENT FURNISHED UNDER OTHER SECTIONS:

A. As specified in Section 16050, install conduit, wiring, and connections for equipment and devices furnished under other Sections of specifications, and as indicated.

B. Unless otherwise indicated, control equipment, relays, control wiring, conduit, and connections for control of heating, ventilating, and air conditioning systems are provided as specified in Division 15. Refer to mechanical specifications and drawings for locations of pressure-operated control switches, float switches, butterfly valves, solenoid operated valves, sump pumps, metering instruments, control panels, alarm actuating contacts, indicating lamps, limit switches, and other devices requiring wiring or interconnections with equipment supplied under Electrical Sections of these specifications.

3.03 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16920
MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide motor control center, totally enclosed, free-standing, cabinet-type structure with motor starters, circuit breakers and/or fused switches and other equipment, as indicated and specified. Motor control center to operate at 480 volt, 3 phase, 3 wire, 60-Hertz.

B. Complete motor control center to be designed, assembled, wired, and tested at the point of manufacture in accordance with the latest NEMA, UL, and ANSI standards.

C. Use manufacturer's standard when data is not specified.

D. Provide Surge Protection Devices (SPDs) as indicated, and as specified in Section 16400.

1.02 REFERENCES:

A. Institute of Electrical and Electronic Engineers (IEEE):

1. C57.13: Standard Requirements for Instrument Transformers

B. National Electrical Manufacturers Association (NEMA):

1. AB 1: Molded Case Breakers
2. ICS 2: Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.
3. KS 1: Enclosed Switches

C. National Fire Protection Association (NFPA):

1. 70: National Electric Code (NEC).

D. Underwriters' Laboratories, Inc. (UL):

1. 489: Molded-Case Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
2. 845: Standards for Motor Control Centers

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Sections 01300 and 16050.

B. Complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, installation instructions.

C. Complete wiring and schematic diagrams for the equipment furnished. Each wiring diagram shall be legible and not reduced from the original design drafted format. Provide a list of equipment on each wiring diagram for which it is applicable.

D. Equipment layout.

E. Time versus current curves for protective devices.

F. Data sheets for all devices provided as part of the assembly.

G. All other details required to demonstrate that system has been coordinated and will properly function as a unit.

H. Spare Parts Data: Provide a list of recommended spare parts for the material and equipment to be provided, including current unit prices and source of supply (indicate which supplies are furnished at no extra cost with purchase of equipment) and in accordance with Section 01730.

I. Operating and Maintenance Instruction Manuals:

1. Furnish:

a. Operating instruction manuals outlining step-by-step procedures required for system startup and operation and in accordance with Section 01730.
b. Manufacturer's name, model number, service manual parts list.
c. Brief description of equipment and basic operating features.
d. Maintenance instruction manuals outlining maintenance procedures, for all devices, including compartment installation, circuit breakers, motor starters and fuses.
e. Troubleshooting guide listing possible breakdown and repairs.
f. As-built wiring diagrams for the system.

J. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed to prove compliance with specified performance criteria including final position of controls.

K. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Review the proper installation of each type of device with the equipment supplier prior to installation.

C. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Assist in location of devices, methods of mounting, field erection, etc.

   a. 1 person-day

3. Functional Completion testing.

   a. 1 person-day

4. Startup.

   a. 1 person-day

5. Commissioning.

   a. 2 person-days

6. Service-inspections during first year of operation, for use at Owner's request, and exclusive of repair, malfunction or other trouble-shooting service calls:

   a. 5 person-days

7. Person-day is defined as one 8-hour day, excluding travel time.

8. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

9. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Shipping:

1. Ship equipment, and materials, except where partial disassembly is required by transportation regulations or for protection, complete with identification and quantity of items.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. MCCs shall be separated into shipping blocks no more than three vertical sections each. Each shipping block shall include a removable lifting angle, to allow attachment by suitable lifting equipment.

4. Deliver spare parts at same time as pertaining equipment. Delivery to Owner after completion of work.

5. Channel bases:

   a. For front and rear, minimum of 1-1/2 inch by 3 inch standard channel with suitable holes for mounting motor control center, and holes for grouting and flow of concrete.
   b. Shipped in advance with accurate template of motor control center mounting holes or dimension layout drawing for embedding in concrete pad, floor slab, or securing to floor.

6. Attach lifting angles to main frame of structure to distribute weight equally. Deflection or distortion is cause for rejection.

7. If the equipment cannot be placed into service after its receipt, store in a closed building or structure, in a clean, dry and ventilated area free from temperature, dirt and moisture extremes. Acceptable storage temperatures are from 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) with temporary heaters provided within enclosures to prevent condensation. Provide heavy plastic envelope directly over motor control center to protect against dust, dirt, and moisture. Provide lifting angles outside of envelope.

C. Storage:

1. Inspection and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts.

1.06 WARRANTY AND SERVICE:

A. Provide in accordance with Section 01740 and as specified.

B. Guarantee components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a period of 5 years.

C. Ensure that equipment manufacturer has local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. The equipment manufacturer shall be ISO 9001 or 9002 certified.

B. Manufacturer’s acceptable contingent upon products' compliance with the specifications.

1. Siemens Energy & Automation, Inc.
2. Square D Company.

2.02 COMPONENTS:

A. Motor control center construction: Comply with UL 845.

B. Starters: Comply with the requirements of NEMA ICS 2.

C. Instruments: Comply with ANSI C39.1.

D. Enclosures:

1. Enclosures for motor control centers: NEMA Type 1 gasketed, unless otherwise indicated on the Contract Drawings.
2. Motor control centers: NEMA Class II-S, Type B wiring.
3. Outline dimensions of motor control centers and arrange equipment and devices as indicated.
4. The minimum depth of a motor control center is 20 inch. Arrange motor control centers for back-to-back mounting of the starter units where indicated.
5. Each MCC shall consist of one or more vertical sections of heavy gage steel bolted together to form a rigid, free-standing assembly. A removable 7 gage structural steel lifting angle shall be mounted full width of the MCC shipping block at the top. Removable 7 gage bottom channel sills shall be mounted underneath front and rear of the vertical sections extending the full width of the shipping block. Vertical sections made of welded side-frame assembly formed from a minimum of 12 gage steel. Internal reinforcement structural parts shall be of 12 and 14 gage steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand normal stresses included in transit and during installation.

E. Buses:

1. Locate main horizontal bus at top with ampere rating as indicated. Isolate bus from both front and back compartments.
2. Neutral bus if required: Rated at full capacity.

3. Main and vertical buses: 98 percent conductivity tinned copper bars of suitable size carried on supports fabricated from an acceptable insulating material.

4. Short circuit bus bracing: As indicated.

5. Vertical buses: A minimum rating of 300 amperes for front only units, a minimum rating of 600 ampere for back-to-back units. Insulate or isolate vertical buses.

6. Provide continuous 2 inch by 1/4 inch tinned copper ground bus along length of the motor control center.

7. Contact surfaces of bar-to-bar connections and lug-to-bar connections: Silver plated.

8. Phase rotation of vertical buses: Make same when viewed from front or from either side of motor control center.

9. Bolts and other hardware: Galvanized or stainless steel or equal.

10. Provide horizontal wireways at top and bottom of each vertical section. Provide vertical wireways with wire supports for each vertical section. Interconnect all wireways.

11. Provide standard corrosion resistant fasteners for unit doors hardware which operate without special tools.

F. Barriers:

1. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two-piece rigid non-conductive barrier. The barrier design shall allow qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without having to remove the barrier. Barrier sliding shall occur via an upper and lower track system.

2. The vertical bus shall be housed in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 inch for unit stab-on connections. Each opening shall be provided with an automatic shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.

3. Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a pull wire routed through the conduit or wireway areas.

G. Motor Control Center Units:

1. Motor control center units: Drawout type. Units larger than NEMA Size 4 having bolt-in construction. Provide fully interchangeable removable units of same size and type.

2. Interlock disconnect devices with associated doors, to prevent closing the disconnect device with the door open unless a tool is used or a defeater device is operated.

3. Furnish disconnect devices capable of being locked in either the open or closed position.

4. Arrange each unit so that when its starter has been removed, its door may be closed to cover the opening.

H. Motor Control Center Starter Units:

1. Unless otherwise indicated, use minimum NEMA Size 1 combination starter, consisting of a circuit breaker or motor circuit protector and magnetic starter, as indicated. Momentary and interrupting ratings of circuit breakers and motor circuit protectors coordinated with main bus bracing. Type of starters, i.e., full voltage, reduced voltage, reversing, non-reversing, two-speed, etc., are as indicated. Furnish magnetic starters with thermal overload protection on each phase with external manual reset.

2. Solid-State Overload Relay:

   a. Provide a solid-state overload relay for protection of the motors. The relay shall be Cutler-Hammer type CEP7.
   b. The overload relay shall provide high accuracy through the use of state-of-the-art microelectronic packaging technology. The relay shall be suitable for application with NEMA Size 1 through Size 7 motor starters.
   c. The overload relay shall be modular in design, be an integral part of a family of relays to provide a choice of levels of protection, be designed to directly replace existing electromechanical overload relays, and be listed under UL Standard 508.
   d. The overload relay shall have the following features:

      i. Self-powered.
      ii. Class 10 or 20 fixed tripping characteristics.
      iii. Manual or automatic reset 4.
      iv. Phase loss protection. The relay shall trip in 2 seconds or less under phase loss condition when applied to a fully loaded motor.
      v. Visible trip indication.
      vi. One normally open and one normally closed isolated auxiliary contact.
      vii. Test button that operates the normally closed contact.

viii. Test trip function that trips both the normally and normally closed contacts.
ix. A current adjustment range of 3.2:1 or greater.
x. Ambient temperature compensated.
xi. Ground fault protection. Relay shall trip at 50 percent of full load ampere setting.
xii. Jam/Stall protection. Relay shall trip at 400 percent of full load ampere setting, after inrush.

3. Provide reduced voltage solid-state type starters with thyristor (SCR) bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors.

   a. The soft start shall provide torque control for linear acceleration without external feedback independent of motor load or type of application.
   b. The gating of the thyristors will be controlled in such a manner to ensure smooth and stable acceleration ramp.
   c. The soft start shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCRs. Analog control algorithms shall not be allowed.
   d. All soft start power ratings will utilize the same control board/module.
   e. A shorting contactor shall be supplied with the soft start controller units. Protective features and deceleration control options integral to the soft start shall be available even when the shorting contactor is employed.
   f. The soft start controller unit shall be designed to operate from an input voltage between minus 10 percent and plus 10 percent of nominal voltage rating.
   g. The soft start controller unit shall operate from an input voltage frequency range of plus or minus 5 percent. By configuration, it shall be capable of operation at a supply line frequency that can vary by plus or minus 20 percent during steady state operation.
   h. The soft start shall be capable of supplying 400 percent of rated full load current for 23 seconds at maximum ambient temperature.
   i. All soft start controller unit power and control devices shall be rated heavy duty and capable of 5 evenly spaced starts per hour at 400 percent of full rated current for 25 seconds per start without tripping.

4. Furnish starter operating coils suitable for operation on 120 volt, single-phase, 60 Hertz.

5. Furnish each starter with at least one normally open and one normally closed auxiliary contact. Furnish additional normally open and/or normally closed auxiliary contacts for indicating lights, interlocking and other requirements as indicated.

6. Motor horsepower indicated on Contract Drawings may not be same as furnished, if larger motors are furnished, circuit breakers, starters, wire and conduits of larger capacity may be necessary and, if so, furnish them at no additional cost.

7. Furnish within each starter compartment a control transformer with primary fuses and secondary fuse. Secondary voltage 120 VAC, unless otherwise indicated. Determine load of each motor control circuit including equipment and devices provided under the other specification sections and furnish control circuit transformer 2-winding, dry-type of suitable volt-ampere rating, but not less than 75 volt-amperes. Control circuit loads may consist of but not be limited to solenoid operators, motorized valves, motorized dampers, relays, motor heaters, etc.

I. Circuit Breakers:

1. Unless otherwise indicated, furnish manually operable circuit breakers and provide thermal-magnetic, inverse-time-limit overload, and instantaneous, short-circuit protection. U.L. listed circuit breakers conforming to NEMA Std. AB-1 and UL Std. 489.

2. Breakers: Molded case type, rated 480 volts, 2 or 3 pole and having 100 ampere or larger frames. Minimum interrupting rating equal to bus bracing required. Furnish current limiting type, where indicated.

3. Furnish overload protection on all poles with trip settings as indicated. Breakers of 225 ampere frames and larger with interchangeable trip units and adjustable magnetic trip elements.

4. Furnish time-current characteristic curves and other necessary information and data for each size of breaker furnished.

J. Motor Circuit Protectors:

1. Motor circuit protectors being completely enclosed molded case devices with current sensing coil in each of 3 poles having adjustable magnetic trip setting by means of single knob on front. Motor circuit protector manually operable. Protector designed to meet NEC requirement concerning motor full load and locked-rotor current. Minimum interrupting rating equal to bus bracing required.

2. Where indicated, current limiters, completely enclosed in molded case, bolted to load end of motor circuit protector to provide at least 100,000 amperes symmetrical interrupting rating at 600 volts. Limiters coordinated with protector so at low level short circuit, protector interrupts circuit without limiter operation. Faults interrupted by limiter also trip the protector and open all 3 poles. Equip each limiter with an indicator to show that the limiter has interrupted a fault.

K. Control Devices:

1. Control relays: Heavy-duty, industrial or machine tool type with at least two normally open and two normally closed contacts. Coils 120 volts, 60 Hertz.

2. Contacts: Rated 10 amperes, 250 volt alternating current.

3. Time-delay relays: Adjustable, pneumatic type, range 2 to 60 seconds and operated on 120 volts, 60 Hertz, with at least one normally open and one normally closed timed contact.

4. Pushbuttons and instrument selector switches: Heavy-duty, oil tight units, 30 mm, rated 10 amperes continuous current at 120 volts.

5. Indicating lights: LED type, heavy-duty, oil-tight, 30 mm units with push-to-test features.

6. Control and selector switches: Rotary type with enclosed contacts. Equip each switch with rectangular escutcheon and pistol-grip handle, except handles for instrument phase selector switches equipped with round knurled or slotted handles. Switch contacts rated 10 amperes continuous, 600 volts.

L. Nameplates: Furnish each motor control center and each unit of motor control center with engraved nameplate. Nameplates of laminated sheet plastic, 1/16 inch thick, engraved to provide white letters on black background. Fasten nameplates in place with corrosion-resistant screws.

2.03 WIRING:

A. Conductors: Copper; size as required by load, except that no control wire is smaller than 14 AWG. Use insulation that is flame retardant, and moisture and heat resistant.

B. Cables and conductors: Bundled and tie wrapped securely in wireways furnished.

C. Identify internal wiring at terminations by T&B wire markers.

D. All spare starter auxiliary contacts to be wired to terminal blocks.

E. Terminal Blocks:

1. Rated 600 volt for power with current rating as required by loads.

2.04 SPARE PARTS:

A. Furnish following spare parts for each motor control center:

1. Twelve lamps for indicating lights.

2. One coil for each size of starter furnished for each motor control center.

3. One complete set of fuses for each size furnished.

4. One set of contacts for each size of starter furnished.

5. One control transformer for each volt-ampere capacity unit furnished.

B. Package items in suitable containers bearing labels clearly indicating contents and equipment with which used.

2.05 FINISH:

A. Finish motor control centers with ANSI No. 61, light-gray enamel over rust-resistant undercoat.

B. Furnish instruments and control devices with standard black finish.

C. Use, mixing, application, and curing of paint on items requiring painting in accordance with paint manufacturer's written recommendations.

2.06 FACTORY TESTS:

A. The entire MCC shall go through a quality inspection before shipment, verifying the equipment to the factory shop drawings. This inspection will include:

1. Physical inspection and verification of:

a. Structure including verification of all bolted connections,
b. Electrical conductors, including:
c. Bussing including verification of all bolted connections.
d. Wiring.
e. Unit compartments.

2. Electrical Tests:

a. Electrical tests include:
b. Power circuit phasing.
c. Control circuit wiring and verification of satisfactory operation of all relays and other devices.
d. Instrument transformers.
e. Meters.
f. Ground fault system.
g. Device electrical operation.
h. AC dielectric tests shall be performed on the power circuit.

3. Markings/Labels, include:

a. Instructional and warning type labels.
b. Underwriters Laboratory (UL)
c. Inspector's stamps.

4. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC meets operating specifications.

B. Equipment that is shipped without evidence of the required tests being performed to verify satisfactory operation will be subject to non-acceptance.

C. If the MCC cannot be placed into service reasonably soon after its receipt, store it in a clean, dry and ventilated building free from temperature extremes. Acceptable storage temperature is from 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F).

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install steel channel sills that have suitable drilled holes for mounting, aligning, and bolting each motor control center in place. Method of mounting, as indicated. Size and arrangement of sills, as recommended by motor control center manufacturer and acceptable to Engineer. Paint completed sills with two coats of aluminum paint or other acceptable corrosion-resistant finish before being set in place. Properly set and level channel sills.

B. If motor control center equipment pads are located on concrete floor slabs, furnish painted steel channel mounting sills and anchor bolts, in time for placing concrete for construction of concrete equipment pads.

C. Install items in accordance with manufacturers' printed instructions.

D. Verify all loads on the motor control center including equipment and devices provided under the other electrical and non electrical specification sections. Provide information to motor control center manufacturer for sizing of buses, control transformers, and protective devices. Verify that cables and conduits for loads are sized for the actual equipment provide in accordance with the NEC.

E. Set motor circuit protectors and circuit breakers based on load installed.

F. Check and provide a thermal overload on each phase of a starter unit. Match overloads to motor being installed.

G. Deliver spare parts to Owner.

H. Provide conduit, wiring, and grounding interconnections.

I. Perform continuity and operational tests on circuits to demonstrate that motor control center is operationally safe and functionally correct.

J. Provide one set of manufacturer wiring diagrams marked with all changes made in the field.

3.02 TESTING:

A. Factory authorized technician and Engineer shall witness all testing as required by Section 01784.

B. Adjust and verify all settings and inputs to meters and relays.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 16990
ELECTRICAL SYSTEM STUDIES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide electrical system studies as indicated and in compliance with Contract Documents.

1. Provide a short circuit, protective device coordination and arc-flash study for the electrical distribution system constructed under this contract. The study shall consider the electrical system upstream protective devices down to the 208Y/120V transformer secondary. The study shall include calculations used to verify the short circuit ratings of the electrical distribution equipment to be provided under this contract and to identify the required settings of associated protective devices.

a. Provide a report summarizing the coordination study including: one-line of system, relay and breaker setting tabulation, relay, circuit breaker, and fuse protective device coordination and short circuit calculation, all prepared by an independent specialty firm. Device calibration and settings are to be based on the results of this coordination study.

B. Provide a motor starting study for low voltage motors over 200 Hp in size identifying bus voltages on the system before, during and after motor starting.

C. The Contractor shall employ the services of a specialty firm, subject to review, with the specified demonstrated capability for calibrating and setting protective devices as specified herein.

D. Changes and additions of equipment characteristics, based on the actual equipment supplied may be suggested by the results of the short circuit and protective device coordination studies. Submit suggested changes and additions as a part of the study. Field settings of devices, adjustments, and minor modifications to equipment that are required to accomplish conformance with the accepted short circuit and protective device coordination studies shall be provided at no additional cost.

1.02 REFERENCES:

A. Institute of Electrical and Electronics Engineers (IEEE):

1. C37.010: Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

2. 242: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

3. 519: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power System.

4. 1584: IEEE Guide for Performing Arc-Flash Hazard Calculations

B. National Fire Protection Association (NFPA):

1. 70E: Standard for Electrical Safety Requirements for Employee Workplaces.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Short circuit and protective device coordination study for review and acceptance, concurrent with the preliminary shop drawing submission for the main electrical distribution system equipment and overcurrent protective devices. Submit an initial study for comment and a final study, with all electronic files, at the completion of the project.

a. The study shall be performed using the latest edition of one of the following commercial software program.

i. EDSA Paladin
ii. EasyPower
iii. SKM System Analysis
iv. ETAP

b. The study shall consider the effects of motor contribution during fault conditions, at various buses in the system.
c. The study shall include cable sizes, cable lengths and raceway types for considering the effects of cables impedance in the system based on information to be provided by the Contractor.
d. The maximum fault contribution at the incoming source(s) shall be documented via correspondence from the authority responsible for this source(s).
e. Transformer inrush points and damage curves shall be plotted on coordination curves.
f. Plot on common drawings, single line diagrams and the curves for each protective device to verify proper selectivity and protection for all components of the system for both the normal utility and standby generator source. Label each device uniquely.
g. Identify recommended settings for all devices.
h. Devices which do not provide full selectivity and coordination are not to be used as a recommended device in the study.
i. Submittals of electrical distribution equipment affected by the study are not to be submitted until successful review of this study.

2. Voltage drop motor starting study to determine system voltage dip or power inrush limitations at the new Influent Pump Station distribution system due to the starting of all installed influent pump motors:

3. This study shall consider starting when the system is powered from the utility and from the standby generator sources.

4. After review of coordination study, the Contractor shall set all devices based on the study.

5. Qualifications of specialty testing and/or study firm, as specified.

1.04 QUALIFICATIONS OF SPECIALTY FIRM:

A. Submit evidence of the following:

1. Firm's experience:

a. Specialty firm shall have been in the business of the type of work specified, for at least the past five years.
b. The firm shall have a minimum of five projects of equal or greater size, service, and the type of equipment specified.
c. At least the following information must be submitted:

i. The number of years the firm has been in the business of performing coordination studies.
ii. Summary of five previously performed studies including:

I. A brief description of each study.
II. Name of owner of installation on which study was performed with address, telephone number, and contact person.
III. Date of study.

iii. List of projects and contact persons for which protective device settings were performed.
iv. Any other information indicating the firm's experience, ability to perform the work, and business status.

B. Firm shall have a licensed Professional Electrical Engineer supervise all work and seal all reports.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SHORT CIRCUIT STUDY:

A. Perform a short circuit study in accordance with ANSI Standard C37.010 to verify the adequacy and correct application of circuit protective devices and other electrical system components.

B. The study shall address the case when the system is being powered from the utility source as well as from the on-site generating facilities. Minimum and maximum possible fault conditions shall be covered in the study.

C. Include the fault contribution of all motors. Horsepower shown in the Contract Documents may be used to calculate fault contribution of motors. In the short circuit study VFDs shall be replaced by conductors of the same size as the branch circuit conductors.

D. Calculate short-circuit momentary duties and interrupting duties on the basis of an assumed bolted 3-phase short circuit at each bus. The short circuit tabulations shall include X/R ratios, asymmetry factors, kVA and symmetrical fault-current. Where ground fault protection is specified, provide a ground fault current study for the same system areas, including the associated zero sequence impedance diagram. Include in tabulation form, fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

E. The studies shall include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.

3.02 PROTECTIVE DEVICE COORDINATION STUDY:

A. Provide a protective device time current coordination study with coordination plots of current limiting devices, plus tabulated data, including ratings and settings selected. In the study, balance shall be achieved between the competing objectives of protection and continuity of service (with emphasis on continuity of service) for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

B. Provide separate plots for utility and generator operation as applicable. Show maximum and minimum fault values in each case. Multiple power sources shown in one plot is not acceptable.

C. Each primary protective device required for a delta-to-wye-connected transformer shall be selected so the characteristic or operating band is within the transformer

parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults. Separate low voltage circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults. Separate protective relays by a 0.4 second time margin when the maximum 3 phase fault flows to assure proper selectivity. The protective device characteristics or operating bands shall be terminated to reflect the actual symmetrical and asymmetrical fault-currents sensed by the device. Provide the coordination plots for 3 phase and phase-to-ground faults on a system basis. Include all devices down to largest branch circuit feeder circuit breaker. Include all adjustable setting ground fault protective devices.

D. Identify discrepancies in the conclusions and recommendations of the report. Upon resolution of discrepancies and recommendation, update all associated analyses and revise the affected studies.

E. The coordination plots shall graphically indicate the coordination proposed for the several systems centered on full scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated upstream power system relays, fuse or system characteristics, significant motor starting characteristics, significant generator characteristics, complete parameters for power, and substation transformers, complete operating bands for low voltage circuit breaker trip devices, fuses, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required. The short-time region shall indicate the relay instantaneous elements, the magnetizing inrush, and ANSI transformer damage curves, the low voltage circuit breaker and instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault-currents.

F. The thermal limit of all feeder cables to each bus and large motors, where applicable in the study, shall be shown.

G. No more than six devices shall be shown on one coordination plot. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots in order to provide cross reference. Give each unique protective device curve in the study a study-unique number or letter identifier to permit cross reference between plots. Do not use identifier letters or numbers more than once.

H. Each primary protective device required for delta-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to assure protection for secondary line-to-ground faults.

I. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap,

time dial, pickup, instantaneous, and time delay settings. Include C.T. ratio, burden and all other calculations required for the determination of settings.

3.03 MOTOR STARTING/RUNNING STUDY:

A. Provide a motor starting study for all large electric motors and drives over 200 Hp in size to determine voltage dip or power inrush limitations at selected locations due to starting of motors. Define minimum system voltages and compare to standard equipment voltage capabilities.

B. Provide a complete independent set of current-time characteristic curves for all motors 100 Hp and above indicating coordination between the protective relays and the thermal characteristics of the motor.

C. Obtain from the motor supplier the necessary information to perform the study. Certified curves for "Safe Time vs. Current at 100 percent Voltage" and "Accelerating Time vs. Current at 100 percent Voltage" are absolutely necessary and shall become part of the final report.

D. Provide recommended settings for all motor protective devices supplied under this contract.

3.04 ARC FLASH HAZARD ANALYSIS:

A. Perform arc flash hazard analysis for the following items:

1. Switchgear
2. Panelboards
3. Control panels with voltage over 50 Volts
4. Motor control centers
5. Transformers that have auxiliary electrical devices operating at over 50 Volts
6. Variable Frequency Controllers

B. Methods of performing analysis:

1. Use NFPA 70E article 130 tables if the short circuit study shows that the condition for those tables are met.
2. Otherwise use IEEE 1584 calculations.
    a. If the conditions fall within the IEEE 1584 parameters use the IEEE 1584 calculations based on actual OCPD curves and settings.
    b. If the conditions do not fall within the 1584 parameters, use the Lee method.

C. Label each item for which the calculations were performed with the following information:

1. Limited approach boundary
2. Author, date of study, and equipment identification
3. Restricted approach boundary
4. Personal protective equipment required within restricted approach boundary
5. Arc flash protection boundary
6. Personal protective equipment required within flash protection boundary
7. Cal/cm^2 ratings

3.05 FIELD TESTING:

A. Provide in accordance with Section 01783 and as specified.

B. Integrate results of this study with functional testing of the contract electrical equipment in accordance with Section 16050.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

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Appendix A

Geotechnical Report

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GEOTECHNICAL INVESTIGATION REPORT
INFLUENT PUMP STATION
SOUTH WATER RECLAMATION FACILITY
ORANGE COUNTY, FLORIDA
AEA PROJECT No. 20610

Antillian Engineering Associates, Inc.
3331 Bartlett Boulevard
Orlando, Florida 32811
(407) 422-1441

ANTILLIAN
ENGINEERING ASSOCIATES, INC.

February 7, 2017

Reiss Engineering, Inc.
1016 Spring Villas Point
Winter Springs, Florida 32708

Attention: Alejandro Solanilla

Reference: Geotechnical Investigation Report
Influent Pump Station
South Water Reclamation Facility
Orange County, Florida
AEA Project No. 201610

Dear Mr. Solanilla:

Antillian Engineering Associates, Inc. has completed a geotechnical-engineering investigation for the proposed influent pump station at the Orange County South Water Reclamation Facility. The investigation was conducted in general accordance with the scope of services presented in our proposal dated February 2, 2016. This report contains the results of our investigations, our recommendations for pump station design, structural foundations, pipeline installation, earthwork, and groundwater control, and other concerns as appropriate.

It has been our pleasure to serve Reiss Engineering, Inc. and Orange County Utilities on this project. Please contact our office if you have any questions, or if you need additional information.

Respectfully submitted,
ANTILLIAN ENGINEERING ASSOCIATES, INC.
Certificate of Authorization No. EB6685

PETER G. SUAH LICENSE No. 46910 STATE OF FLORIDA PROFESSIONAL ENGINEER
02.07.2017

Peter G. Suah, P.E.
Florida PE No. 46910
Principal Engineer

Attachments: Figures
Appendix A: Field and Laboratory Testing Results
Appendix B: Important Information About This Geotechnical-Engineering Report
Appendix C: Constraints and Restrictions

PROJECT DESCRIPTION

Orange County Utilities ("OCU") is planning to expand the influent pumping capability at the South Water Reclamation Facility by constructing a larger, influent pump station on a site adjacent to the existing pump station. The South Water Reclamation Facility is situated on Sand Lake Road about one-quarter mile west of Shingle Creek. Its approximate location is shown on Figure 1.

The new influent pump station will include the following components:

1. Two wet wells between 38 feet and 41 feet deep. Each wet well will have a concrete, bottom slab between four feet and five feet thick.

2. A junction ("splitter") box about 25 feet deep, with a concrete bottom slab about three feet thick.

3. A new single-story electrical service building measuring about 24 feet by 30 feet in plan, on a cast-in-place-concrete, slab-on-grade foundation.

4. Underground pipes and service lines buried up to 20 feet below the ground surface.

Underground pipes and service lines buried up to 20 feet below the ground surface.

OCU selected the design team led by Reiss Engineering, Inc. ("Reiss") to design this project. Reiss retained Antillian Engineering Associates, Inc. ("AEA") to conduct the geotechnical-engineering investigation and develop recommendations for design of the structures and the pipelines.

AVAILABLE INFORMATION

We examined the United States Geological Survey (USGS) quadrangle topographic map for the project vicinity, the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey of Orange County and the USGS map "Potentiometric Surface of the Upper Florida Aquifer in the St Johns River Water Management District" dated September, 2008 to obtain general information about the project site. We also examined preliminary drawings and other documents furnished by Reiss, for site-specific information.

The USGS map showed a "Sewage Disposal" facility on the southern side of a divided roadway that appeared to be Sand Lake Road. The facility was on a broad plain about 1,500 feet west of Shingle Creek. Ground surface elevations near the facility were between the Elevation 80 feet NGVD (El. 80) contour and the El. 95 contour. The Shingle Creek floodplain was mapped as wetlands or marsh below the El. 80 contour.

The NRCS Soil Survey reported Immokalee fine sand, Ona fine sand, St Johns fine sand and Smyrna fine sand as the predominant soil units near the "Sewage Disposal" facility shown on the USGS map.

These soils are typically found at lower elevations on the broad plains of Orange County. They tend to be nearly level to level and poorly drained, with a seasonal high groundwater level reported less than a foot below the natural ground surface. Basinger fine sand and the Samsula-Hontoon-Basinger association were mapped in the Shingle Creek floodplain. These low-lying, "depressional" soils are typically found in freshwater swamps, marshes and other low-lying features on the plains, and are usually submerged. Organic materials from derived from plants decomposed in the water are typically associated with these soils. Depths are reported to range from four feet to more than seven feet, which was the maximum depth of exploration in the NRCS soils survey.

The potentiometric surface map showed the elevation of the potentiometric surface of the Upper Floridan aquifer near the El. 50 feet NGVD contour in the general area of the project.

The preliminary drawings included a layout of the proposed pump station, a preliminary engineering report/scope document and a topographic survey of the site by BFA Environmental. The layout plan showed two wet wells with associated pipelines and the electrical building south of the existing pump station building. The splitter box was shown adjacent to the west wall of the existing pump station building. Reiss had also marked preferred test boring locations on a second copy of the plans.

The preliminary engineering report indicated that the wet wells would be installed using the "caisson/tremie method . . . to reduce the required excavation area and . . . decrease the required dewatering." The report further stated that a "separate caisson was anticipated for each of the proposed trench type wet wells," but the wet-well depth was not stated. The report also noted that each "trench will be cast in sections directly above the installation area. Once each section is cured, the structure can be incrementally lowered into place. Once all the caissons are sunk, tremie concrete can be installed to provide the bottom slab and ballast against flotation forces from groundwater." The report did note that "other construction methods should be considered such as conventional excavation and cast-in-place structures or sheeting and shoring and cast-in-place structures."

The BFA survey showed the proposed site, existing buildings and underground utility services. Ground surface elevations were mapped between Elevation 92 feet and Elevation 95 feet NAVD88.

FIELD INVESTIGATIONS

We visited the site on September 27, 2016 to observe the surface conditions on the proposed pump station site, and prepare for the field investigation program. We established test boring locations near the locations Reiss had selected using the preliminary plan as a reference and adjusting as needed to avoid possible conflicts with marked utilities or other visible obstructions. We staked the locations for underground utility location and marking as required by Florida Statutes, and to facilitate subsequent identification by the drilling crew.

Our crew drilled six test borings on October 24, 2016. Boring locations, designations and depths are summarized on the following page in Table 1. Approximate locations are shown on Figure 2.

TABLE 1
SUMMARY OF SUBSURFACE EXPLORATIONS

STRUCTURE DESCRIPTION	BORING DESIGNATIONS	DEPTH (feet)
Influent pump station wet wells	WB-1, WB-2	50
Electrical building	EB-1	25
Splitter Box	SB-1	40
Pipelines	PB-1, PB-2	25

The field crew drilled the test borings to the intended depths shown in Table 1. They advanced the boreholes by hand to depths between four feet and seven feet using a bucket auger to reduce the likelihood of damaging possibly unmarked underground utilities. Auger drilling and sampling were conducted in accordance with ASTM D 1452. The crew advanced the test borings from the augered depths to the completion depths by split-spoon soil sampling and mud-rotary drilling, and conducted the Penetration Test (SPT) with the split-spoon sampling in accordance with ASTM D 1586.

The crew logged the soils recovered from the auger and the samplers, sampler penetration resistance expressed in hammer blows per foot ("SPT N-values"), and other noteworthy field observations. They measured the depth to groundwater in each borehole, recorded those depths on the field logs, and sealed representative soil samples in clean, airtight containers for transportation to our Orlando office. At the completion of drilling, the field crew backfilled the boreholes with soil cuttings.

LABORATORY TESTING

A geotechnical engineer examined the recovered soil samples in our office, confirmed the field descriptions, classified the soils visually in accordance with the Unified Soil Classification System, ASTM D 2488, and developed a representation of the soil stratigraphy at each boring location. The engineer selected representative soil samples for laboratory testing, which consisted of 18 percent fines tests, two Atterberg limits test series and two natural moisture content tests. The tests were done in accordance with the applicable ASTM standards. Results are presented on the boring logs and on the Summary of Laboratory Test Results sheet in Appendix A.

[END OF SECTION]

SURFACE CONDITIONS

The influent pump station site was an unpaved area south of the existing pump station building, which was about 110 feet east of the west entrance to the South Water Reclamation Facility. Above-ground tanks, operations and maintenance buildings, industrial-pipe runs and other features of a typical wastewater recovery facility were observed. The proposed locations for the structures were nearly level to level, and were covered with well-maintained grass turf or asphalt-concrete pavement. Plastic flags, paint markings, and manhole covers indicated numerous buried, underground utility pipelines, conduits or ducts.

SUBSURFACE CONDITIONS

The stratigraphy, soil types and groundwater levels described below are based on the results of the test borings and laboratory testing programs. SPT N-values were used as empirical indications of soil condition, when available. Unified Soil Classification System group names and group symbols were used for soil classification. The descriptions below are general and describe the major soil types that we encountered. Detailed subsurface characteristics at each boring location are shown on the boring logs and on the Summary of Laboratory Test Results sheet in Appendix A.

The uppermost materials encountered in the borings were gray, dark gray, brown, dark brown, very dark brown, grayish brown, dark grayish brown, and very dark grayish brown sands that contained silt. Pieces of crushed limestone, broken pieces of cemented sand, and clayey sand nodules were occasionally encountered within these soils. The field crew reported lost fluid circulation while drilling between ten feet and 13 feet below the ground surface at SB-1. The encountered thicknesses of these soils ranged from four feet to about 12 feet. SPT N-values ranged from 3 blows per foot (bpf) to 51 bpf, with most values lower than 20 bpf, indicating soil conditions that ranged from very loose to very dense but were mostly very loose to medium dense. Percent fines testing of four samples indicated fines contents between 9 percent and 18 percent. Based on visual examination and laboratory testing, these soils were classified as sand with silt (“SP-SM”) and silty sand (“SM”). Because of the limestone fragments and other inclusions, and observed variations in soil composition and condition, we also characterized these soils as “possible fill”.

Beneath the possible fill were brown, dark brown, grayish brown, dark grayish brown and occasionally light brownish gray sands that contained more silt. Some samples had a slightly plastic texture. Encountered thicknesses ranged from about 12 feet to about 30 feet. Actual thicknesses could not be verified in EB-1, SB-1, PB-1 and PB-2, which had been terminated at their intended depths without fully penetrating these soils. SPT N-values ranged from 5 bpf to 16 bpf, indicating loose to medium dense conditions. Percent fines testing of 11 samples indicated fines contents between 14 percent and 36 percent. Based on visual examination and laboratory testing, these soils were classified as silty sand (“SM”).

Beneath the silty sands in WB-1 and WB-2 was light greenish gray sandy clay and greenish gray clay. The overall encountered thickness of these soils was about 12 feet. Actual thicknesses could

not be verified because both borings had been terminated at their intended depths without fully penetrating these soils SPT N-values ranged from 5 bpf to 8 bpf, indicating firm consistency. Percent fines testing of two samples indicated fines content of 52 percent and 87 percent. Atterberg limits testing of two samples yielded liquid limit values of 45 and 98, and plasticity index values of 25 and 72. Additional testing indicated natural moisture contents of 39 percent and 45 percent. Based on visual examination and laboratory testing, these soils were classified as low-plasticity ("lean") sandy clay ("CL") and high-plasticity ("fat") clay ("CH").

Groundwater was encountered in these borings at depths between five feet and nine feet below the existing ground surface. Encountered groundwater levels and details of the subsurface characteristics encountered at each location are shown on the boring logs in Appendix A.

[END OF SECTION]

GENERAL COMMENTS ON RECOMMENDATIONS

The following recommendations are based on a review of the field and laboratory test data, our understanding of the proposed construction and our experience with similar projects and subsurface conditions. If plans for the proposed pump station change from those discussed in this report, we request the opportunity to review those changes and revise our recommendations as needed to accommodate them. In addition, if subsurface conditions encountered during construction differ significantly from those discussed in this report, those conditions should be reported to us immediately for our observation and recommendations.

GENERAL DISCUSSION OF ENCOUNTERED SUBSURFACE CONDITIONS

As discussed earlier in the SUBSURFACE CONDITIONS section this report, the uppermost soils encountered during the subsurface investigations were sands that contained varying amounts of silt. Those sands were mostly very loose to medium dense; some dense to very dense conditions were also encountered. Some sands were characterized as "possible fill" because of observed variations in color, composition and condition and pieces of cemented sand, and limestone fragments. The possible fill was underlain by loose to medium dense sands that were more silty. Some samples had a slightly plastic texture. Firm clays of unknown thickness were encountered beneath the silty sands, at depths near 38 feet.

Groundwater was encountered between five feet and nine feet below the existing ground surface at the boring locations. Deep excavations will be needed to build the below-grade structures for this project, so significant efforts will be needed to support those excavations temporarily and control the groundwater effectively. Recommendations are provided in the GROUNDWATER CONTROL and BELOW-GRADE CONSTRUCTION sections of this report.

In our opinion, the subsurface conditions encountered during this investigation pose some challenges to the proposed construction of this project, but those challenges can be met if they are carefully taken into consideration and handled competently. Geotechnical-engineering recommendations for design and construction are discussed in the following sections of this report.

GENERAL COMMENTS ON SOIL BEARING PRESSURE

The vertical design load of a structure distributed over the area beneath its foundation is known as the "gross bearing pressure." Excavating soil to install a buried structure on a footing reduces the vertical stress on the intended bearing surface by an amount equal to the stress that had been imposed by the self-weight of the soil that was removed, i.e., the "overburden" pressure. The stress increase induced by the structure on the bearing soils is the difference between the gross bearing pressure and the overburden stress, and is known as the "net bearing pressure." Structural analysis and design of a footing are based on gross bearing pressure, while geotechnical engineering analysis of that footing (typically settlement and bearing resistance) are based on net bearing pressure.

Bearing capacity is the net bearing pressure that would induce a sudden, shear failure in the soils beneath the footing. It is a function of the size and depth of the foundation and the properties of the bearing soils. Bearing capacity failure is generally not a concern for large footings, mat foundations, foundations bearing more than four feet below the ground surface, or foundations bearing in medium dense to very dense soils. Foundation settlement is the cumulative, primary compression of the soils in the zone of influence beneath the footing in response to the net bearing pressure. In many cases, the net bearing pressure beneath deeply buried structures is zero, and settlement does not occur.

DESIGN OF BURIED STRUCTURES

Based on the anticipated structure depths and footing thicknesses discussed earlier in this report, the wet-well footings are expected to bear between 34 feet and 38 feet below the existing ground surface. Similarly, the splitter box footing is expected to bear about 20 feet below the ground surface.

To design the walls of these structures, we recommend setting the groundwater level with the existing grade. In addition, we recommend a saturated soil unit weight of 120 pounds per cubic foot (pcf), a soil friction angle of 30 degrees and a lateral earth pressure coefficient of 0.5. That coefficient represents the "at-rest" condition because enclosed, buried structures tend to be self-bracing, and so are not likely to allow the soil to displace to the extent needed to attain the active condition. The lateral earth pressure coefficient of 0.5 should also be applied to loads on the ground surface around the buried structures, including any nearby shallow foundations and incidental vehicular traffic. In the absence of specific load information, incidental traffic should be represented by a uniformly distributed vertical load of 250 pounds per square foot (psf). If the groundwater is assumed to level with the ground surface, the lateral earth pressure induced by the soil only may be represented by an equivalent fluid pressure of 29 pcf for structural design purposes only. The unit weight of water should be added to that equivalent fluid pressure value in order to represent the full lateral load being imposed by the saturated soils on the exterior walls of the buried structures.

The structures should be designed to ensure that they have adequate resistance against uplift when empty. Uplift resistance should be derived from the overall weight of the empty structures and their thick concrete bases, which should be sized to provide the necessary uplift resistance. The buoyant weight of soils resting on any parts of the foundation projecting horizontally beyond the exterior

walls may be used to augment uplift resistance, but soil friction against the exterior walls should not be considered as contributing to uplift resistance.

The worst-case loading condition on a wet-well foundation installed conventionally in a braced, dewatered, excavation typically occurs during hydro-testing, when the structure is full of water but has not been backfilled and the groundwater has been lowered to at least two feet below the lowest foundation bearing surface. Structures installed by the "caisson/tremie" method may not impose the same bearing pressure, but since we do not know which method will be used for construction, we assumed the worst-case condition described above for the purposes of settlement analysis.

The project structural engineer advised that the foundation bearing pressure during water testing, i.e., the gross bearing pressure, beneath the wet wells would be about 5,000 psf. Based on the depths provided for the splitter box, we assumed a gross bearing pressure of about 2,800 psf for the splitter box. Excavating soils to the depth of the wet-well footings should reduce the overburden stress by about 4,800 psf, and resulted in an estimated net bearing pressure of about 200 psf. Similarly, the reduction in overburden stress for the splitter box would be about 2,500 psf, yielding an estimated net bearing pressure of about 300 psf.

These net bearing pressures are so small that they are effectively negligible. In addition, water tests typically last about 24 hours, whereas even clean, granular soils take two to three days to settle under vertical loading. Once the water testing is completed, the structures are not likely to be as heavy for very long during their service lives, As a result, we do not anticipate significant settlement beneath them, so it is our opinion that the wet wells can be supported on large, spread footings as planned, provided the recommendations in the EARTHWORK FOR BELOW-GRADE CONSTRUCTION sections of this report are followed.

WET WELL CONSTRUCTION

As discussed earlier in this report, OCU intends to construct the wet wells and the splitter box using the "caisson/tremie" method, also known as the "sinking caisson" method.

Although more technically demanding, this method simultaneously avoids the potential drawbacks of temporary excavation, dewatering and cast-in-place concrete construction. Precast sections of the open-ended structures are assembled and lowered progressively into an excavation created from inside the structure, the sides of which serve as the temporary support of excavation. As work progresses, the level of the water or slurry in the shaft must be kept above the level of the groundwater in the surrounding soil to reduce the potential for disturbance. Once the design depth has been reached, the bottom of the well is installed and filled with concrete placed through a tremie. As the fluid concrete rises in the excavation, it displaces the water or slurry into a catchment system.

The wet well should be designed to resist not only the anticipated service loads but also any loads that may be imposed during typical construction activity, which may require more coordination than usual with the contractor.

The contractor should submit a detailed work plan, with detailed descriptions of the methods for supporting, positioning, aligning and connecting the individual precast wet well sections; excavation and sinking of the wet well, maintaining an appropriate fluid level in the well relative to the ambient groundwater level during excavation, placing the well bottom, grouting the annulus of the well, placing the tremie concrete and disposal of the excavated soils and well fluid. Detailed contingency plans providing correction procedures should also be provided.

Despite the reduced needs for temporary excavation support and dewatering that are anticipated with this method, temporary excavation-support systems will still be needed. These systems should be designed to maintain the stability of the excavation and the surrounding soils and withstand lateral loads. The excavation must be dewatered properly to provide a dry, stable and safe work area. Recommendations for excavation safety and dewatering are provided later in this report.

The wet well should be monitored frequently during installation and appropriate steps should be taken as needed to ensure that it is being installed as shown on the drawings. The finished well should not be more than 2 percent out of plumb measured on orthogonal axes. Lateral displacement of the top of the wet well relative to its design location should not exceed three inches. Maximum vertical displacement relative to the design elevation should not exceed 0.05 feet.

Careful attention must be paid to the selection, installation, operation, maintenance, and removal of the systems for dewatering and excavation support. The potential constraints that these temporary systems may impose on wet well construction also need to be considered along with the possible impacts of dewatering (such as induced settlement of nearby structures). The ability to recognize the early signs of impending problems and address the underlying causes promptly and decisively is critical.

PIPELINE DESIGN

A minimum modulus of soil reaction (E') value of 1,000 pounds per square inch (psi) may be used to design the pipelines for this project, provided the earthwork, compaction and subgrade preparation recommendations described in the EARTHWORK FOR BELOW-GRADE CONSTRUCTION section of this report are implemented.

PIPELINE FOUNDATIONS SUPPORT

Manholes, thrust blocks, anchor blocks and other underground structures should be supported on natural soils or backfill compacted as recommended in the EARTHWORK FOR BELOW-GRADE CONSTRUCTION section later in this report. Soils compacted to that condition should support bearing pressures up to 1,500 pounds per square foot (psf) with total settlements less than an inch.

UPLIFT RESISTANCE

All buried pipes and structures should be designed to resist hydrostatic pressure corresponding to the design high groundwater level. Uplift resistance calculations should consider the weight of the structure, the weight of any soils directly above the structure and the weight of backfill over any parts of the foundation that project horizontally beyond the side walls. Side friction resistance along the walls should not be considered.

SOIL RESISTANCE TO HORIZONTAL PIPELINE FORCES

Changing fluid pressure inside a pipeline can induce horizontal forces at junctions with buried structures and in locations where the pipe changes direction. Those forces can cause the pipe to move uncontrollably and eventually lead to distress, so anchor blocks or thrust blocks are typically provided to restrain the pipe. Those blocks resist horizontal forces by virtue of their mass as well as the ability to mobilize the shear resistance of the soil beneath their bases and the passive resistance of the soil in contact with their vertical faces.

In order to provide effective resistance, soils in contact with anchor blocks or thrust blocks should be in a medium dense to dense condition. Naturally loose soils (and all fill or backfill materials) should be compacted as recommended in the EARTHWORK FOR BELOW-GRADE CONSTRUCTION section later in this report to at least two feet below the base of any block or structure and at least five feet beyond its vertical face in contact with the soil. The soils should be continuous with no voids or other discontinuities.

Shear resistance beneath the base of any block or structure may be estimated using the following expression:

$$S = \frac{(W + \gamma_s A H_t - U) \tan (0.67\phi)}{FS_b}$$

where
- S = allowable shear resistance, in pounds
- W = total weight of the block, in pounds
- γ_s = unit weight of the soil above the block, in pounds per cubic foot
- A = area of base of structure, in square feet
- H_t = depth from ground surface to the top of the block, in feet
- U = total uplift force, in pounds
- ϕ = soil friction angle (30 degrees typically assumed)
- FS_b = desired factor of safety for base shear (1.5 typically assumed)

The unit weight for compacted soil in central Florida is often estimated to be about 110 pounds per cubic foot (pcf) for moist soil and about 120 pcf for saturated soil.

Passive soil resistance against the face of any block or structure may be calculated conventionally using the estimated soil properties and the desired factor of safety for passive resistance. Surcharges, traffic loads and the weight of construction equipment should not be considered in these analyses.

SLAB-ON-GRADE FOUNDATIONS

As discussed earlier in this report, the electrical building will be supported on slab-on-grade foundations bearing near existing grade. Detailed structural information was not available at the time, so a gross bearing pressure (the increase in vertical pressure induced in the soil beneath a structure by the total weight on its foundation) of 500 psf was assumed for settlement analysis of the slab-on-grade foundations.

Potential settlement was calculated by applying the gross bearing pressure to the soil stratification developed from the boring log. The foundation was assumed to bear on compacted soils. Engineering properties were then estimated for each soil type within the anticipated zone of foundation influence using empirical correlations with the SPT N-values.

The result of the settlement analysis indicated that the slab-on-grade foundations should settle less than one-half inch under the assumed bearing pressure. Since the actual bearing pressure is expected to be lower than the assumed value, the actual settlement also should be less. Measurable long-term foundation settlement is not expected because fine-grained soils and plastic soils were not encountered within the anticipated zone of influence of the foundation.

EARTHWORK FOR BELOW-GRADE CONSTRUCTION

All below-grade construction should be conducted in accordance with the recommendations for excavation safety and groundwater control presented later in this report. Below-grade construction is likely to require temporary excavation support systems to withstand the anticipated lateral loads and limit unacceptable movement of surrounding soils and adjacent structures. Dewatering will probably be needed in order to establish and maintain dry, stable, safe, below-grade work areas.

Careful attention must be paid to the selection, installation, operation, monitoring, maintenance and removal of temporary excavation support systems. They should provide sufficient working room for anticipated below-grade activities such as installation of formwork and compaction of backfill. Temporary excavation support systems should be removed so as not to disturb completed structures, the backfill nor adjacent structures. The contractor should prepare contingency plans so that the cause(s) of any observed distress to excavation support systems, surrounding soils, or adjacent structures can be identified promptly and accurately, and addressed decisively.

Pavement materials, grass and other vegetation, roots, topsoil or any other unsuitable materials within the limits of the proposed construction should be removed and either discarded or stockpiled

away from the immediate work areas for reuse as appropriate, possibly as landscaping material. Any organic materials encountered deeper below the ground surface should be treated in a similar fashion.

Conventional construction equipment should be able to dig excavations for the anticipated pump station improvements. However, some medium dense soils and silty sands may be difficult to excavate. Roots, organic materials, debris, dense to very dense soils and cemented soils are also possible and should be expected, even though they were not encountered in the borings.

The excavations should be dug to the depths and widths needed for installation of the buried structures, piping, excavation support systems, and any below-grade construction equipment or materials that may be needed. This work should be closely supervised to ensure that excavations are not being over-dug and that the bearing soils are not being disturbed. Any soft, loose or muddy materials should be carefully and completely removed to expose uniform, undisturbed soil.

Below-grade concrete foundations need uniform support to function effectively, even when lightly loaded. Exposed subgrade soils at the bearing depths should be examined and probed by a geotechnical engineer or qualified representative to locate soft or yielding areas, hard spots or other non-uniform conditions. Non-uniform conditions should be treated as directed by the OCU on-site representative in consultation with the examining geotechnical engineer.

Exposed subgrade soils at the bottoms of excavations should be thoroughly and uniformly compacted to achieve not less than 95 percent of the maximum dry density obtained by the Modified Proctor method (ASTM D 1557) to a depth at least one foot below subgrade level.

Backfill should be placed uniformly on all sides of the proposed pipelines and manholes in loose lifts approximately eight inches thick before initiating compaction. Each lift should be compacted to not less than 95 percent of the maximum dry density obtained by the Modified Proctor method (ASTM D 1557).

EARTHWORK FOR SLAB-ON-GRADE FOUNDATIONS

All vegetation, topsoil, organic matter and debris within the foundation area should be removed to expose clean, undisturbed soils. Clearing and grubbing should extend at least five feet beyond the edges of the foundation area and should be expected to a depth of at least one foot.

The cleared ground surface should be examined and probed by a geotechnical engineer or designated representative to locate soft or yielding areas, hard spots or other non-uniform conditions. Non-uniform conditions should be treated as directed by the OCU on-site representative in consultation with the examining geotechnical engineer. The cleared ground surface should be compacted to not less than 95 percent of the maximum dry density obtained by the Modified Proctor method (ASTM D 1557) to a depth at least two feet.

Minor filling and regrading of the site is anticipated. Fill soils should be placed in uniform lifts approximately 10 to 12 inches in loose thickness and compacted to not less than 95 percent of the maximum dry density obtained by the Modified Proctor method (ASTM D 1557).

CONSTRUCTION MONITORING

A program should be established to ensure that excavation, backfilling and compaction operations are conducted in accordance with the project plans and specifications. In-place density testing should be conducted at the bottoms of excavations and during backfilling and compaction operations. Trench subgrade and trench backfill should be tested for adequate compaction at a frequency not less than one test per vertical foot per 300-foot run of pipe. Subgrade soils beneath buried structures should be tested for adequate compaction at a minimum of one location. Backfill around buried structures should be tested for adequate compaction at a frequency not less than one test per vertical foot of backfill. The moisture content of the subgrade soils and backfill soils should be within the range that will optimize the densification process. The contractor should be prepared to adjust the moisture content and change equipment, procedures and lift thickness as needed at no additional cost to the Owner in order to achieve the recommended compaction. We also recommend that a geotechnical engineer or the OCU on-site representative be present during construction to confirm that the contractor complies with the plans, specifications, and approved submittals.

REUSE OF EXCAVATED SOILS

We anticipate that excavated soils will be reused as backfill and fill. Most of the soils encountered in the borings may be too for immediate reuse as backfill and are likely to require proper moisture conditioning to achieve the recommended degree of compaction. Clayey sands and clays are likely to be too difficult to work efficiently. Fill and backfill should consist of sand with a fines content less than 12 percent that is free from debris and rubbish, topsoil, mud, muck, peat, stumps, roots, vegetable matter or other unsuitable materials that might decompose or cause excessive settlement. It should be non-plastic and contain no more than 5 percent by dry weight of organic matter.

Dewatering in preparation for excavation should not be expected to reduce in-situ water contents to more favorable levels. Excavated soils are often stockpiled to drain, spread to dry or blended with drier materials to achieve a suitable moisture condition. Despite the cost, off-site borrow material meeting the criteria discussed above may be more beneficial in terms of ease and efficiency of use.

Because a limited number of borings were drilled for this investigation, variations in consistency and fines content of the uppermost soils are likely, and should be expected. As a result, soil types encountered during excavations are likely to vary. Possible soil types that might be encountered within the planned depths of excavation and general recommendations for their reuse are discussed below for general guidance. These guidelines should not override the project specifications. There is the possibility that other soils may be encountered during construction that do not fall into one of the categories discussed below.

Poorly Graded Sands (SP)

These soils had fines contents of 5 percent or less, and are commonly referred to as "clean" sands. They are highly desirable for use as fill and backfill in central Florida because they drain freely. That characteristic allows these soils to be placed and compacted readily, even if they have been excavated from below the groundwater level. Satisfactory levels of compaction can be achieved using a wide variety of compaction equipment and across a relatively broad range of moisture contents. Some instability or "pumping" should be expected if these soils are compacted near saturation.

Sands with Silt and Sands with Clay (SP-SM, SP-SC)

These soils consisted of sands with fines contents between 5 percent and 12 percent. Although they do not drain as freely as clean sands, these soils are still quite suitable for use as fil or backfilll. If excavated from below the groundwater surface, they may have to be stockpiled and allowed to drain (or spread to dry) before being placed as fill. Satisfactory compaction can be achieved using a variety of compaction equipment and across a moderate to wide range of moisture contents. However, efforts should be made during compaction to maintain the moisture content below the optimum. Some instability or "pumping" should also be expected if these soils are compacted near saturation.

Silty Sands and Clayey Sands (SM, SC)

These soils consisted of sands with fines contents higher than 12 percent. They do not drain as well as sands. These soils can be reused as fill, but they will require very close attention to moisture content and careful selection of compaction equipment. Excavated soils of these types can be stockpiled to drain and/or possibly spread to dry before being used as fill. However, the contractor should be discouraged from considering this option because of the limited room that is available at the pump station site. Suitable compaction is generally achieved in these soils only across a narrow range of moisture contents, and this range narrows even further as the fines content increases. Silty sands should be compacted below the optimum moisture content to reduce the potential for moisture-related instability. Soils with more than 20 percent fines should not be used as backfill.

GROUNDWATER CONTROL

Based on the encountered soil and groundwater conditions and the anticipated excavation depths, significant dewatering efforts will be needed to enable below-grade construction. The methods typically used to dewater excavations for manholes and small pump stations should not be expected to be adequate for the larger, deeper below-grade structures such as the clarifier, pump stations and ROF controller.

In addition, USGS maps of the area had shown the ground surface between the El. 80 and El. 95 contours, while the potentiometric surface of the Upper Floridan aquifer (the approximate level to which water in the aquifer would rise were it not confined by low-permeability materials above the

aquifer) was shown near El 50. These elevations suggested that excavations for the deeper structures might encounter artesian conditions, so those conditions should be expected. Near-surface seepage from higher elevations after rainfall events may also cause inflows similar to artesian conditions. That situation can be exacerbated by isolated horizons of material with lower permeability than the surficial sands, which can impede percolation and cause perched groundwater.

Suggested dewatering efforts for the larger, deeper excavations may include, but are not limited to, single-stage or multi-stage systems using well casings, high-volume or high-lift submersible pumps, deep wells to relieve pressure locally in the Floridan aquifer, or other methods.

The contract documents should require the contractor to verify groundwater levels before starting construction, and to be responsible for all aspects of dewatering, regardless of those groundwater levels. That responsibility includes not just the installation and operation of an effective dewatering system, but also all permits needed to satisfy applicable environmental regulations, and all systems needed to monitor groundwater volume and quality. The contractor should monitor groundwater levels during below-grade construction using piezometers or other devices that can provide efficient, accurate and reliable groundwater level measurements. The contractor should also monitor the adjacent ground surface and equipment, nearby structures, utilities, roadways and other facilities for subsidence, cracking or other distress that may result from temporarily lowered groundwater levels.

All excavations and below-grade construction should be conducted in the dry. The contractor should be prepared to lower and maintain the groundwater level at least two feet below the bottoms of all excavations for the duration of below-grade construction activities. Groundwater should be lowered to the recommended levels prior to excavation in order to minimize the potential for instability of excavations, bottom heave or quick conditions within the excavations. Dewatering systems should be maintained in operation until foundation construction is complete and the excavations have been completely backfilled in a satisfactory manner to prevent uplift. Dewatering systems should be decommissioned progressively to avoid any heave or other potential instability of the below-grade structures and should be addressed in the contractor's dewatering submittal.

Water from dewatering pumps should be discharged as far as practically possible away from the work areas to prevent return flow or erosion into the excavations. The contractor should also have submersible pumps ready on site to intercept and remove any localized inflows. The ground surface around excavations should be graded to minimize inflow of runoff.

GROUNDWATER QUALITY SCREENING

Groundwater screening was not part of our scope for this project.

EXCAVATION SAFETY

The sides of all excavations more than four feet deep must be sloped or supported to withstand lateral forces exerted by the existing soils in accordance with the latest regulations promulgated by the Occupational Safety and Health Administration ("OSHA"). Any excavation support system must also be able to support possible hydrostatic pressures and surcharge loads. For calculating the lateral loads from the site soils on unbraced temporary excavation support systems, we recommend a soil unit weight of 125 pcf and a lateral earth pressure coefficient of 0.4. This coefficient should be increased to 0.5 if the system is braced (the "at-rest" condition). The same coefficients should be applied to loads on the ground surface and from traffic (including construction equipment) around the excavations. Traffic loads should be represented by a uniformly distributed surcharge of 250 psf.

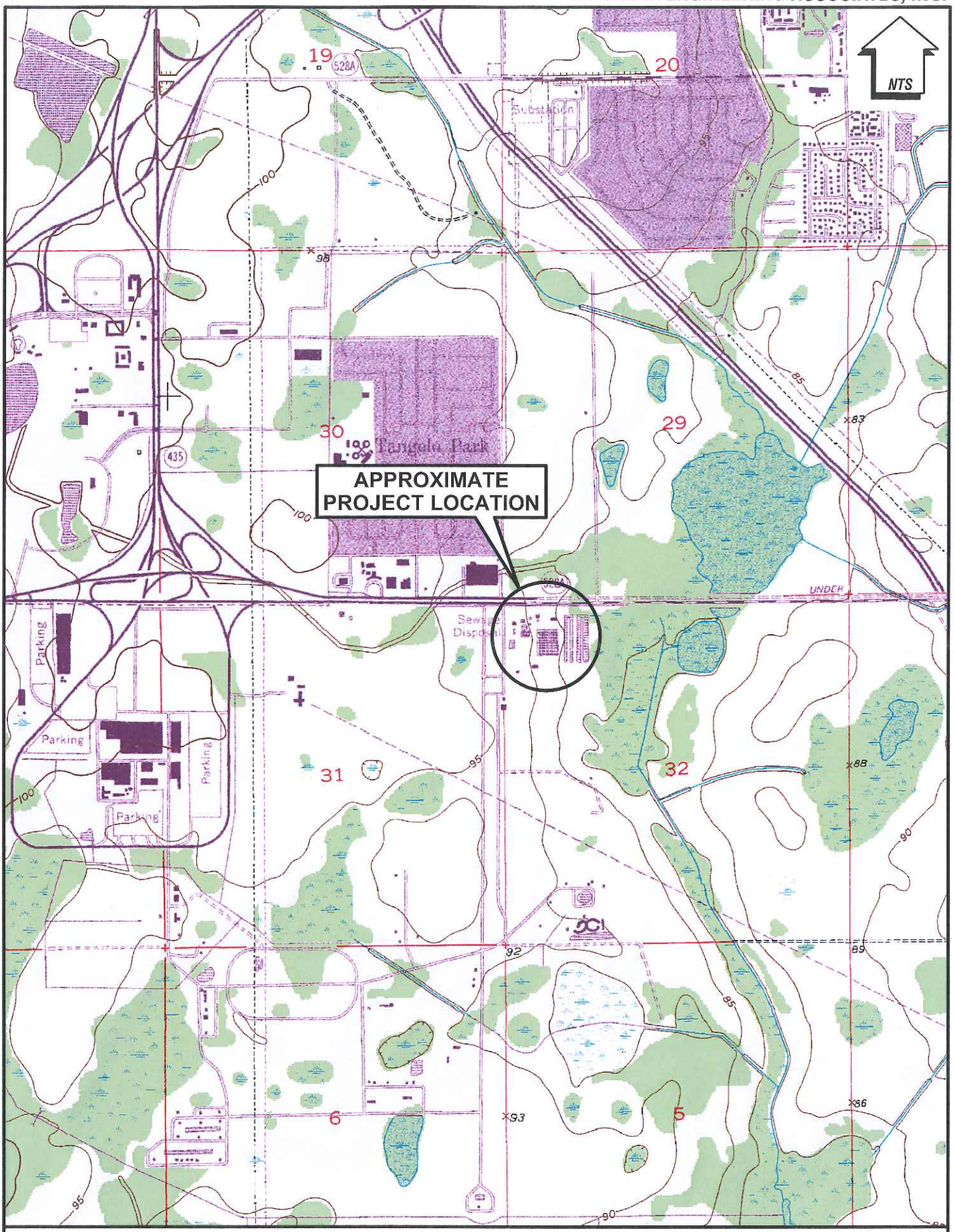
All excavations must be kept dry so that work can proceed safely and efficiently. As discussed in the GROUNDWATER CONTROL section, the groundwater level should be maintained at least two feet below the bottoms of all excavations. However, dewatering systems can fail, which would allow the groundwater to return to its pre-construction level and possibly fill the excavation. Pumping water out the excavations to resume work can temporarily reduce soil strength. This "rapid drawdown" condition should be analyzed using the design high water level.

LIMITATIONS

This report presents an evaluation of the subsurface conditions on the basis of accepted geotechnical engineering procedures for site characterization. The investigation was confined to the zone of soil which is likely to be affected by the proposed construction, and did not address the potential of surface expression of deep geologic activity such as sinkholes. This type of evaluation requires a more extensive range of field services than those performed for this study.

Because of the natural limitations inherent in working below the ground surface, a geotechnical engineer cannot predict and address all possible soil-related problems. During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. The bulletin "Important Information About This Geotechnical Engineering Report" published by the Geoprofessional Business Association (GBA) is presented in Appendix B to help explain the nature of geotechnical engineering analysis. Additional information is presented in Appendix C to bring to your attention basic limitations of a typical geotechnical engineering report.

FIGURES



SITE LOCATION MAP

201610	ORANGE COUNTY SOUTH WRF INFLUENT PUMP STATION	FIG. 1

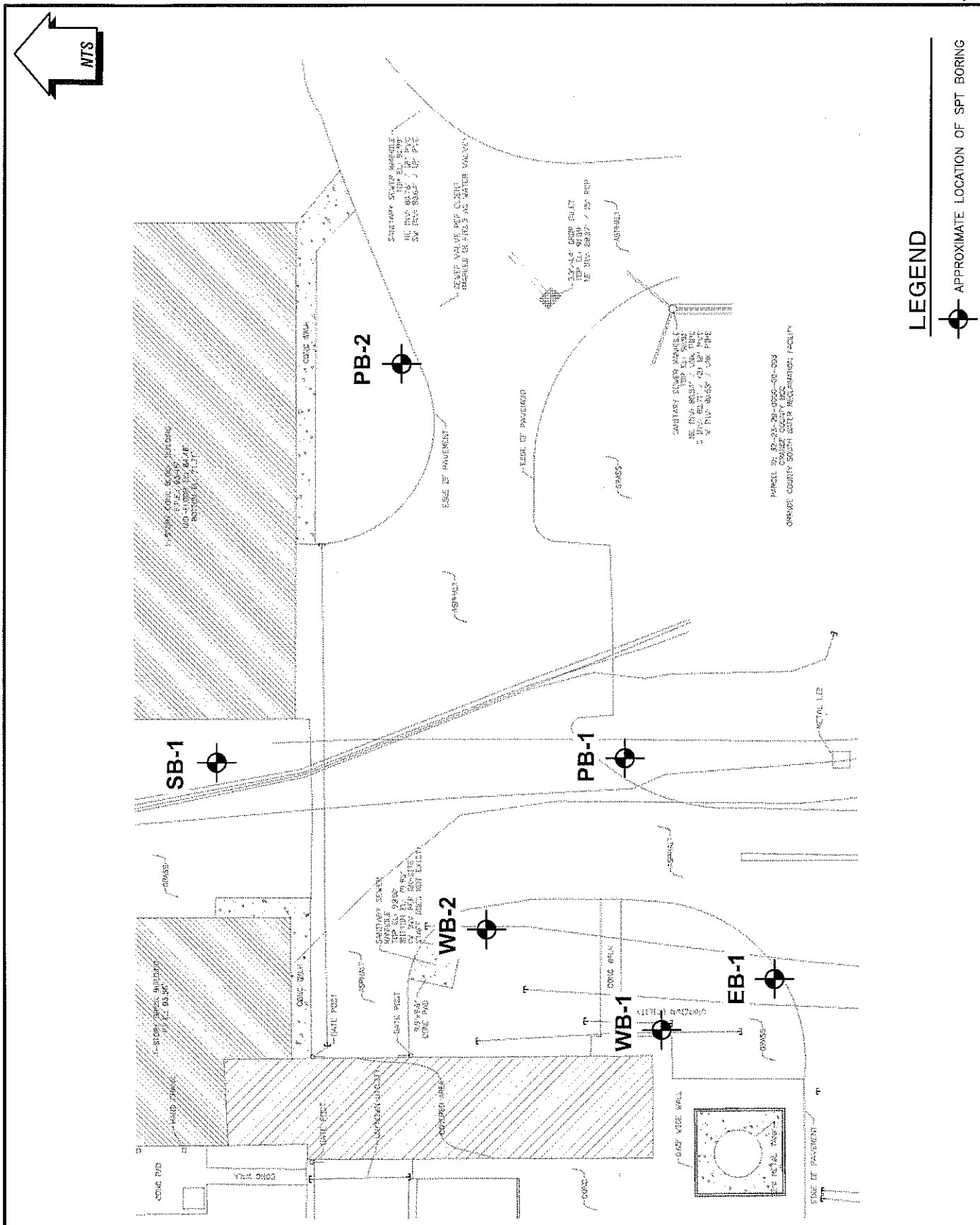


Figure developed from topographic survey provided by Client

BORING LOCATION PLAN

201610	ORANGE COUNTY SOUTH WRF INFLUENT PUMP STATION	FIG. 2

APPENDIX A

ANTILLIAN ENGINEERING ASSOCIATES, INC.
3331 Bartlett Boulevard Orlando, Florida 32811
Tel (407) 422-1441 Fax (407) 422-2226

KEY TO BORING LOGS

SYMBOLS

10	SPT N-Value (number of blows a 140-lb weight falling 30 inches required to drive a Standard Split-Spoon sampler one foot into otherwise undisturbed soil)
WR	Penetration of sampler under weight of drill rods
WH	Penetration of sampler under weight of drill rods and hammer
SS	Split Spoon sample
ST	Undisturbed thin-walled Shelby Tube sample
	Observed change in soil type
	Unobserved change in soil type
▽	Estimated seasonal high groundwater level
▼	Encountered groundwater level

SOIL CONSISTENCY

(Based on empirical correlation with SPT N-Value)

GRANULAR SOILS

Very Loose - Less Than 4 blows/ft.
Loose - 4 to 10 blows/ft.
Medium Dense - 10 to 30 blows/ft.
Dense - 30 to 50 blows/ft.
Very Dense - More Than 50 blows/ft.

FINE-GRAINED SOILS

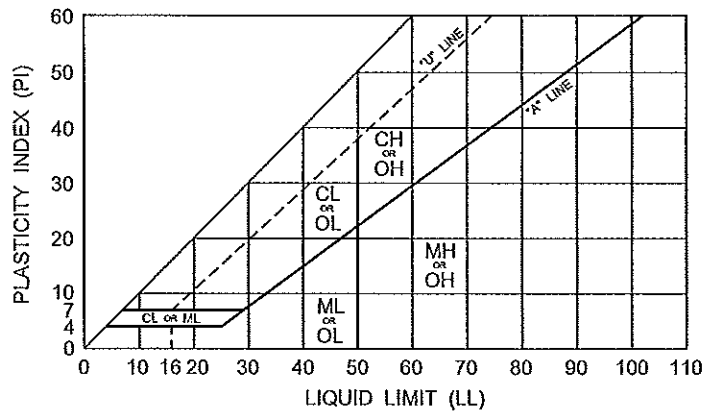
Very Soft - Less Than 2 blows/ft.
Soft - 2 to 4 blows/ft.
Firm - 4 to 8 blows/ft.
Stiff - 8 to 15 blows/ft.
Very Stiff - 15 to 30 blows/ft.
Hard - More Than 30 blows/ft.

UNIFIED SOILS CLASSIFICATION SYSTEM ASTM D 2487

(Based on material passing the 3-inch (75-mm) sieve)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% passing No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			Pt	Peat, muck and other highly organic soils

PLASTICITY CHART



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LOG OF BORING WB-1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**5.5**
DATE:	**10/24/16**	COMPLETION DEPTH:	**50.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
0			HA	Gray to dark gray fine SAND with silt, occasionally cemented (SP-SM)							
				- gray							
				Brown silty fine SAND, occasionally cemented (SM)							
				- very dark brown, more silty							
5							17				
				- dark brown, less silty (POSSIBLE BACKFILL)							
		5	SS	Loose, dark grayish brown silty fine SAND (SM)	7.0						
		8	SS								
10							22				
		12	SS	- medium dense							
15											
		11	SS								
20											
		9	SS	- loose							
25											
		6	SS	- more silty							
30							36				

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LOG OF BORING WB-1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**5.5**
DATE:	**10/24/16**	COMPLETION DEPTH:	**50.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
35		16	SS	- medium dense							
					38.0						
40		6	SS	Firm, light greenish gray sandy CLAY (CL)			52	39	45	25	
45		5	SS								
					48.0						
50		6	SS	Firm, greenish gray CLAY (CH)			87	45	98	72	
					50.0						

ANTILLIAN ENGINEERING ASSOCIATES, INC.

LOG OF BORING WB-2

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**5.7**
DATE:	**10/24/16**	COMPLETION DEPTH:	**50.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
0			HA	Brown silty fine SAND (SM)							
				- dark brown, fine SAND with silt (SP-SM)							
		6	SS	- loose, mixed brown and dark brown							
5		17	SS	- medium dense, dark brown, occasionally cemented (POSSIBLE BACKFILL)			9				
		13	SS	Medium dense, dark brown silty fine SAND (SM)	7.0		18				
		11	SS								
10											
		13	SS	- grayish brown							
15											
		15	SS				24				
20											
		8	SS	- loose							
25											
		11	SS	- medium dense, dark grayish brown, more silty							
30											

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ENGINEERING ASSOCIATES, INC.

LOG OF BORING WB-2

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**5.7**
DATE:	**10/24/16**	COMPLETION DEPTH:	**50.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
35		12	SS	- less silty			23				
					38.0						
40		6	SS	Firm, light greenish gray sandy CLAY (CL)							
45		6	SS								
					48.0						
50		8	SS	Firm, greenish gray CLAY (CL)							
					50.0						

ANTILLIAN ENGINEERING ASSOCIATES, INC.

LOG OF BORING EB-1

SHEET 1 OF 1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**5.2**
DATE:	**10/25/16**	COMPLETION DEPTH:	**25.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
0			HA	Gray fine SAND with limestone fragments (SP)							
				- brown							
				Dark grayish brown silty fine SAND (SM)							
		3	SS	- more silty							
5				(POSSIBLE BACKFILL)	▼						
		11	SS	Medium dense, brown silty fine SAND (SM)	5.5						
		12	SS								
		16	SS	- grayish brown							
10											
		8	SS	- loose, light brownish gray			24				
15											
		9	SS								
20											
		9	SS								
25					25.0						

ANTILLIAN ENGINEERING ASSOCIATES, INC.

LOG OF BORING SB-1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**8.0**
DATE:	**10/25/16**	COMPLETION DEPTH:	**40.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
0			HA	Dark brown silty fine SAND, a few crushed limestone fragments (SP-SM)							
							18				
		8	SS	- loose							
5		12	SS	- medium dense							
		7	SS	- loose							
		8	SS	- grayish brown							
10				*Lost circulation while drilling between 10 ft. and 13 feet*							
				(POSSIBLE BACKFILL)	12.0						
		10	SS	Loose, grayish brown silty fine SAND (SM)			22				
15											
		8	SS	- more silty, slightly plastic			25				
20											
		7	SS	- non-plastic							
25											
		12	SS	- medium dense, grayish brown, slightly plastic			23				
30											

ANTILLIAN ENGINEERING ASSOCIATES, INC.

LOG OF BORING SB-1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**8.0**
DATE:	**10/25/16**	COMPLETION DEPTH:	**40.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
35		10	SS	- loose, light greenish gray, non-plastic							
		8	SS	- more silty							
40					40.0						

ANTILLIAN ENGINEERING ASSOCIATES, INC.

LOG OF BORING PB-1

SHEET 1 OF 1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**6.1**
DATE:	**10/25/16**	COMPLETION DEPTH:	**25.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
0			HA	Dark grayish brown silty fine SAND with a few crushed limestone fragments (SM)							
		13	SS	- medium dense, more silty, no limestone fragments			15				
5		16	SS	- brown, a few crushed limestone fragments	▼						
		13	SS								
				(POSSIBLE FILL)							
		10	SS	Loose, brown silty fine SAND (SM)	8.5		14				
10											
		7	SS	- gray, more silty, slightly plastic			27				
15											
		8	SS								
20											
		8	SS								
25					25.0						

ANTILLIAN ENGINEERING ASSOCIATES, INC.

LOG OF BORING PB-2

SHEET 1 OF 1

PROJECT NO:	**201610**	SURFACE ELEVATION:	**93 approx.**
PROJECT:	**South WRF Influent Pump Station**	GROUNDWATER DEPTH:	**9.0**
DATE:	**10/25/16**	COMPLETION DEPTH:	**25.0**
LOCATION:	**See Figure 2**	DRILLING METHOD:	**Mud Rotary**

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	OC %
0			HA	Dark grayish brown silty fine SAND with a few crushed limestone fragments (SM)							
		20	SS	- medium dense, dark grayish brown, more silty							
5		29	SS	- dark brown with a few limestone fragments							
		37	SS	Dense, brown silty fine SAND with nodules of gray clayey sand (SM)							
		51	SS	- very dense, dark brown	▼						
10				(POSSIBLE FILL)	13.0						
		9	SS	Loose, grayish brown silty fine SAND, slightly plastic (SM)							
15											
		6	SS								
20											
		7	SS	- brown, more plastic			27				
25					25.0						

Project: **South WRF Influent Pump Station** Job Number: **201610** **Sheet 1 of 1**

Manager: _____ Client: _____ Project Description: _____

Location: **See Figure 2**

Boring Depth	Sample Description	#4	#10	#40	#60	#100	Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)	Stratum Number	AASHTO	USCS
WB-1 5.5	Very dark brown silty sand						16.9								SM
WB-1 10.0	Dark grayish brown silty sand						22.2								SM
WB-1 30.0	Dark grayish brown silty sand						36.4								SM
WB-1 40.0	Light greenish gray sandy clay						52.3	39	45	25					CL
WB-1 50.0	Greenish gray clay						86.5	45	98	72					CH
WB-2 5.5	Brown sand with silt						9.4								SP-SM
WB-2 8.5	Dark brown silty sand						17.8								SM
WB-2 20.0	Grayish brown silty sand						24.0								SM
WB-2 35.0	Dark grayish brown silty sand						22.6								SM
EB-1 15.0	Light brownish gray silty sand						24.2								SM
SB-1 4.0	Dark brown silty sand						17.7								SM
SB-1 15.0	Grayish brown silty sand						22.0								SM
SB-1 20.0	Grayish brown silty sand						24.7								SM
SB-1 30.0	Grayish brown silty sand						23.0								SM
PB-1 5.5	Dark grayish brown silty sand						14.7								SM
PB-1 10.0	Brown silty sand						14.1								SM
PB-1 15.0	Gray silty sand						26.8								SM
PB-2 25.0	Brown silty sand						27.0								SM

Summary Of Laboratory Test Results

ANTILLIAN
ENGINEERING ASSOCIATES, INC.

APPENDIX B

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX C

ANTILLIAN ENGINEERING ASSOCIATES, INC.
CONSTRAINTS AND RESTRICTIONS

WARRANTY

Antillian Engineering Associates, Inc. has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Antillian Engineering Associates, Inc., as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Antillian Engineering Associates, Inc. of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Antillian Engineering Associates, Inc. to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Antillian Engineering Associates, Inc. is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Antillian Engineering Associates, Inc..

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Antillian Engineering Associates, Inc..

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Antillian Engineering Associates, Inc. cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Antillian Engineering Associates, Inc. to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Antillian Engineering Associates, Inc. to locate any such buried objects. Antillian Engineering Associates, Inc. cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of investigation. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.

Appendix B

Forms

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APPENDIX B **FORMS**

Pressure Test February, 2017

Project Name: _____

Constructed by: _____

☐ **Force Main**
☐ **Reclaimed Main**
☐ **Water Main**

Allowable Loss – 2 Hours
L = SD (P) 1/2
148,000 ***See Note Below***

DATE	LINE SEGMENT	STATION		LENGTH	N	D	START		END		LOSS (gal)		Pass /Fail STATUS
		From	To				Time	PSI	Time	PSI	Allow	Actual	

COUNTY Inspector's Name:		**Signature:**		**Date:**
Tester's Name:		**Signature:**		**Date:**
Comments:				

Note: L - Allowable leakage in gallons per hour.
S - Length of pipe tested, in feet.
D - Nominal diameter of the pipe in inches.
P - Average test pressure during leakage test in pounds per square inch gauge.

Appendix C

Permits Obtained by Owner

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The following permit applications will be filed for:

- FDEP Permit for Minor Revision to a Wastewater Facility or Activity Permit
- FDEP Notification/Application For Constructing A Domestic Wastewater Collection/Transmission System
- County Building Department

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Appendix D

Orange County Utilities Department
List of Approved Products

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APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Air Release	ARV Enclosure	**All ARV above ground enclosures shall be vented with tamper proof locking device**						
		Water Plus Polyethylene Enclosure	131632 H30-B	Blue 44" Tall	131632 H30-P	Pantone 44"	131632 H30-G	Green 44" Tall
			171730 H40-B	Blue 30" Tall	171730 H40-P	Pantone 30"	171730 H40-G	Green 30" Tall
		Hot Box Vent Guard Fiberglass Enclosure	AVG2036 Encl GP3232 Base	Blue 36" Tall	AVG2036 Encl GP3232 Base	Pantone 36" Tall	AVG2036 Encl GP3232 Base	Green 36" Tall
			AVG2041 Encl GP3232 Base	Blue 41" Tall	AVG2041 Encl GP3232 Base	Pantone 41" Tall	AVG2041 Encl GP3232 Base	Green 41" Tall
		Safety-Guard/Hydro Guard	15100 Encl	Blue 34" Tall	15100 Encl	Pantone 34" Tall	15100 Encl	Green 34" Tall
	Air Release Valves	**Air Release Valves shall be Combination Type, 316 SS**						
		ARI	D-040SS	Combination	D-040SS	Combination	D-020 (SS)	Combination
		H-TEC	NA	NA	NA	NA	986 (316SS)	Combination
		Vent-O-Mat	Series RBX DN50	2"	Series RBX DN50	2"	RGX series	
	ARV Vault	**Air Release Valve Frame and Cover**						
		US Foundry	NA	NA	NA	NA	USF 7665-HH-HJ	
Blow Off	Auto Blow Off	**Automatic Blow Off Valve**						
		Hydro Guard	HG-1 Standard Unit	Automatic	NA	NA	NA	NA
	Blow Off Valve	**Blow Off Valve - Fits standard 5-1/4 inch Valve Box**						
		Kupferle Foundry Co	Truflo Series TF #550		Truflo Series TF #550		NA	NA
		Water Plus Corp	The Hydrant Plus Series VB 2000B		The Hydrant Plus Series VB 2000B		NA	NA
Casing Seals / Spacers	Casing End Seals	**Casing End Seals. Annular space between pipe and steel casing shall be brick and mortar with end seals to secure ends.**						
		Advance Products	Model AC and AW		Model AC and AW		Model AC and AW	
		BWM Company	Model WR and PO		Model WR and PO		Model WR and PO	
		Cascade Water Works	Model CCES		Model CCES		Model CCES	
		CCI Pipeline	Model ESW and ESC		Model ESW and ESC		Model ESW and ESC	
		Pipeline Seal & Insulator, Inc (PSI)	Model C and W		Model C and W		Model C and W	
		Power Seal	Model 4810ES		Model 4810ES		Model 4810ES	

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Casing Seals / Spacers	Casing spacer	**Casing spacers shall be a min. 8-inches wide for pipe 12" Dia or less or min. 12-inches wide for pipe 16 or greater , shall have a minimum 14 gauge 304 stainless steel shell/band, minimum 10 gauge 304 reinforced risers; minimum thickness of 0.090 EPDM or PVC interior liners, glass reinforces polymer or ultra high molecular weight polyethylene and 304 stainless bolts, nuts and washers.**						
		Advance Products	SSI8 / SSI12		SSI8 / SSI12		SSI8 / SSI12	
		BWM Company	BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		BWM-SS-8 / SS-12	
		Cascade Water Works	Series CCS 8" / 12"		Series CCS 8" / 12"		Series CCS 8" / 12"	
		CCI Pipeline	Model CCS8 / CSS12		Model CCS8 / CSS12		Model CCS8 / CSS12	
		Pipeline Seal & Insulator, Inc (PSI)	Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		Series S8G-2 / S12G-2	
Coatings	Exterior Coatings for Exposed Metal Assets	**Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 1 Zinc / Urethane / Fluoropolymer application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.**						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
			Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils
			EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils
			Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils
	Exterior Coatings for Exposed Metal Assets	**Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 2 Zinc / Epoxy / Urethane application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.**						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
			Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils
			Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils
			EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils
		PPG / Ameron	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils
			Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils
			Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Fittings	Fittings	**Ductile Iron Fittings C153 SSB / C110 FLG: (Water & Reclaimed Water fittings shall cement lined or holiday free fusion bonded epoxy lined) (Wastewater fittings interior shall be Protecto 401 and holiday free)**						
		American	30" & up	FBE / Cement	30" & up	FBE / Cement	30" & up	Protecto 401
		Sigma		FBE / Cement		FBE / Cement		Protecto 401
		Star		FBE / Cement		FBE / Cement		Protecto 401
		Tyler Union & Clow		FBE / Cement		FBE / Cement		Protecto 401
Flow	Flow Meter	**Flow Meters With Replaceable Sensors**						
		EMCO	NA	NA	NA	NA	Unimag 4411E	
Hydrants	Hydrants	**Hydrants Shall open left, 1-1/2 Pentagon operating nut, NST hose & pumper thread, rotate 360 degrees, closed drains, epoxy on shoe in & out and 304 SS nuts & bolts below ground.**						
		American Flow Control	B-84-B (6 inch)		NA	NA	NA	NA
		Clow	Medallion 2545		NA	NA	NA	NA
		Mueller	Super Centurion 250		NA	NA	NA	NA
Joint Restraints	Ductile iron pipe MJ Restraints	**Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain ductile iron pipe to mechanical joint fittings, pipe and appurtenances.**						
		EBAA Iron Inc	Megalug Series 1100		Megalug Series 1100		Megalug Series 1100	
		Ford / Uni-Flange	UFR-1400		UFR-1400		UFR-1400	
		Sigma	OneLok Series SLD/SLDE		OneLok Series SLD/SLDE		OneLok Series SLD/SLDE	
		Smith Blair	Cam Lok Series 111		Cam Lok Series 111		Cam Lok Series 111	
		Star	Star Grip Series 3000		Star Grip Series 3000		Star Grip Series 3000	
		Tyler Union	TufGrip Series TLD		TufGrip Series TLD		TufGrip Series TLD	
	DIP Bell Joint Restraints (4"-12") (New & Existing)	**Bell Joint Restraints for Ductile Iron Pipe (4"-12") (New & Existing) - All restraints split serrated on bell and spigot ends. Pipe 16" and greater shall have restraint gaskets or locking bells. (Wastewater only for restraint of existing DIP FM)**						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390C		Uni-Flange Series 1390C		Uni-Flange Series 1390C	
		Sigma	PV-Lok Series PWP-C		PV-Lok Series PWP-C		PV-Lok Series PWP-C	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	StarGrip Series 3100S		StarGrip Series 3100S		StarGrip Series 3100S	
		Tyler Union	TufGrip-Series 300C		TufGrip-Series 300C		TufGrip-Series 300C	
	DIP Bell Joint Restraints (16" & Greater)	**Ductile Iron Pipe Bell Joint Restraints for Ductile Iron Pipe (16" & Greater) - All restraints shall have a split back-up ring for the bell and a serrated or wedge action gland for the spigot end. New installation for water & reclaimed water piping 16" and greater shall have restraint gaskets or locking bells.**						
		EBAA Iron Inc	Series 1100HD	Existing Only	Series 1100HD	Existing Only	Series 1100HD	Existing Only
		Sigma	Series SSLDH	Existing Only	Series SSLDH	Existing Only	Series SSLDH	Existing Only
		Star	Series 3100S	Existing Only	Series 3100S	Existing Only	Series 3100S	Existing Only

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Joint Restraints	Ductile iron pipe Bell Joint Restraint Gaskets and Locking Bell (4" & Above)	**Bell Joint Restraint Gaskets and Locking Bell (4" & Above) Stainless Steel locking wedges built into the gasket-rubber. ANSI/AWWA C111/A21.11 Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe. Ductile Iron Bell Joint Restraint for Push-On Pipe- Locking bell joint system that prevents joint separation and allows for joint deflection. Bells shall be painted red to verify restrained gasket.**						
		American	Fast Grip Gasket	Gasket	Fast Grip Gasket	Gasket	NA	NA
			Flex-Ring Joint	Bell Lock	Flex-Ring Joint	Bell Lock	NA	NA
			Lok-Ring Joint	Bell Lock	Lok-Ring Joint	Bell Lock	NA	NA
		Griffin	Talon RJ Gasket	Gasket	Talon RJ Gasket	Gasket	NA	NA
			Snap-Lok	Bell Lock	Snap-Lok	Bell Lock	NA	NA
		McWane Inc. DI Pipe Group	Sure Stop 350 Gasket	Gasket	Sure Stop 350 Gasket	Gasket	NA	NA
			Thrust-Lock	Bell Lock	Thrust-Lock	Bell Lock	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			Super-Lock	Bell Lock	Super-Lock	Bell Lock	NA	NA
		US Pipe	Field Lok 350 Gasket	Gasket	Field Lok 350 Gasket	Gasket	NA	NA
			Field Lok Gasket	Gasket	Field Lok Gasket	Gasket	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			HP Lok Restraint Joint	Bell Lock	HP Lok Restraint Joint	Bell Lock	NA	NA
	SS to DIP Transition Restraint	**SS to DIP Transition Restraint -Flanged stainless steel pipe from Wetwell to Valve box restrained joint transition (epoxy coated, SS hardware) Flg x PE RJ.**						
		EBAA Iron Inc	NA	NA	NA	NA	Megaflange 2100	
		Sigma	NA	NA	NA	NA	SigmaFlange with One Lock SLDE	
		Smith Blair	NA	NA	NA	NA	911 Flange - Lock Restrained FCA	
	PVC Pipe MJ Restraints	**Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain PVC pipe to mechanical joint fittings, and appurtenances.**						
		EBAA Iron Inc	Mega-lug Series 2000PV		Mega-lug Series 2000PV		Mega-lug Series 2000PV	
			NA	NA	NA	NA	Megalug Series 2200	(42"-48")
		Ford / Uni-Flange	UFR 1500 Series		UFR 1500 Series		UFR 1500 Series	
		Sigma	One Lok Series SLC/SLCE		One Lok Series SLC/SLCE		One Lok Series SLC/SLCE	
		Smith Blair	Cam Lok Series 120		Cam Lok Series 120		Cam Lok Series 120	
		Star	Star Grip Series 4000		Star Grip Series 4000		Star Grip Series 4000	
		Tyler Union	TufGrip Series TLP		TufGrip Series TLP		TufGrip Series TLP	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	**PVC Bell Joint Restraints: PVC pipe Split Serrated on Bell End and Spigot End. (4" - 12") (New & Existing)**						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390		Uni-Flange Series 1390		Uni-Flange Series 1390	
		Sigma	PV-Lok Series PWP		PV-Lok Series PWP		PV-Lok Series PWP	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	Series 1100C		Series 1100C		Series 1100C	
		Tyler Union	TufGrip 300C		TufGrip 300C		TufGrip 300C	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Joint Restraints	PVC Bell Joint Restraints (16" & Greater)	**PVC Bell Joint Restraints: (16" & Greater) PVC pipe Split Serrated on Bell End and Spigot End. Water & Reclaimed Water Existing pipe only. Wastewater shall be new and existing pipe.**						
		Ford / Uni-Flange	Series 1390	Existing Only	Series 1390	Existing Only	Series 1390	
		JCM	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	
		Sigma	PV-Lok PWP	Existing Only	PV-Lok PWP	Existing Only	PV-Lok PWP	
		Smith Blair	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	
		Star	Series 1100C	Existing Only	Series 1100C	Existing Only	Series 1100C	
Pipe	PVC C900 DR 18 Bell & Spigot (4" - 12")	**C900 Bell & Spigot PVC Pipe: 4 to 12-inch - AWWA C-900, Minimum DR18 for Water, Reclaimed and Wastewater. DR14 for Fire Lines. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed 4" to 12"	Certa-Lok C900/RJ	Blue	Certa-Lok C900/RJ	Pantone Purple	Certa-Lok C900/RJ	Green
		Diamond Plastics Corp	C-900	Blue	C-900	Pantone Purple	Diamond C900	Green
		Ipex Inc	C-900 Blue Brute	Blue	C-900	Pantone Purple	C900 Blue Brute	Green
		JM Eagle	C-900	Blue	C-900	Pantone Purple	C-900	Green
		National Pipe & Plastics Inc	C-900 Dura- Blue	Blue	C-900	Pantone Purple	C-900 Pipe	Green
		North American Pipe Corp (NAPCO)	C-900	Blue	C-900	Pantone Purple	C-900	Green
		Sanderson Pipe Corp	C-900	Blue	C-900	Pantone Purple	C-900	Green
	PVC C905 DR 18 Bell & Spigot 16" and Larger	**C905 Bell & Spigot PVC Pipe 16" and Larger: AWWA C-905, Minimum DR18 for all Force Mains up to 24". Minimum DR21/DR25 for 30" and greater. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed 16"	NA	NA	NA	NA	Certa-Lok C905/RJ	NA
		Diamond Plastics Corp	NA	NA	NA	NA	Trans-21 DR18	Green
		Ipex Inc	NA	NA	NA	NA	IPEX Centurion	Green
		JM Eagle	NA	NA	NA	NA	C905 Big Blue	Green
		National Pipe & Plastics Inc	NA	NA	NA	NA	C905	Green
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	C905 Big Blue	Green
	HDPE C906 DR11	**HDPE Pipe DR11 AWWA C906 shall be Ductile Iron Pipe Size, PE 3408/3608/4710 DIPS manufactured in accordance with ASTM F-714 and listed with NSF. Pipe shall be marked in accordance with either AWWA C901,AWWA C906. Compression type connections are not acceptable in new installations. Pipe joints shall be butt fusion or electro-fusion with flange or adapter. All HDPE shall be color coded to the Utility. Color identifications are in accordance with the APWA/ULCC Uniform Color Code. Manufacturers shall be members in good standing with PPI to maintain approval status.**						
		JM Eagle	HDPE	DR11 Blue	HDPE	DR11 Pantone	HDPE	DR11Green
		Performance Pipe(Chevron)	Driscoplex 4000	DR11 Blue	Driscoplex 4000	DR11 Pantone	Driscoplex 4300	DR11 Green
		PolyPipe, Inc.	EHMW Poly Pipe	DR11 Blue	EHMW	DR11 Pantone	EHMW	DR11Green

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pipe	Ductile Iron Pipe	**Ductile iron/Cast iron: (4" to 12" = Class 350, 16" to 24" - Class 250, 30" to 64" = Class 200). Water and Reclaimed water shall be cement lined. Wastewater Piping shall be Protecto 401 and Holiday Free. Exterior coatings as specified. Wastewater DIP piping shall be for pump station piping only. Manufacturers shall be members in good standing with DIPRA to maintain approval status.**						
		American	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		Griffin	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		McWane Inc. DI Pipe Group	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		US Pipe	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
Sample	Sample Station	**Sample Stations - Bacteriological Sample Station with built in flush system, all internal piping to be 2", brass and includes lockable green enclosures.**						
		Safety-Guard	SG-BSS-05 pedestal #77	green enclosure	NA	NA	NA	NA
		Water Plus Corp	Model 5000	green	NA	NA	NA	NA
Services	Brass Service Saddles	**Brass Service Saddles for 1" & 2" water & reclaimed water services on 4" through 12" Mains - Service saddles can be hinge or bolt controlled OD saddles to be used on C-900 and existing IPS OD PVC pipe.**						
		Ford	Series S-70, S-90	4"-12"	Series S-70, S-90	4"-12"	NA	NA
		AY McDonald	Model 3891 / 3895,3801 / 3805	4"-12"	Model 3891 / 3895,3801 / 3805	4"-12"	NA	NA
		Mueller	Series S-13000/H-13000	4"-12"	Series S-13000/H-13000	4"-12"	NA	NA
	Service Saddles	**Service Saddles for 1" (CC) & 2" (Iron pipe threads) Water & Reclaimed Water services on mains greater than 12". Service saddles for 2" taps (iron pipe threads) on 4" mains and greater for Waste Water. : Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on C-900 / C905 or DI for all 1-in and -2in taps on pipes over 12in.**						
		Ford	Series FC202	16" & greater	Series FC202	16" & greater	Series FC202	4" & greater
		JCM	Series 406	16" & greater	Series 406	16" & greater	Series 406	4" & greater
		Mueller	DR2S	16" & greater	DR2S	16" & greater	DR2S	4" & greater
		Romac	Series 202NS	16" & greater	Series 202NS	16" & greater	Series 202NS	4" & greater
		Smith Blair	Series 317	16" & greater	Series 317	16" & greater	Series 317	4" & greater
	Service Saddles for HDPE	**Service Saddles for 1" (CC) & 2" (Iron Pipe threads) Water and Reclaimed Water Services: Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on HDPE for all 1-in and -2in taps. Taps to HDPE pipe shall be approved on a case by case basis.**						
		Ford	Series FCP202		Series FCP202		Series FCP202	
		Romac	Series 202N-H		Series 202N-H		Series 202N-H	
		Smith Blair	Series 317-1 for HDPE		Series 317-1 for HDPE		Series 317-1 for HDPE	
	Corporation Stops Ball Type	**Corporation Stops Ball Type (1-inch with AWWA taper C threads only/pack joint outlet for CTS) 2" Corporation Stop Ball Type shall be 2" MIP X FIP threads.**						
		Ford	FB1000, FB1700-7		FB1000, FB1700-7		FB1700-7	2" ARV
		AY McDonald	4701B-22, 3149B2		4701B-22, 3149B2		3149B2	2" ARV
		Mueller	P25008, B-20046		P25008, B-20046		B-20046	2" ARV

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Services	Curb Stops	**Curb Stops - Straight Valves: Ball type compression 2" cts O.D. tubing by 2" FIP**						
		Ford	B41-777W		B41-777W		NA	NA
		AY McDonald	6102W-22		6102W-22		NA	NA
		Mueller	P25172		P25172		NA	NA
	Curb Stops	**Curb Stops - Straight Valves: ball type compression x compression**						
		Ford	B44-444W		B44-444W		NA	NA
		AY McDonald	6100W-22		6100W-22		NA	NA
		Mueller	P25146		P25146		NA	NA
	PE tubing	**Polyethylene tubing: AWWA C901. UV protection (SDR-9) 1-inch and 2-inch only. PE 3408 / PE 4710**						
		Charter Plastics	Blue Ice		Lav Ice		NA	NA
		Endot	Endopure Blue		Endocore Lavender		NA	NA
		JM Eagle	Pure-Core		NA	NA	NA	NA
Tapping Sleeves and Valves	Line Stops	**Line Stops**						
		JCM						
		Romac						
		Smith Blair						
	Tapping Sleeves	**Tapping Sleeves: (Mechanical joint for taps on cast iron, ductile iron, PVC & AC pipe, including size on size) with stainless steel nuts and bolts.**						
		American Flow Control	Series 2800		Series 2800		Series 2800	
			Series 1004		Series 1004		Series 1004	
		Clow	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC
			Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	Series F-5207	A/C Pipe
		JCM	Series 414	FBE	Series 414	FBE	Series 414	FBE
		Mueller	Series H-615	DIP/PVC	Series H-615	DIP/PVC	Series H-615	DIP/PVC
			Series H-619	A/C Pipe	Series H-619	A/C Pipe	Series H-619	A/C Pipe
		Smith Blair	Style 623	FBE	Style 623	FBE	Style 623	FBE
	Tapping Valves: 12" and smaller	**Tapping Valves: 12" and smaller - Tapping Valves shall be furnished with an alignment lip and installed in the vertical position for Water and Reclaim Water. Wastewater shall be installed horizontally and abandoned in the open position. Tapping valves shall be resilient seated only and meet the requirements of AWWA C509 or C515**						
		American Flow Control	Series 2500	Alignment Lip	Series 2500	Alignment Lip	Series 2500	Alignment Lip
		Clow	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip
		Mueller	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Tapping Sleeves and Valves	Tapping Valves: 16" and Larger	**Tapping Valves: 16" and Larger - Tapping valves shall be furnished with an alignment lip and be installed in the vertical position for Water and Reclaimed Water. No tapping valve shall be installed horizontally for Water and Reclaim Water unless approved by the engineer. Tapping Valves 16" and larger AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a spur gear actuator unless noted by the engineer. All tapping valves above 24" shall be furnished with NPT pipe plugs for flushing the tracks when valves are installed horizontally. Tapping valves for Wastewater shall be installed horizontally and abandoned in open position.**						
		American Flow Control	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port
		Clow	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port
		Mueller	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port
Valves	Butterfly Valve 42" and Above	**Butterfly Valves 42"and above. AWWA C504. Actuators input torques based on 150 psi valve pressure and 16 fps velocity with a maximum input of 80 ft-lb on 2" nuts and shall withstand 250 ft-lbs. Valve seats shall be leak-tight in both directions at 150 psi.**						
		Clow	Style #1450		Style #1450		NA	NA
		Dezurik	BAW		BAW		NA	NA
		Mueller / Pratt	LINSEAL III / Groundhog		LINSEAL III / Groundhog		NA	NA
	Check Valves	**Valves (Check) 4-inch and Larger (8 mil epoxy lined)**						
		American Flow Control	NA		NA		Series 600 or 50 line	
		Clow / M&H / Kennedy	NA		NA		106	
		Mueller	NA		NA		Series 2600	
	Gate Valves 4" - 12"	**Gate Valves 12" and smaller - resilient seated only AWWA C509 or C515. Valve seat shall be leak-tight in both directions at 150 psi.**						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2360		Series A-2360		NA	NA
	Gate Valves (Vertical) 16" and Up	**Gate Valves 16" and larger (Vertical Installation) AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a gear actuator unless noted by the engineer. Valve seat shall be leak-tight in both directions at 150 psi.**						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100			
		Mueller	Series A-2361		Series A-2361		NA	NA

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Valves	Plug Valves	**Plug Valves - Bi-directional, MJ & Flanged (min. 8mil fusion bonded epoxy with stainless steel bolts), gear operator to be sized for rated pressure of the valve. Valves 4"-20" shall be 80% Full Port and valves 24" and greater shall be minimum of 70% full port. Valve shall be factory tested to minimium 100 PSI in both directions.**						
		Clow	NA	NA	NA	NA	F-5412 FLG	4" & up
			NA	NA	NA	NA	F-5413 MJ	4" & up
		Dezurik	NA	NA	NA	NA	Series PEF or PEC	4"& up
		Millikan / Pratt	NA	NA	NA	NA	Eccentric / Ballcentric	4"& up
		Val-Matic	NA	NA	NA	NA	5600 or 5800 (FLG)	4" & up
			NA	NA	NA	NA	5700 or 5900 (MJ)	4" & up
Valve Boxes	Valve Boxes with Locking Lids (Cast Iron)	**Two piece standard screw type Heavy Duty Valve Boxes with Locking Lids (Cast Iron) and type of service cast in heavy duty traffic lid (H20 loading) ASTM A48**						
		Bingham/Taylor	Series 4905	Box	NA	NA	Series 4905	Box
			4905-X	Extension	NA	NA	4905-X	Extension
			4904-L	Blue Water Locking Lid	NA	NA	4904-L	Green Sewer locking Lid
		Sigma	Series VB 261X-267X	Box	VB-25031LK-VB-2612	Box	Series VB 261X-267X	Box
			VB 6302	Extension	VB-6302	Extension	VB 6302	Extension
			VB 4650W	Blue Water Locking Lid	VB2503LK	Purple Square Locking Lid	VB 4650S	Green Sewer locking Lid
		Star	Series VB-0002	Box	NA	NA	Series VB-0002	Box
			VBEX 12-24S	Extension	NA	NA	VBEX 12-24S	Extension
			VBLIDLOCK	Blue Water Locking Lid	NA	NA	VBLIDLOCK	Green Sewer locking Lid
		Tyler Union	Series 6850	Box	NA	NA	Series 6850	Box
			58, 59, 60	Extension	NA	NA	58, 59, 60	Extension
			Locking Lid	Blue Water Locking Lid	NA	NA	Locking Lid	Green Sewer locking Lid
	Valve Box	**For mains equal to, or greater than, 16" diameter or equal to greater than 6' feet deep**						
		American Flow Control	# 2A - 9A Retrofit Valve Box Insert	Fit inside std valve boxes	NA		2A - 9A Retrofit Valve Box Insert	Green Sewer locking Lid
		Mueller Company	MVB050C thru MVB130C with Extension Stem MVB875 Guide Plate	Blue Water Locking Lid	MVB050CR thru MVB130CR with Extension Stem MVB875 Guide Plate	Purple Square Locking Reclaim Lid	MVB050C thru MVB130C with Extension Stem MVB875 Guide Plate	Green Sewer locking Lid

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Coatings	Anti-Graffiti Paint	**Block Walls-Anti-Graffiti Paint per Section 3119 Coatings & Linings**						
		American Building Restoration Products	NA	NA	NA	NA	Polyshield Graffiti Preventer for Unpainted Masonry Type B	Super Bio Strip or Strip it all
		Tnemec / Chemprobe	NA	NA	NA	NA	626 DUR A PEL	680 Mark A Way
		Professional Products of Kansas, Inc	NA	NA	NA	NA	Professional Water Seal & Anti-Graffitiant (PWS-15 Super Strength)	Professional Phase II Cleaner
	Coatings for Existing Manholes	**Rehabilitation corrosion protection system per Section 3119 Coatings & Linings. Interior coating for force main connections to existing concrete manholes only. New precast structures and existing pump stations shall be lined.**						
		CCI Spectrum, Inc	NA	NA	NA	NA	Spectrashield	min of 500 mils
		Kerneos Aluminate Technologies	NA	NA	NA	NA	Sewpercoat	1" (1000mil)
		Raven Lining System	NA	NA	NA	NA	Raven 155 Primer Raven 405	min 8 mils min 125 mils
		Sauereisen	NA	NA	NA	NA	210 Series Topcoat Glaze 210G	min 125 mils min 20 mils
		Tnemec	NA	NA	NA	NA	Series 434 Topcoat Glaze 435	min 125 mils 15-20 mils
PVC Pipe and fittings	Pipe SDR 35 Gravity Mains	**PVC Pipe for Gravity SDR26/SDR 35 (Green in color) ASTM-D034. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed	NA	NA	NA	NA	Gravity Sewer Pipe	
		Diamond Plastics Corp	NA	NA	NA	NA	Sani-21 SDR-35	
		JM Eagle	NA	NA	NA	NA	Gravity Sewer	
		National Pipe & Plastics, Inc.	NA	NA	NA	NA	Ever-Green Sewer Pipe	
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	Gravity Sewer	
		Sanderson Pipe Corp	NA	NA	NA	NA	Gravity Sewer	
	Locate Balls	**Locating Marker Systems - Wastewater Locator balls placed at all sanitary sewer cleanouts**						
		3M	NA	NA	NA	NA	3M™ EMS 4" Extended Range 5' Ball Marker 1404-XR	
	Fittings SDR 35	**Fittings, Adapters and Plugs - Gravity PVC ASTM-D3034, Min SDR26/ SDR 35**						
		GPK Products, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Harrington Corporation (HARCO)	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Multi Fittings Corp.	NA	NA	NA	NA	SDR26/SDR 35 Trench Tough Sewer Fittings	
		JM Eagle	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Plastic Trends Inc	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		TIGRE USA, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
PVC Pipe a	Flexible Pipe Connectors	**Flexible Pipe Connectors and Transitions**						
		Fernco	NA	NA	NA	NA	1002, 1051, 1056 Series	
		Indiana Seal	NA	NA	NA	NA	102, 151, 156 Series	
		Mission Rubber	NA	NA	NA	NA	MR02, MR51, MR 56 Series	
Precast Concrete Structures	MH Lids	**Frame and Cover**						
		USF Fabrication Inc.	NA	NA	NA	NA	USF 225-AS	
	Adj Ring	**Top Adjusting Rings - HDPE with heavy duty loading (H-20)**						
		Ladtech, Inc	NA	NA	NA	NA	24R, 24S with Rope Sealant CS2455	
	Hatches	**Wet Well and Valve Vault Access Frames and Covers (Include the term "Confined Space" etched or cast into the cover with recessed lock & hasp. Frames and covers per manufacturers specifications.**						
		Halliday Products	NA	NA	NA	NA	S1R or S2R Series	
		USF Fabrication Inc.	NA	NA	NA	NA	APS or APD Series	
	Precast Concrete Structures	**Precast Manhole and Wetwell Structures ASTM C478. Precast concrete shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Concrete without admixture or without color tint /tracer shall be rejected.**						
		Allied Precast	NA	NA	NA	NA	Dyed Admix	
		Atlantic Concrete Products, Inc.	NA	NA	NA	NA	Dyed Admix	
		Delzotto Products, Inc.	NA	NA	NA	NA	Dyed Admix	
		Dura Stress Underground Inc.	NA	NA	NA	NA	Dyed Admix	
		Hanson Pipe & Product	NA	NA	NA	NA	Dyed Admix	
		Mack Concrete	NA	NA	NA	NA	Dyed Admix	
		Oldcastle Precast	NA	NA	NA	NA	Dyed Admix	
		Standard Precast Inc.	NA	NA	NA	NA	Dyed Admix	
	Concrete Admix	**Crystalline Waterproofing Concrete Admix with color dye shall be added to all concrete structures (precast and cast-in-place) to provide waterproofing and corrosion resistance. Concrete without admixture or without color tint / tracer shall be rejected. % concentration of admix with colored dye added to the mix shall be based on weight of cement.**						
		Kryton International	NA	NA	NA	NA	KIM K-301R (with red dye)	2%
		Xypex Chemical Corp	NA	NA	NA	NA	Xypex Admix C-1000Red (with red dye)	3.0 - 3.5%
	Liners	**Interior Liner for New or existing Precast Manhole and Precast Wetwell Structures per Section 3119 Coatings & Linings**						
		AFE	NA	NA	NA	NA	Fiberglass Liner	
		AGRU Liner	NA	NA	NA	NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)	
		Containment Solutions Inc. (Flowtite)	NA	NA	NA	NA	Fiberglass Liner	
		GSE Studliner	NA	NA	NA	NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)	
		GU Liner	NA	NA	NA	NA	Reinforced Plastic Liner	
		L & F Manufacturing	NA	NA	NA	NA	Fiberglass Liner	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Precast Concrete Structures	Heat Shrink Seal	**Heat Shrink Seal - Precast structures shall be primed with manufacturer approved primer prior to application of heat shrunk encapsulation.**						
		Canusa-CPS	NA	NA	NA	NA	Wrapid Seal with WrapidSeal Primer (Canusa G Primer)	
		Pipeline Seal & Insulator, Inc (PSI)	NA	NA	NA	NA	Riser Wrap with Polyken 1027 or 1039 primer	
	Jointing Material	**Jointing Material Min. 2" width for all products to ensure squeeze out with manufacturer approved primer.**						
		Henry Company	NA	NA	NA	NA	Ram-Nek	with Primer
		Martin Asphalt Company	NA	NA	NA	NA	Evergrip 990	with Primer
		Trelleborg Pipe Seals	NA	NA	NA	NA	NPC – Bidco C-56	with Primer
	Pipe Seals Gravity	**Resilient Connector Pipe Seals, Manhole - Gravity less than 12-inch and less than 15-ft deep**						
		Atlantic Concrete	NA	NA	NA	NA	A-Lok (cast-in-place)	
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal (cast-in-place)	
		IPS	NA	NA	NA	NA	Wedge Style	
		NPC	NA	NA	NA	NA	Kor-N-Seal Model WS	
		Press seal gasket	NA	NA	NA	NA	PSX Direct Drive	
	Pipe Seals Gravity	**Cast in Place Pipe Seals, Manhole - Gravity Greater Than or Equal to 12-inch and all pipe sizes greater than 15-ft deep**						
		Atlantic Concrete	NA	NA	NA	NA	A-Lok	cast in place
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal	cast in place
	FM Pipe Seals	**Modular Pipe Seals for Wet Well and Valve Box penetrations and all forcemain connections to existing and new precast concrete structures. EPDM Rubber with 316 SS Hardware**						
		CCI Pipeline Systems	NA	NA	NA	NA	Wrap-It Link WL-SS Series	
		Pipeline Seal & Insulator, Inc / Link Seal	NA	NA	NA	NA	Link-Seal S-316 Modular Seal	
		Proco Products, Inc	NA	NA	NA	NA	PenSeal ES-PS Series	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Generator	Gen	**Generator Systems, Fixed Shall be UL 2200 Certified.**						
		Caterpillar	NA	NA	NA	NA	CAT Diesel Generator Set	
		Cummins Power Generation	NA	NA	NA	NA	Diesel Generator Set	
	Fuel Tanks	**Generator Fuel Tanks. Shall be UL2085 certified.**						
		Convault	NA	NA	NA	NA	CVT-3SF or CVT-3FF	
		Phoenix	NA	NA	NA	NA	Envirovault	
	GR	**Generator Receptacle (GR)**						
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042 (230V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042-S22 (460V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Pyle National	NA	NA	NA	NA	JRE-4100 (230V, 100A, 3P, 4W)	
	ATS	**Generator Transfer Switch**						
		Russelectric	NA	NA	NA	NA	RMTD Series with model 2000 controller	NEMA 12/3R 316SS Enclosure
Odor Control Units	Biotrickling Filters	**Biotrickling filters**						
		BioAir	NA	NA	NA	NA		
		Biorem	NA	NA	NA	NA	Biosorbens BTF	
		Envirogen	NA	NA	NA	NA	BTF	
		Siemens	NA	NA	NA	NA	Zabocs BTF	
	Carbon Adsorption Units	**Carbon Adsorption Units**						
		Calgon	NA	NA	NA	NA		
		Pure Air Filtration	NA	NA	NA	NA		
		Siemens	NA	NA	NA	NA		
Pressure Gauges	Pressure Gauges	**Pressure Gauges shall have Diaphragm Seals. Oil filled.**						
		Ashcroft	NA	NA	NA	NA	10 1008SL 02L 60# 25 200SS 02T XYTSE	Gauge Diaphragm Seal
		Trerice	NA	NA	NA	NA	D83LFSS4002LA100 - Gauge M51001SSSS - Diaphragm Seal D99100 Fill and Mount Charge	
		Winter Gauges	NA	NA	NA	NA	PFQ770 0-60 PSI D70950 top D70954 Bottom	
Pumps	Pumps	**Submersible Pumps**						
		ABS	NA	NA	NA	NA		
		Flygt	NA	NA	NA	NA		

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pumps	Floats	**Float Regulator (FR) - Duplex and Triplex Pump Stations**						
		Atlantic Scientific	NA	NA	NA	NA		Roto-Float
	Radar	**Radar - Pulse Burst Radar Transmitter. Input 24 VDC and Output 4-20 mA**						
		Magnetrol	NA	NA	NA	NA		R82-520A-011
Pump Station Main Ser	Main Srvc Disconne	**Main Service Disconnect Breaker**						
		Square D	NA	NA	NA	NA		H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)
	Surge Protector Device	**Surge Protector - UL 1449, 3rd Edition listed and labeled, minimum 10 year warranty, NEMA LS-1 and IEEEC62, 41/45 tested with NEMA 4X enclosure, internal fusing, voltage and phase to match service. Rated 80,000 amps per mode for Duplex & Triplex stations and 150,000 Amperes per mode for Master Stations. All devices shall be provided with a NEMA 4X Plastic enclosure which is approved in lieu of stainless steel.**						
		Current Technology (Power & Systems	NA	NA	NA	NA		XN-80, TG-150 or CurrentGuard 150 Plus Series
		Josyln AKA (Total Protection Solutions)	NA	NA	NA	NA		TSS-ST 160 Series, ST 300 Series or JSP-300 Series
		Surge Suppressors, Inc	NA	NA	NA	NA		LSE Series or SHL Series
Sub Panel	Sub Panel	**Sub-Panel Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated-finish inside and out, With 3 Point Pad lockable Handle, and Door Stop**						
		Hoffman	NA	NA	NA	NA		
		Schaefer	NA	NA	NA	NA		
		Universal enclosure systems	NA	NA	NA	NA		
Pump Station Control Panel	Control Panel	**Control Panel Supplier**						
		ECS	NA	NA	NA	NA		
		Sta-Con Inc	NA	NA	NA	NA		
	Enclosure	**Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated finish inside and out, With 3 Point Pad lockable Handle, and Door Stop**						
		Hoffman	NA	NA	NA	NA		
		Schaefer	NA	NA	NA	NA		
		Universal enclosure systems	NA	NA	NA	NA		
	Mnts	**Mounting Channel for Enclosures**						
		Unistrut Stainless Steel	NA	NA	NA	NA		1" 5/8 x 1" 5/8 316 SS
	Seal-off	**Explosion-Proof Sealoff**						
		Cooper Crouse-Hinds	NA	NA	NA	NA		EYSR - 2 Inch Min.
	FL	**Flasher (FL)**						
		MPE	NA	NA	NA	NA		025-120-105
		SSAC	NA	NA	NA	NA		FS-126

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	AL	**Alarm Light / With Base and Globe (AL)**						
		American Electric	NA	NA	NA	NA	F32552	
		Red Dot Globe Red Dot Base	NA	NA	NA	NA	VGLR-01 VA-01	
	AH	**Alarm Horn (AH)**						
		Wheelock	NA	NA	NA	NA	3IT-115-R	
	Fuse	**Fuses (F)**						
		Bussmann	NA	NA	NA	NA	FNQ-R or KTK-R	
	HOA	**Hand-Auto-Off Selector (HOA)**						
		Square D	NA	NA	NA	NA	9001-SKS43B	
	HSS	**Horn Silence Button (HSS)**						
		Square D	NA	NA	NA	NA	9001-SKR1RH5	
	Inter-lock	**Mechanical Interlock**						
		Square D	NA	NA	NA	NA	S29354	
	Breakers	**Control Panel Main Circuit Breaker (MCB) With S29450 Circuit Breaker Auxiliary Switch**						
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Emergency Circuit Breaker (ECB) With S29450 Circuit Breaker Auxiliary Switch						
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Motor Circuit Breaker (MB)						
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Control Circuit Breaker/ GFCI Receptacle Breaker/ SCADA Breaker						
		Square D	NA	NA	NA	NA	QOU120	
	MS	**Motor Starter (MS)**						
		Square D	NA	NA	NA	NA	Type S Class 8536	
	OL	**Overload Heater(OL)**						
		Square D	NA	NA	NA	NA	Part number will vary with size needed	
	OR	**Overload Reset**						
		Square D	NA	NA	NA	NA	9066-RA1	
	Transformer	**Control Circuit Transformer (XMFR)**						
		Square D	NA	NA	NA	NA	9070TF75D23	120/24 Volt .075 KVA
		Main Circuit Transformer (MCT)						
		Square D	NA	NA	NA	NA	9070T2000D1	480/120 2KVA
	SPB	**Supplemental Protector Breaker - 3 pole, 1-amp for Phase Monitor**						
		Square D	NA	NA	NA	NA	MG24532	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	PM	**Phase Monitor (PM)**						
		MPE 240 V.	NA	NA	NA	NA	001-230-118-OVG5	
		MPE 480 V.	NA	NA	NA	NA	002-480-123-OVG5	
	Pump Alternator	**Pump Automatic Alternator (PAA)**						
		Diversified Duplex	NA	NA	NA	NA	ARA-120-ACA	
		Diversified Triplex	NA	NA	NA	NA	ARA-120-AME	
		MPE Duplex	NA	NA	NA	NA	008-120-13SP	
		MPE Triplex	NA	NA	NA	NA	009-120-23P	
		MPE Triplex Socket	NA	NA	NA	NA	SD-12-PC	
	Alt. Test Switch	**Alt. Test Switch**						
		Carling Technologies	NA	NA	NA	NA	6GG5E-78	
		Honeywell	NA	NA	NA	NA	2TL1-50	
	Relay	**Relay**						
		Potter Brumfield 24 Volt	NA	NA	NA	NA	KRPA-11AN-24	
		Potter Brumfield 120 Volt	NA	NA	NA	NA	KRPA-11AN-120	
		Square D 24 Volt	NA	NA	NA	NA	8501KP12P14V14	
		Square D 120Volt	NA	NA	NA	NA	8501KP12P14V20	
	Relay Base	**Relay Base**						
		IEDC 8 Pin Relay Base 600 Volt	NA	NA	NA	NA	SR2P-06	
	Duplex Receptacle / GFCI	**Duplex Receptacle/GFCI (DR) Upgraded to 20 Amp**						
		Hubbell	NA	NA	NA	NA	GFTR20BK	
		Pass & Seymour	NA	NA	NA	NA	2095TRBK	
	ETM	**Elapse Time Meter (ETM)**						
		Reddington	NA	NA	NA	NA	711-0160	
	Grounding	**Grounding System**						
		Marathon	NA	NA	NA	NA	Neutral Isolation Block 1421570	
		Panduit	NA	NA	NA	NA	Ground Lug LAM2A 1/0 - 014 -6Y	
		Square D	NA	NA	NA	NA	Ground Buss PK7GTA	
	TS	**Terminal Strip (TS)**						
		Marathon	NA	NA	NA	NA	Series 200	
		Square D	NA	NA	NA	NA	9080GR6	
	TS	**Terminal Strip End Blocks and End Clamps**						
		Square D	NA	NA	NA	NA	9080GM6B & 9080GH10	

APPENDIX D **LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	PL	**Pilot Light (PL) 24 Volt with 1819 Bulb**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelight 930507X	
	RL	**Run Indicator Light (RL) 120 Volt**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X With 120MB Bulb	
	MT	**Moisture and Temperature Failure Light (MT) 120 Volt with 120MB Bulb**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X	
Sluice	Sluice Gate	**Sluice Gate for Wet Well with Motorized Operator**						
		BNW	NA	NA	NA	NA	Model 77 - 316 SS	
		Fontaine	NA	NA	NA	NA	Model 20 - 316 SS	
VFD	VFD	**Variable Frequency Drives**						
		Square D	NA	NA	NA	NA		