
IFB NO. Y17-727-PH

ISSUED: December 2, 2016

INVITATION FOR BIDS

FOR

**WESTERN SERVICE AREA MECHANICAL AND ELECTRICAL IMPROVMENTS
(OAK MEADOWS WSF, WESTERN REGIONAL WATER SUPPLY FACILITY (WSF)
AND BENT OAK STORAGE AND REPUMP FACILITY)**

**TECHNICAL SPECIFICATIONS
PART H**

PART H Volume II

**WESTERN WATER SUPPLY FACILITIES
MISCELLANEOUS IMPROVEMENTS
TECHNICAL SPECIFICATIONS**

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PROJECT MANUAL

FOR THE

**WESTERN WATER SUPPLY FACILITIES
MISCELLANEOUS IMPROVEMENTS**

TECHNICAL SPECIFICATIONS

Prepared For:



Prepared By:

**BFA Environmental Consultants
1230 Hillcrest Street
Orlando, Florida 32803**

**November 2016
100% Submittal**

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SECTION 01001
GENERAL WORK REQUIREMENTS

PART 1 - GENERAL

1.01 NOTICE AND SERVICE

- A. In conformance with the requirements of Notice and Service of the General Conditions, all notices or other papers required to be delivered by the Contractor to the County shall be delivered to the office of the Engineering Division, Orange County Utilities Department, 9150 Curry Ford Road, Orlando, FL 32825.

1.02 WORK TO BE DONE

- A. The Contractor shall furnish all labor, materials, equipment, tools, services, and incidentals to complete all work required by these specifications and as shown on the Drawings, at a rate of progress that will ensure completion of the Work within the Contract Time stipulated.
- B. All materials, equipment, skills, tools, and labor that are 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 Specifications or Drawings shall be furnished and installed by the Contractor without additional compensation, whether specifically indicated in the Contract Documents or not.
- C. The Contractor shall perform the Work complete, in place, and ready for continuous service, and shall include repairs, testing, permits, clean up, replacements, and restoration required as a result of damages caused during this construction.
- D. The Contractor shall comply with all City, County, State, Federal, and other codes that are applicable to the proposed construction Work.
- E. All newly constructed Work shall be carefully protected from injury in any way. No wheeling, walking, or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his or her own expense.
- F. Scope of Work: See Section 01010 "Summary of Work" and the Bid Schedule for details.

1.03 DRAWINGS AND PROJECT MANUAL

- A. The Work shall be performed in accordance with the Drawings and Specifications prepared by the County/Professional. All work and materials shall conform to the Orange County Utilities Standards and Construction Specifications Manual, latest edition or as indicated in these Specifications or Drawings.
- B. The Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, Schedules, Specifications, or other data received from the County/Professional, and shall notify same, in writing, 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 or her own expense.

C. All schedules are given for the convenience of the County 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 quantity of materials and equipment included in the Work to be done under this Contract.

D. 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 either in 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. Items of material, equipment, machinery, and the like may be specified on the Drawings and not in the Specifications. Such items shall be provided by the Contractor in accordance with the specification on the Drawings.
3. 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.

E. When obtaining data and information from the Drawings, conflicts, errors, and discrepancies shall be resolved from the documents given the following order of precedence:

1. Agreement
2. Change Orders
3. Addenda
4. Supplementary Conditions
5. Instructions to Bidders
6. General Conditions
7. Specifications (Divisions. 1 through 16)
8. Drawings
9. Dimensions: when measurements are affected by conditions already established or where items are to be fitted into constructed conditions, it shall be the Contractor's responsibility to verify all such dimensions at the site and the actual job dimensions shall take precedence over scale and figure dimensions on the Drawings.
10. Full-size Drawing
11. Large-scale Drawing
12. Small-scale Drawing
13. Advertisement for Bids
14. Bid
15. Bonds
16. Insurance Certificates
17. Insurance Endorsements

18. Affidavits

1.04 PROTECTION AND RESTORATION

- A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every means of protection 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 or her expense, to a condition similar or equal to that existing before the damage was done, or s/he shall make good the damage in other manner acceptable to the County/Professional.
- B. Protection of Trees and Shrubs:
 - 1. Protect with boxes or other barricades.
 - 2. Do not place excavated material so as to injure trees or shrubs.
 - 3. Install pipelines in short tunnels between and under root systems.
 - 4. Support trees to prevent root disturbance during nearby excavation.
- C. Tree and Limb Removal:
 - 1. Tree limbs, which interfere with equipment operation and are approved for pruning, shall be neatly trimmed and the tree cut coated with tree paint.
 - 2. The County may order the Contractor, for the convenience of the County, to remove trees along the line or trench excavation. The Contractor shall obtain any permits required for removal of trees. Ordered tree removal shall be paid for under the appropriate Contract Items.
- D. Trees or shrubs destroyed by negligence of the Contractor or Contractor's employees shall be replaced by the Contractor with new stock of similar size and age, at the proper season and at his or her sole expense.
- E. Lawn Areas: All lawn areas disturbed by construction shall be replaced with like kind to a condition similar or equal to that existing before construction. Where sod is to be removed, it shall be carefully removed, and the same re-sodded, or the area where sod has been removed shall be restored with new sod in the manner described in the applicable section.
- F. Fences: 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.
- G. Where fencing, walls, shrubbery, grass strips or area must be removed or destroyed incident to the construction operation, the Contractor shall, after completion of the Work, replace or restore to the original condition all such destroyed or damaged landscaping and improvements.
- H. The cost of all labor, materials, equipment, and work for restoration 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.

1.05 PUBLIC NUISANCE

- A. The Contractor shall not create a public nuisance including, but not limited to, encroachment on adjacent lands, flooding of adjacent lands, or excessive noise.
- B. Sound levels measured by the County/Professional shall not exceed 45 dBA from 8 p.m. to 8 a.m. or 55 dBA 8 a.m. to 8 p.m. This sound level shall be measured at the exterior of the nearest exterior wall of the nearest residence. Levels at the 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 levels. Work stoppage by the County/Professional 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.
- C. No extra charge may be made for time lost due to work stoppage resulting from the creation of a public nuisance.

1.06 CONTRACTOR'S PAYMENTS TO COUNTY FOR OVERTIME WORK

- A. County Inspector Work Hours: Normal work hours for the County's inspector(s) are defined as any 10-hour period between the hours of 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday. Any County Inspector(s) work beyond the aforementioned normal work hours shall be requested in writing 48-hours in advance. All overtime and weekend work compensation to the County's Inspector(s) for working beyond the normal working hours are considered overtime compensation and shall be paid for by the Contractor at the overtime pay rate of \$50.00 per hour. This overtime pay rate is subject to adjustment by the County. The Contractor agrees that the County shall deduct charges for work outside normal work hours and for overtime pay from payments due the Contractor.

1.07 LABOR

- A. Supervision: The Contractor shall keep the Contract under his or her own control and it shall be his or her responsibility to see that the Work is properly supervised and carried on faithfully and efficiently. The Contractor shall supervise the Work personally or shall have a competent, English-speaking superintendent or representative who shall be on the site of the Project at all working hours, and who shall have full authority by the Contractor to direct the performance of the Work and make arrangements for all necessary materials, equipment, and labor without delay.
- B. Jurisdictional Disputes: It shall be the responsibility of the Contractor to pay all costs that may be required to perform any of the Work shown on the Drawings or specified herein to avoid any work stoppages due to jurisdictional disputes. The basis for subletting work in question, if any, shall conform to precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, dated June, 1973, including any amendments thereto.
- C. Apprenticeship: The Contractor shall comply with all of the requirements of Section 446, Florida Statutes, for all contracts in excess of \$25,000 excluding roadway, highway or

bridge contracts and the Contractor agrees to insert in any subcontract under this Contract the requirements of this Article.

1.08 MATERIALS AND EQUIPMENT

A. Manufacturer:

1. All transactions with the manufacturers or Subcontractors shall be through the Contractor, unless the Contractor shall request and at the County/Professional's option, that the manufacturer or Subcontractor communicate directly with the County/Professional. Any such transactions shall not in any way release the Contractor from his or her full responsibility under this Contract.
2. All work and materials shall be of the highest quality. The equipment shall be the product of manufacturers who are experienced and skilled in the field with an established record of research and development. No equipment will be considered unless the manufacturer has designed and manufactured equipment of comparable type and size and have demonstrated sufficient experience in such design and manufacture.
3. All materials and equipment furnished by the Contractor shall be subject to the inspection, review and acceptance of the County and meet the requirements as outlined in the Orange County Utilities Standards and Construction Specifications Manual. No material shall be delivered to the Work without prior approval of the County/Professional.
4. All apparatus, mechanisms, equipment, machinery, and manufactured articles for incorporation into the Project shall be the new (most current production at time of bid) and unused standard products of recognized reputable manufacturers.
5. Manufactured and fabricated products:
 - a. Design, fabricate, and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges to be interchangeable.
 - c. 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.
 - d. Products shall be suitable for service conditions as specified and as stated by manufacturer.
 - e. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - f. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.09 MANUFACTURER'S SERVICE

- A. Where service by the manufacturer is specified to be furnished as part of the cost of the item of equipment, the Work shall be at the Contractor's expense.
- B. The services provided shall be by a qualified manufacturer's service representative to check and verify the completed installation, place the equipment in operation, and instruct the County's operators in the operation and maintenance procedures. Such

services are to be for period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the job and does not include travel time.

- C. The services shall further demonstrate to the County/Professional's complete satisfaction that the equipment will satisfactorily perform the functions for which it has been installed.

1.10 INSPECTION AND TESTING

A. General:

1. If, in the testing of any material or equipment, it is ascertained by the County/Professional that the material or equipment does not comply with the Contract, the Contractor shall be notified thereof, and s/he 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 County.
2. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEE, except as may otherwise be stated herein.

B. Cost:

1. County shall employ and pay for the 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. The cost of field leakage and pressure tests and shop tests of materials and equipment 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. Notify County employed laboratory a minimum of 48-hours, 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.
4. The Contractor shall pay for all work required to uncover, remove, replace, retest, etc.; any work not tested due to the Contractor's failure to provide the 48-hours advance notice or due to failed tests. The Contractor shall also provide compensation for the County/Professional's personnel for required re-testing due to failed or rescheduled testing.

C. Shop Testing:

1. Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function, or special requirements are specified shall be tested in the shop of the manufacturer in a manner that shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents. No such equipment shall be shipped to the worksite until the County/Professional notifies the Contractor, in writing, that the results of such tests are acceptable.
2. Five (5) copies of the manufacturer's actual shop test data and interpreted results thereof, accompanied by a certificate of authenticity notarized and signed by a responsible official of the manufacturing company, shall be furnished to the County/Professional as a prerequisite for the acceptance of any equipment. The cost of shop tests (excluding cost of County's representative) and of furnishing

manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor and shall be included in the Contract price.

3. The Contractor shall give notice in writing to the County sufficiently in advance of his or 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 County shall arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials; or s/he will notify the Contractor that the inspection will be made at a point other than the point of manufacture; or s/he will notify the Contractor that inspection will be waived.
4. When inspection is waived or when the County/Professional so requires, the Contractor shall furnish to him or her authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the Work have been manufactured and tested in conformity with the Contract Documents. These certificates shall be notarized and shall include five (5) copies of the results of physical tests and chemical analysis, where necessary, that have been made directly on the product or on similar products of the manufacturer.
5. The Contractor must comply with these provisions before shipping any material. Such inspections by the County shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Field Testing:

1. The County shall employ and pay for services of an independent testing laboratory to perform testing specifically indicated in the Contract Documents. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract. The Contractor shall provide compensation for retesting of all failed tests.
2. The County may at any time during the progress of the Work, request additional testing beyond that which is specified in the Contract. This testing will be at the County's expense. The Contractor shall assist the testing laboratory personnel in all ways so as to facilitate access to the location of the material or equipment to be tested. Contractor shall:
 - a. Cooperate with laboratory personnel, provide access to the Project.
 - b. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.
 - c. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes, which require control by the testing laboratory.
3. The following schedule summarizes the responsibilities of various tests that may be required by the Contract Documents. Contractor shall notify the County in advance of work so that arrangements can be made with the testing laboratory.

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	County
Asbestos	Environmental testing of materials	County
All Other Testing	As specified in various sections of the Project Manual	As Indicated

- E. Demonstration Tests: Upon completion of the Work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance or demonstration tests as specified or required to provide compliance with the Contract Documents. The Contractor shall furnish all labor, fuel, energy, water and all other equipment necessary for the demonstration tests at no additional cost to the County.
- F. Final Inspection: Prior to preparation of the final payment application, a final inspection will be performed by the County to determine if the Work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents. See also Section 01700 "Project Closeout."
- G. Inspection by existing utility owners: The Contractor shall pay for all inspections during the progress of the Work required and provided by the owner of all existing public utilities paralleling or crossing the Work, as shown on the Drawings. All such inspection fees 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.
- H. Inspection by Other Agencies: The Florida Department of Transportation, the Florida Department of Environmental Protection, and other authorized governmental agencies shall have free access to the site for inspecting materials and work, and the Contractor shall afford them all necessary facilities and assistance for doing so. Any instructions to the Contractor resulting from these inspections shall be given through the County. These rights of inspections shall not be construed to create any contractual relationship between the Contractor and these agencies.

1.11 PROJECT SITE AND ACCESS

- A. Right-Of-Way and Easements:
 1. The use of public streets and alleys shall be such as to provide a minimum of inconvenience to the public and to other traffic. Any earth or other excavated material spilled from trucks shall be removed by the Contractor and the streets cleaned to the satisfaction of the County.
 2. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the property owner.
 3. At the time of the Pre-Construction meetings, the Contractor shall fully acquaint himself with the status of all easements required for the Work and the possibility of parcels remaining to be acquired, if any. Should easements not be acquired by the County in specific areas of the Work, the Contractor shall sequence and reschedule his or her work therein so as not to interfere with the progress of work in other areas of the Project. Such rescheduling of work shall be performed by the Contractor at no additional cost to the County. The County agrees that it will make every effort to

acquire all remaining easements with all speed and diligence possible so as to allow the completion of the Work within the Contract time.

B. Access:

1. Neither the material excavated nor the materials or equipment used in the construction of the Work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.
2. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business access with the business Owner. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored and all construction debris removed within 48-hours of backfilling trench.
3. Contractor agrees that representatives of the County and any governmental agents will have access to the Work wherever it is in preparation or progress and that the Contractor shall provide facilities for such access and inspection.

1.12 UTILITIES

A. Utility Construction:

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes, and all other appurtenances and facilities pertaining thereto, whether owned or controlled by governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage or water. Other public or private property, which may be affected by the Work, shall be deemed included hereunder.
2. 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 or her own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workers. Bridges provided for access to private property during construction shall be removed when no longer required.
3. The length of open trench will be controlled by the particular surrounding conditions, but shall always be confined to the limits described by the County. If any excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures. As a minimum, the Contractor shall conform to the following restoration procedures:
 - a. Interim Restoration: All excavations shall be backfilled and compacted as specified by the end of each working day. For excavations within existing paved areas; limerock base or soil cement base (match existing) shall be spread and compacted to provide a relatively smooth surface free of loose aggregate material. At the end of each workweek, the S-I asphaltic surface course shall be completed and opened to traffic. Contractor shall coordinate construction activity, including density tests and inspections, to allow sufficient time to achieve this requirement. All driveway cuts shall be backfilled, compacted, and limerock base spread and compacted immediately after installation. Contractor shall coordinate with the individual property owners prior to removing the driveway section. Any utility crossing an existing roadway, parking lot or other paved area shall be patched by the end of the working day.

- b. All pipe and fittings shall be neatly stored in a location, which will cause the least disturbance to the public. All debris shall be removed and properly disposed of by the end of each working day.
- c. Final Restoration Overlay: After completing all installations, and after testing of the pipe (but no sooner than 30-days after applying the S-I asphaltic surface), final restoration shall be performed. In no event shall final restoration begin after substantial completion. Final restoration shall provide an S-III asphaltic overlay as specified in an uninterrupted continuous operation until completion. Any additional restoration required after testing shall be repaired in a timely manner at no additional cost to the County.
- d. Maintenance of all restored facilities shall be the Contractor's responsibility. This maintenance shall be performed on an on-going basis during the course of construction. The Contractor's Progress Schedule shall reflect the above restoration requirements.
- e. Additional Restoration for Work in Business or Commercial Districts: The Contractor shall restore all private property, damaged by construction, to its original condition. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business accesses with the business owner. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored within 24-hours of backfilling trench.

B. Existing Utilities:

- 1. The locations of all existing underground piping, structures, and utilities have been taken from information received from the respective owner. The locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping, conduit and cables to be encountered. It is the Contractor's responsibility to verify all depths of marked locates as well as underground structures.
- 2. Contractor shall, at all times in performance of the Work, employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of existing 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.
- 3. Pipelines shall be located substantially as indicated on the Drawings, but the County reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. When the location of piping is dimensioned on the Drawings, it shall be installed in that location; when the location of piping is shown on a scaled drawing, without dimensions, the piping shall be installed in the scaled location unless the County approves an alternate location for the piping. Where 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. The County/Professional may require detailed pipe laying drawings and schedules for project control.
- 4. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities that do not interfere with the completed work shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his or her expense as

directed by the County. Any existing facilities that require operation to facilitate repairs shall be operated only by the owner of the respective utility.

5. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the proximity of excavation, be temporarily stayed and/or shored in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

C. Notices:

1. All governmental utility departments and other owners of public utilities that may be affected by the Work will be informed in writing by the Contractor two (2) weeks after the execution of the Contract or Contracts covering the Work. Such notice will be sent out in general and be directed to the attention of the governmental utility departments and other owners of public utilities for such installations and structures as may be affected by the Work.
2. The Contractor shall also comply with Florida Statute 553.851 regarding notification of existing gas and oil pipeline company owners. Evidence of such notice shall be furnished to the County within two (2) weeks after the execution of the Contract.
3. It shall be the Contractor's responsibility to contact utility companies at least 72-hours in advance of breaking ground in any area or on any unit of the Work so maintenance personnel can locate and protect facilities, if required by the utility company.
4. The Contractor shall give a minimum five (5) working day notice prior to utility personnel interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the utility owner and make arrangements for the utility personnel to isolate the existing lines thus providing interruption which will be satisfactory to the utility owner.

D. Exploratory Excavations:

1. Exploratory excavations shall be conducted by the Contractor for the purpose of locating underground pipelines or structures in advance of the construction. Test pits shall be excavated in areas of potential conflicts between existing and proposed facilities and at piping connections to existing facilities a minimum of 48-hours or 1,000-feet in advance of work. If there is a potential conflict, the Contractor is to notify the County/Professional immediately. Information on the obstruction to be furnished by the Contractor shall include: Location, Elevation, Utility Type, Material, and Size. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the County.

E. Utility Crossings:

1. It is intended that wherever existing utilities must be crossed, deflection of the pipe within specified limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the County this procedure is not feasible, s/he may direct the use of fittings for a utility crossing or conflict transition as detailed on the Drawings.

F. Relocations:

1. Relocations shown on the Drawings: Public utility installations or structures, including but not limited to light poles, signs, fences, piping, conduits, and drains that interfere with the positioning of the Work which are shown on the Drawings to be

- removed, relocated, replaced, or rebuilt by the Contractor shall be considered as part of the general cost of doing the Work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.
2. Relocations not shown on the Drawings:
 - a. Where public utility installations or structures 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 County, 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 County, for the Contractor to accomplish.
 - b. 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 a Change Order.
 3. All existing castings, including valve boxes, junction boxes, manholes, hand holes, pull boxes, inlets, and similar structures in the areas of construction that are to remain in service and in areas of trench restoration and pavement replacement, shall be adjusted by the Contractor to bring them flush with the surface of the finished work.
 4. All existing utility systems which conflict with the construction of the Work herein, which can be temporarily removed and replaced, shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the Work may be done by the Contractor.

1.13 RELATED CONSTRUCTION REQUIREMENTS

A. Traffic Maintenance:

1. Maintain public highway traffic within the limits of the Project for the duration of the construction period, including any temporary suspensions of Work. Work shall also include construction and maintenance of any necessary detour facilities; furnishing, installing, and maintaining of traffic control and safety devices during construction, control of dust, or any other special requirements for safe and expeditious movement of vehicular and pedestrian traffic.
2. Traffic Control shall be provided at the Contractor's expense by the Contractor's personnel or off-duty uniformed police officer, depending on and as required by the applicable traffic control requirements jurisdictional to the construction or road.
3. The Contractor shall prepare and submit a Maintenance of Traffic plan (MOT) to the County/Professional and to the County Public Works Department for review and acceptance prior to commencing any Work on the site. The Traffic Control Plan shall 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. All references to the respective agency in the above referenced standards shall be construed to also include the County for this Work.
 - d. The cost of any required road permits shall be borne by the Contractor.
 - e. The Contractor will notify the public one (1) week in advance of any scheduled work via the use of portable message boards. The message boards shall be located at each approach to the construction area.
4. Before closing any thoroughfare, the Contractor shall give written notice to, and if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction over the thoroughfare. Notice shall be given no less than 72-hours in advance of the time when it may be necessary in the process of construction to close such thoroughfare, or as may be otherwise provided in the acceptable Maintenance of Traffic plan (MOT).
 5. The Contractor shall sequence and plan construction operations and shall generally conduct his or her work in such a manner as not to unduly or unnecessarily restrict or impede existing normal traffic through the streets of the local community.
 6. Insofar as it is practicable, excavated material and spoil banks shall not be located in such a manner as to obstruct traffic. The traveled way of all streets, roads and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary.
 7. If required by duly constituted public authority, the Contractor shall, at his or her own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such a manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the County and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or property resulting from his or her work.
 8. The Contractor shall make provisions at all "open cut" street crossings to allow a minimum of one lane to be open for vehicular traffic at all times. Lane closing shall be as permitted by the local governing authority and shall be repaired to a smooth, safe driving surface immediately following the installation of pipe or conduit. Flaggers shall be required, in addition to barricades, signs and other protective devices at all lane closings.
 9. The Contractor shall make provisions at cross streets for the free passage of vehicles and pedestrians, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters.
 10. The Contractor shall immediately cart away all offensive matter; exercising such precaution as may be directed by the County. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences and adjacent property of all kinds.

B. Barrier And Lights:

1. The Contractor shall exercise extreme care in the conduct of the Work to protect health and safety of the workers and the public. The Contractor shall provide all

protective measures and devices necessary, in conformance with applicable local, state and federal regulations regarding their need and use. Protective measures shall include but are not limited to barricades, warning lights/flashers and safety ropes.

2. All equipment and vehicles operating within 10-feet of the roadway shall have flashing strobe lights attached.

C. Dewatering and Flotation:

1. The Contractor, with his or her own equipment, shall do all pumping necessary to dewater any part of the Work area during construction operations to insure dry working conditions. The Contractor shall be completely responsible for any tanks, wetwells or similar structures that may become buoyant during the construction and modification operations due to the ground water or floods and before the structure is put into operation. The proposed final structures have been designed against buoyancy; however the Contractor may employ methods, means, and techniques during the various stages of construction (or other conditions) that may affect the buoyancy of structures. Should there be any possibility of buoyancy of a structure; the Contractor shall take the necessary steps to prevent its buoyancy either by increasing the structure's weight, by filling it with approved material or other acceptable methods. Damage to any structures due to floating or flooding shall be repaired or the structures replaced at the Contractor's expense.
2. Contractor shall be responsible for any required permits for the discharge of ground water.

D. Dust and Erosion Control:

1. The Contractor shall prevent dust nuisance from his operations or from traffic by the use of water and deliquescent salts.
2. Erosion and Sedimentation Control:
 - a. Temporary erosion controls include, but are not limited to, grassing, mulching, netting, watering and reseeding on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations that will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the County, FDEP and any other agency having jurisdiction.
 - b. Temporary sedimentation controls include, but are not limited to; silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the County, FDEP and any other agency having jurisdiction.
 - c. The construction of temporary erosion and sedimentation control facilities shall be in accordance with the technical provision of section 104-6.4 of the 1991 Edition, FDOT Standard Specifications for Road and Bridge Construction.
 - d. Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective.

E. Lines and Grades:

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 County/Professional. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

2. The Contractor shall, at his or her own expense, establish all working or construction lines and grades as required from the project control points set by the County, and shall be solely responsible for the accuracy thereof.
3. Water main and forcemain shall have a minimum of 36-inches of cover over the top of the pipe. Cover shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The stationing shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed. All locations must be acceptable by the County.
4. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:
 - a. Gravity lines; continuous control, using laser beam technology.
 - b. Pressure lines; control stakes set at 50-foot intervals using surveyors' level instrument.

F. Cutting and Patching:

1. The Contractor shall do all cutting, fitting, or patching of his or her portion of the Work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the County and in accordance with the Drawings and Specifications.
2. Preparation:
 - a. Inspect the existing conditions of the Project, including elements subject to damage and/or movement during cutting and patching.
 - b. Provide adequate temporary support to assure the structural integrity of all facilities during completion of the Work.
3. Performance:
 - a. Execute cutting and demolition by methods, which will prevent damage to other existing facilities and will provide proper surfaces to receive installation of equipment and repair.
 - b. Excavation and backfilling shall be performed in a manner that will prevent settlement and/or damage to existing facilities.
 - c. All pipes, sleeves, ducts, conduits and other penetration through surfaces shall be made airtight.
 - d. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

G. Temporary Construction:

1. Temporary fences: If, during the course of the Work, it is necessary to remove or disturb any fencing, the Contractor shall, at his or her own expense, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The County/Professional will be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.
2. 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 save harmless the County from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

H. Daily Reports:

1. Contractor shall submit to the County's Representative daily reports of construction activities including non-work days. The reports shall be complete in detail and shall include the following information:
 - a. Days from Notice to Proceed; Days remaining to substantial and final completion;
 - b. Weather information;
 - c. Work activities with reference to the Critical Path Method (CPM) schedule activity numbers (including labor, equipment, and daily production quantities for each individual activity);
 - d. Major deliveries;
 - e. Visitors to site;
 - f. Test records;
 - g. New problems, and
 - h. Other pertinent information.
2. A similar report shall be submitted for/by each Subcontractor.
3. The report(s) shall be submitted to the County Representative's Field Office within 2 days of the respective report date. Each report shall be signed by the Contractor's Superintendent or Project Manager. Pay request will not be processed unless daily reports are current.
4. If a report is incomplete, in error, or contains misinformation, a copy of the report shall be returned by the County Representative to the Contractor's Superintendent or Project Manager with corrections noted. When chronic errors or omissions occur, the Contractor shall correct the procedures by which the reports are produced.

I. Cleaning:

1. During Construction:
 - a. During construction of the Work, the Contractor shall, at all times, keep the site of the Work 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 the County, such material, debris, or rubbish constitutes a nuisance or is objectionable.
 - b. Provide on-site containers for the collection of waste materials, debris, and rubbish and remove such from the site periodically by disposal at a legal disposal area away from the site.
 - c. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished. Use only those cleaning materials that will not create hazards to health or property and that will not damage surfaces. Use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
 - d. The Contractor shall remove from the site all surplus materials and temporary structures when no longer necessary to the Work at the direction of the County.
2. Final Cleaning:
 - a. At the conclusion of the Work, all equipment, tools, temporary structures, and materials belonging to the Contractor shall be promptly taken away, and s/he shall remove and promptly dispose of all water, dirt, rubbish, or any other foreign substances. Employ skilled workers for final cleaning. Thoroughly clean all installed equipment and materials to a bright, clean, polished, and new-appearing

condition. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

- b. The Work shall be left in a condition as shown on the Drawings and the remainder of the site shall be restored to a condition equal or better than what existed before the Work.
- c. Prior to final completion, or County occupancy, Contractor shall conduct an inspection of interior and exterior surfaces, and all work areas to verify that the entire Work is clean. The County will determine if the final cleaning is acceptable.

1.14 CONSTRUCTION NOT PERMITTED

A. Use Of Explosives:

- 1. No blasting shall be done except upon approval by the County and the governmental agency or political subdivision having jurisdiction. When the use of explosives is approved by the County as necessary for the execution of the Work, the Contractor shall use the utmost care so as not to endanger life or property, and assume responsibility for any such damage resulting from his or her blasting operations, and whenever directed, the number and size of the charges shall be reduced. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly, "DANGEROUS EXPLOSIVES" and shall be in care of competent watchers. All permits required for the use of explosives shall be obtained by the Contractor at his or her expense. All requirements of the governmental agency issuing permit shall be observed.

1.15 SPARE PARTS

- A. Spare parts for certain equipment provided under Divisions 11: Equipment; 13: Special Construction; 15: Mechanical; and 16: Electrical have been specified in the pertinent sections of the Specifications. The Contractor shall collect and store all spare parts so required in an area to be designated by the Engineer. In addition, the Contractor shall furnish to the Engineer an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier, and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivered cost. Contractor shall package in large plastic military grade containers with all information needed labelled on the outside of container such as equipment item, manufacturer, specification, facility, etc.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. This Contract is for the improvements at the following Orange County Utilities Department's Facilities as shown on the Drawings and specified herein: Oak Meadows Water Supply Facility (WSF), Western Regional WSF, and Bent Oak Storage and Repump Facility (SRF). The Work consists of furnishing all labor, equipment, and materials for the construction of the facilities consisting of, but not limited to, the expansion of or improvements to the equipment and structures associated with the following:

Oak Meadows WSF

1. Demolition of existing Generator.
2. Installation of new 500kW generator and above ground fuel piping to existing above ground fuel storage tank and enclosure.
3. Replace existing motor control center (MCC), automatic transfer switch and related breakers including cables, wires, and conduit.
4. Installation and removal of Temporary MCC, automatic transfer switch and related breakers including cables, wires, and conduit.

Western Regional WSF

1. Demolition of existing motorized entrance gate, chain-link fencing and guardhouse.
2. Installation of new motorized cantilevered gates and fence.
3. Installation of new pre-engineered guardhouse including electrical, communications, and HVAC.
4. Installation of card reader, arm gates and traffic loop detectors including asphalt road lane extension.
5. Retrofit two (2) constant speed motors with variable frequency drives.

Bent Oak SRF

1. Remove and replace existing 12-inch pressure sustaining control valve.

1.02 CONTRACTOR'S USE OF PREMISES/SECURITY

- 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.
- B. The Contractor shall comply with the Owner's security and access guidelines at all times. Refer the Security and Access Guidelines in Attachment B to these Specifications.

1.03 SEQUENCE OF WORK

See Special Project Procedures, Section 01030, 1.05, Sequence of Work

1.04 PUBLIC UTILITY INSTALLATIONS AND STRUCTURES

- A. The Contractor shall give written notice to all governmental utility departments and other owners of public utilities of the location of the proposed construction operations, at least seventy-two hours in advance of breaking ground in any area or on any unit of the Work.
- B. Some of the utility contacts are listed on the plans for the Contractor's convenience.
- C. The maintenance, repair, removal, relocation, or rebuilding of the public utility installation and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the utility involved.

1.05 CONSTRUCTION TRAILERS, STORAGE AND PARKING

- A. Provide construction trailers and other temporary facilities in accordance with the general requirements and Section 01590 at the Oak Meadows Water Supply Facility.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 GENERAL

- A. The Contractor shall receive and accept the compensation provided in the Proposal and the Contract as full payment for furnishing all materials, labor, tools, and equipment, for performing all operations necessary to complete the work under the Contract, and also in full payment for all loss or damages arising from the nature of the work, or from any discrepancy between the actual quantities of work and quantities herein estimated by the Engineer, or from the action of the elements or from any unforeseen difficulties that may be encountered during the prosecution of the work until the final acceptance by the Owner.
- B. The prices stated in the proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the work as shown on the Drawings and specified herein. The basis of payment for an item at the unit price shown in the proposal shall be in accordance with the description of that item in this Section.
- C. The Contractor's attention is again called to the fact that the quotations for the various items of work are intended to establish a total price for completing the work in its entirety. Should the Contractor feel that the cost for any item of work has not been established by the Bid Form or Payment Items, s/he shall include the cost for that work in some other applicable bid item, so that his or her proposal for the project does reflect the total price for completing the work in its entirety.

1.02 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.

1.03 PAYMENT ITEMS

- A. Items are as enumerated on the bid form.
 - Item 1 – General Requirements:
 - a. Measurement for various items covered under General Requirements, Mobilization and Demobilization will not be made for payment and all items shall be included in the lump sum price.

- b. Payment for General Requirements shall include all Insurance requirement costs, the cost of bonds, and all Administrative costs. This item will be paid upon each payment request made by the Contractor. The Contractor shall attach with the pay request invoices to substantiate that appropriate insurance and bonds have been obtained by the Contractor.
- c. Payment for Mobilization/Demobilization will be made at the Contract lump sum price for the item, which price and payment shall be full compensation for the preparatory work and operations in mobilizing for beginning Work on the project including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, and for the establishment of field office, building, safety equipment, and first aid supplies, sanitary and other facilities, as required by these Specifications and State and local laws and regulations; and any other preconstruction expense necessary for the start of the Work; the cost of field engineering, permits, and fees, construction schedules, shop drawings, temporary facilities, laydown storage area, construction aids, erosion control, work associated with contractor support during Owner/Engineer reviews and inspection, re-inspections and any re-work resulting from same, as described in Section 01700: Project Closeout; and Section 01720: Project Records Documents. The Contractor shall submit invoices substantiating the cost of mobilization with each pay request. Mobilization/demobilization shall not be more than five percent (5%) of the Total Base Bid price. Ten percent of the cost for mobilization will be withheld until substantial completion and site clean-up.

Item 2 – Indemnification:

- a. Payment for Indemnification: In consideration of the Contractor's Indemnity Agreement as set out in the Contract Documents, Owner specifically agrees to give the Contractor \$100.00 and other good and valuable consideration, receipt of which is acknowledged upon signing of the Agreement.

Item 3 – Construction of the Oak Meadows Water Supply Facility Improvements:

- a. Measurement: Measurement for this item shall be based on satisfactory replacement of the generator, motor control center (MCC) and automatic transfer switch complete and ready for continuous operation.
- b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, equipment, temporary power and control system, testing, permits, and appurtenances required for the Oak Meadows Water Supply Facility Improvements, including all demolition and salvage of the existing generator and enclosure, installation of a new generator and enclosure, fuel piping, temporary power and control system, replacement of the existing MCC, automatic transfer switch and related breakers, cables, wires, conduit, structural, mechanical, instrumentation, and electrical improvements required to complete the work as specified and training. Additionally, Power System Studies and distribution system field testing shall be performed including a short circuit study, a protective device evaluation study, an arc flash study and a protective device coordination study.

Item 4 – Construction of the Western Regional Water Supply Facility Improvements:

- a. Measurement: Measurement for this item shall be based on satisfactory replacement of the motorized entrance gate, guardhouse, arm gates, and retrofit of two constant speed motors with variable frequency drives complete and ready for operation.
- b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, equipment, testing, permits, and appurtenances required for the Western Regional Water Supply Facility Improvements, including demolition and salvage of the existing motorized entrance gate, arm gates, fencing and guardhouse; installation of new motorized cantilevered gates and a new pre-engineered guardhouse including electrical, HVAC, arm gates, fencing, traffic loop detectors, traffic striping, entrance card reader system, lighting, structural, mechanical, and electrical improvements asphalt road extension, asphalt milling and resurfacing. Work also includes retrofit of two constant speed motors with variable frequency drives including cables, wires, conduit, structural, mechanical, instrumentation, and electrical improvements required to complete the work as specified. Additionally, Power System Studies update and distribution system field testing shall be performed including a short circuit study, a protective device evaluation study, an arc flash study and a protective device coordination study.

Item 5 – Construction of the Bent Oak Storage and Repump Facility Improvements:

- a. Measurement: Measurement for this item shall be based on satisfactory replacement of the 12-inch pressure sustaining control valve complete and ready for operation.
- b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, equipment, testing, permits, and appurtenances required for the Bent Oak Storage and Repump Facility Improvements, including removal and salvage of the existing pressure sustaining control valve and installation of a new pressure sustaining control valve, air release valve, pressure gauge, restraint devices, instrumentation, and electrical improvements required to complete the work as specified.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01027
APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.01 REQUIREMENT

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings and As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables shall be accepted by the County.
- C. Progressive As-Built Drawings shall 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 Asset Attribute Data, Gravity Main, and Pipe Deflection Tables 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 specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies.

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 and payments as certified and paid for by the County.
 - 1. The initial Application for Payment: The Application for Payment at time of Substantial Completion and the final Application for Payment involve additional requirements.
- B. Payment Application Times: As stated in the General Conditions, Payment applications

are to be submitted monthly on a day of the month to be established by the County at the Pre-Construction conference.

- C. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Contractor. Incomplete applications will be returned without action.
 - 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 an extension or continuation sheet, listing Change Order number and dollar amount as for an 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. Submit a stored material log with each application for payment which identifies the type, quantity and value of all stored material, and that tracks when the stored materials are installed and deducts them from stored quantity at that time. Include original invoices for all stored materials that payment is requested.

- E. Waivers of Claims and Mechanics Lien: With each Application for Payment submit waivers of claims and mechanics liens from Subcontractors or Sub-subcontractors and suppliers for the construction period covered by the previous applications.
 - 1. 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, submit final or full waivers.
 - 3. The County reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by 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.
 - 5. Waiver Forms: Submit waivers of claims and lien on forms and executed in a manner acceptable to the County.

- F. Transmittal: Submit seven (7) executed copies of each Application for Payment to the County by means ensuring receipt within 24-hours. One (1) copy shall be complete, including waivers of lien and similar attachments when required.
 - 1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner 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 by prior applications for payment, and 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: Administrative actions and submittals that must precede

or coincide with submittal of the first 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 policies
9. Performance and Payment bonds (if required)
10. Data needed to acquire County's insurance

H. Monthly Application for Partial Payment: Administrative actions and submittals that must precede or coincide with submittal of Monthly Partial Payments include the following:

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 Example (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
14. Responsibility + Liability for materials & equipment
15. Draw Schedule

I. Substantial Completion Application for Payment: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for County 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: 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. Completion of project close-out requirements.
 - 3. Completion of items specified for completion after Substantial Completion.
 - 4. Assurance that unsettled claims are settled.
 - 5. Assurance that work not complete and accepted is now completed.
 - 6. Transmittal of required project construction records to the County.
 - 7. Proof those taxes, fees and similar obligations have been paid.
 - 8. Removal of temporary facilities and services has been completed.
 - 9. Removal of surplus materials, rubbish and similar elements.
 - 10. Change of door locks to County's access.
 - 11. Execute certification by signature of authorized officer.
 - 12. Prepare Application for Final Payment as required in General Conditions.

1.04 SUBMITTAL PROCEDURES

- A. Submit seven (7) copies of each Application for Payment at time stipulated in Agreement.
- B. Submit under transmittal letter.

1.05 SUBSTANTIATING DATA

- A. When the County requires substantiating information, submit data justifying line item amounts in question.
- B. Provide one (1) copy of data with cover letter for each copy of submittal. Show Application number and date, and line item by number and description.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01030

SPECIAL PROJECT PROCEDURES

PART 1 – GENERAL

1.01 SECURITY

- A. The 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 Western Regional Water Supply Facility, the Oak Meadows Water Supply Facility, and the Bent Oak Storage and Repump Facility.
- B. The County requires special security measures to protect the public water system. The Contractor shall provide the same level of security. The Contractor shall comply with all provisions of "General Access and Security Guidelines Water Supply Facilities", attached as Appendix B.
- C. No Claim shall be made against the County by reason of any act of an employee or trespasser, and Contractor shall make good all damage to the County's property resulting from the Contractor's failure to provide security measures as specified.

1.02 TEMPORARY POWER SYSTEM (Oak Meadows WSF)

- A. The existing Oak Meadows WSF shall not be shutdown for longer than a 4 hour maximum period. The existing electrical system consisting of a main breaker, automatic transfer switch, motor control center and related control/power wiring cannot be removed and replaced within the maximum period. A Temporary Power System consisting of the components noted above shall be installed by the Contractor.
- B. Prior to initiating any shutdown of the existing electrical system, the Contractor shall construct a temporary power system including generator, ATS, motor starters and controls, cables, and wiring capable of fully operating the facility during construction of the proposed electrical system and controls.
- C. The temporary electrical system shall interface with the automatic control system to control the high service and well pumps.
- D. The Contractor shall remove the temporary electrical system after completion, testing and acceptance of the proposed electrical and control system modifications and/or replacement.
- E. The Contractor shall furnish a written temporary and permanent construction sequence plan for review and approval by the Owner before commencing work.

1.03 POWER DISTRIBUTION SYSTEM COORDINATION STUDY

- A. The Contractor shall perform a Power System Study and distribution system field testing on the Oak Meadows WSF power system and a Power System Study Update and distribution system field testing shall be performed on the Western Regional WSF power system.
- B. The Power System Studies shall include a Short Circuit Study, a Protective Device Evaluation Study, an Arc Flash Study and a Protective Device Coordination Study for a completely coordinated Power Distribution System.
- C. The existing Western Regional WSF power system study by Eaton Powering #GOSOR00516809 dated September 2014, software is SKM, is available for use.

1.04 INSTRUMENTATION and CONTROLS

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The Contractor shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, connection, to calibrate, to place into operation of all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein. The I&C supplier shall have a maintenance repair facility within a 150 mile radius of the project.
- B. Instrumentation and Controls supplier shall be **Curry Controls**.

1.05 SUSPENSION OF WORK

- A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. The orders and decisions of the RPR as to suspensions shall be final and binding. During suspension of the work from any cause, the work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise; and, if the RPR shall so direct, rubbish and surplus materials shall be removed.

1.06 SEQUENCE OF WORK

- A. The Contractor shall submit a detailed Sequence of Construction Plan indicating equipment and material deliveries, installation and testing of proposed temporary facilities, demolition, proposed periods of shutdowns, and demonstrating that the Water Supply Facilities and Storage and Repump Facility remain online.
- B. The sequence of demolition and renovation of existing facilities will be in accordance with the approved Sequence of Construction Plan. All shutdowns shall be coordinated with and approved by the Owner. The Sequence of Construction plan for each facility shall include the following:

1. The Work shall be phased so that the improvements are under construction at only one facility at a time.
 2. The Work shall be phased so that the WSFs and SRF shall remain secure at all times. Access to the Facilities for Orange County Staff and Maintenance shall be maintained at all times. Gate work at Western Regional WSF shall be phased so that gate equipment, gate arms, card readers, etc., are functional at all times for security purposes and to allow access to the facility.
 3. The WSFs and SRF must remain in continuous, permit compliant operation at all times.
 4. The WSFs and SRF shall not be taken offline (Shut-down) for more than four (4) hours for tie-ins or switchovers
- C. The Contractor shall establish a sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time.

1.07 SHUT-DOWN COORDINATION/PREPARATION

- A. As noted above, the WSFs and SRF shall not be taken offline for more than four (4) hours for tie-ins or switchovers, including major equipment and components or systems. The Contractor shall coordinate needed shut-down of any equipment, component or facility in advance of the work by providing a written plan with their proposed schedule of events at least sixty (60) days in advance of the planned shutdown. It is the responsibility of the Contractor to look ahead and plan enough notice to sufficiently coordinate for shut-downs ahead of the work to avoid delay of the work progress.
1. The Contractor shall submit a written plan for the Shut-down to the County for approval and coordination. The plan will indicate the work to be performed, the equipment or components or the entire WSF or SRF to be off-line and the proposed date and duration of the shut-down. The Contractor shall submit a C.A.R (Construction Assistance Request) form a minimum of thirty (30) days following the acceptance of the plan for the County to schedule personnel or other operation systems to be available to allow the shut-down. The Contractor shall indicate what materials are needed to complete the work that is to be performed during the Shut-down as well as any required material deliveries that are needed prior to the work. The Contractors lack of material, equipment, approved shop drawings, tools, etc. are grounds for the plan to be rejected or delayed by the County.
 2. The County will review the plan and make recommendations as needed. After acceptance of the shut-down plan, the County will coordinate the scheduled date with the Contractor. The Contractor and County shall confirm with each other that they are prepared and ready for the shut-down 24-hours prior to the start of the shut-down. All equipment, materials, manpower, tools, etc. that are needed to perform the work, shall be on-site prior to the shut-down. The shut-down will not proceed if the Contractor is not fully prepared per the shut-down plan.

1.08 TRAINING

- A. Unless otherwise specified, a minimum of two (2) separate training sessions shall be provided for each piece of equipment or system supplied, including all electrical installation, instruments, and testing equipment. The duration of each training session shall be as specified or as required in the individual specification section. Each session of training shall be complete and include all training needed for the required purpose. The Contractor shall video and audio record the training session in accordance with Section 01380. The Contractor shall submit a C.A.R (Construction Assistance Request) form seven days prior to beginning of training. Contractor shall submit training agenda, instructor names and resumes, and training handouts to be used. Training shall be based on the O&M manuals supplied by the Contractor.
- B. Upon successful completion of the Start-up, Demonstration and Testing, the Owner's Personnel will receive the specified training for each system. Training of the Owner's personnel will not be considered valid unless it takes place using a system that has successfully passed the start-up, demonstration and testing. Training shall be a minimum of two (2) days for each system, unless the individual equipment specification requires more. All training required by the specifications shall be videotaped with approved equipment and microphones in accordance with Section 01380 and shall be submitted to the County on individual writable DVD's.

1.09 HAULING AND CONSTRUCTION OPERATIONS

- A. Contractor shall conduct access, hauling, filling and storage operations to minimize interference with surrounding activities and in accordance with the Contract Documents.
- B. Contractor shall provide both maintenance of traffic and access to properties during construction.

1.10 OWNER'S ACCESS TO FACILITIES

- A. The Contractor is responsible for coordinating with the Owner and maintaining access to the Owner's existing facilities, including the Western Regional WSF, Oak Meadows WSF, and Bent Oak SRF at all times and scheduling potential site access disruptions at least seven (7) days in advance of performing the work required.

1.11 OWNER'S WORK SCHEDULE

- A. The Owner requires that their Orange County Utilities Resident Project Representative (RPR) be present to witness and inspect all Work performed by the Contractor. Normal working hours for the RPR are any 10-hour period between the hours of 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday. Any Work beyond the normal working hours shall be considered overtime and shall be requested in writing 24 hours in advance. Contractor, with approval of the RPR, may work additional hours 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 Owner in advance. Under emergency situations a verbal request may be made with a follow-up written request within 24 hours of the emergency.
- C. Owner observes the following holidays: New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day and the day after.
- D. Contractor shall pay for the RPR's overtime. Overtime shall be defined as time beyond the normal 10- hour working period between 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday, and all time on Saturdays, Sundays, and on holidays observed by the Owner. Hourly rates for the Owner's RPR shall be \$50.00 per hour. This overtime pay rate is subject to adjustment by the Owner. Contractor agrees that Owner shall deduct such charges from payments due to the Contractor.

1.12 SUBSURFACE UTILITIES ENGINEERING SERVICES

- A. In addition to the requirements specified in the Contract Documents, the Contractor shall employ subsurface utility engineering services prior to excavation along the fence corridor to precisely locate the existing utilities including gas, electrical, fiber optic, instrumentation, water pipes, reclaimed water pipes, wastewater pipes, and process pipes to eliminate any unexpected conflicts, damage to these utilities and pipes, and ensure safety of existing structures. Subsurface utility engineering services shall include designation, ground penetrating radar and test holes by hand excavation and vacuum excavation.
- B. Utility lines that are damaged during construction shall be repaired by the Contractor at his expenses and service restored within 1 hour of the breakage. If the repair is not made in a timely and approved manner, as determined by the Owner's RPR, the Owner may perform the repairs and the Contractor will be charged for the repairs. Owner's RPR must be present during all repairs.

1.13 TOBACCO FREE CAMPUS

- A. All Orange County Facilities and operations under the Board of County Commissioners shall be tobacco free. This policy shall apply to parking lots, parks, break areas and work sites. It is also applicable to the Contractor, their personnel and subcontractors during contract performance on County-owned property. Tobacco is defined as tobacco products including, but not limited to, cigars, cigarettes, E-cigarettes, pipes, chewing tobacco and snuff. This requirement shall be enforced from the beginning of construction and violators will be removed from the property. Failure to abide by this policy may result in civil penalties levied under Chapter 386, Florida Statutes and/ or contract enforcement remedies.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01050
SURVEYING AND FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Professional Surveyor: 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.
- B. Professional Engineer: The Contractor shall provide the services of a Registered Professional Engineer currently licensed in the State of Florida for the following specific services as applicable to the Work.

1.02 REQUIREMENTS

A. Survey Services

- 1. The Contractor shall retain the services of a registered Surveyor and Mapper licensed in the State of Florida to provide professional surveying and mapping services, and maintain both a control survey and an as-built survey during construction. The Surveyor will identify control points (monuments and benchmarks noted on the Drawings). The construction layout survey shall be established from the control points shown on the Construction Drawings and confirmed. The method of field staking for the construction of the Work shall be at the option of Contractor. The accuracy of any method of staking shall be the responsibility of Surveyor. All staking shall be done to provide for easy verification of the Work by the County. The Contractor shall provide all surveys necessary for the construction of the Work.

B. Engineering Services

- 1. The Engineer shall be responsible for duties during Construction to include, but not limited to:
 - a. Inspections, testing, witnessing requiring a licensed Professional Engineer.
 - b. Design of temporary shoring, bridging, scaffolding or other temporary construction, formwork and protection of existing structures.
 - c. Other requirements as specified herein.
- 2. Engineering related designs, tests and inspections shall be signed by the licensed Professional Engineer as required by the County.

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 s/he has the hardware, software, and adequate scope of services in his or her 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 Pre-Construction meeting. Any Surveyor who has not previously performed work for the County shall attend the Pre-Construction meeting.

1.04 SUBMITTALS

- A. Provide qualifications of the Surveyor or Engineer.
 - 1. A Florida Registered Professional Engineer or Registered Surveyor and Mapper who is proposed by the Contractor to provide services for the Work shall be acceptable to the County prior to field services being performed.
 - 2. A Professional Engineer shall be of the discipline required for the specific service for the Work.
 - 3. Submit name, address and telephone number of the Surveyor and/or Engineer, as appropriate to the County for acceptance before starting survey or engineering work.
- B. On request, submit documentation verifying accuracy of survey work.
- C. Surveyor shall certify all elevations and locations included in Table 01050- 2, 3, and 4.

PART 2 - PRODUCTS

2.01 SURVEY DOCUMENTS

- A. Survey documents shall comply with the Minimum Technical Standards of Chapter 5J-17 of the Florida Administrative Code (FAC) and Table 01050-1 Minimum Survey Accuracies, whichever are more stringent. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract Drawings control points for horizontal and vertical controls.
- B. The Surveyor shall not copyright any of their Work related to this project.

**Table 01050-1
Minimum Survey Accuracies**

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
Bench Marks	0.01	0.01	Point
Baseline Control Locational Accuracy	0.01	N/A	Point
Tract and Easement Corners	*	N/A	Survey Monuments
Mains at 100-foot maximum intervals	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
PVC pipe >16-inch at every pipe joint	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
Fittings, Sleeve, Tapping Saddle, and end of the pipe if Plugged or Capped.	0.1	0.1	Fitting
Restrained Pipe	0.1	N/A	Restrained Joint Limits
Connections	0.1	0.1	Pipe
Bore & Jack Casing	0.1	0.1	Top of Casing at the Casing Limits
Directional Drill	0.1	0.1	10-foot intervals during the directional drill operation
Hydrants	0.1	N/A	Operating Nut of Hydrant
Valves	0.1	0.1	Operating Nut
Air Release, Blow off, and Backflow Valves	0.1	N/A	Valve Enclosure
Master Meters, Deduct Meters & Wastewater Meters	0.1	N/A	Register
Meter Box	0.1	N/A	Meter Box
Clean out	0.1	N/A	Clean out
Manhole Rim	0.1	0.1	Manhole
Manhole Inverts	N/A	0.01	Pipe Inverts
Pump Station (Public & Private)	0.1	0.01	Wetwell and Pipe Inverts
Production Well or Monitoring Well	0.1	0.1	Well
Grease Interceptor	0.1	0.1	
Oil / Water Separators	0.1	0.1	
Demolished Pipe (abandoned in place or removed)	0.1	0.1	Limits of Abandoned or Removed Pipe
Existing Utilities water, wastewater, reclaimed water, and appurtenant structures **	0.1	0.1	Pipe or Structure
* Shall conform to the requirements of the "Chapter 5J-17, 'Minimum Technical Standards', FAC", certified by a SURVEYOR.			
** Existing utilities including but not limited to water, wastewater, reclaimed water, stormwater, fiber optic cable, electric, gas and structures within the limits of construction.			

TABLE 01050-2
Asset Attribute Data Form Examples

Hydrants Worksheet

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Manufacturer	Model #	Comments
2	FH-1	C-7	518456.40	1483743.63	49.53	Brand B	XJ7-B	
3	FH-2	C-9	518477.68	1483758.95	54.23	Brand B	XJ7-B	

Valves Worksheet

	A	C	D	E	F	G	H	I	J
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Valve Type	Main Type	Valve Size	Valve Manufacture
2	ARV-1	C301	518060.09	1483231.33	81.72	ARV - Combination	Water Main	2	Brand H
3	ARV-1	C303	518083.55	1483280.50	81.15	ARV - Vacuum	Force Main	4	Brand G
4	BFP-1	C303	518086.00	1483282.88	78.21	Backflow Preventer	Reclaimed Water Main	8	Brand F
5	BO-9	C405	518088.83	1483289.43	78.20	Blowoff	Water Main	2	Brand E
6	BFV-1	C405	518088.11	1483295.00	81.95	Butterfly	Water Main	30	Brand D
7	GV-3	C405	518132.54	1483372.75	81.23	Gate	Water Main	16	Brand C
8	LS-W1	C405	576779.36	1539706.97	64.30	Line Stop	Water Main	16	Brand B
9	PV-22	C405	576880.60	1539718.32	64.52	Plug	Force Main	12	Brand A

	J	K	L	M	N	O	P	Q
1	Valve Manufacturer	Valve Model #	# of Turns to Close	Gear Actuator	Gear Ratio	Side Actuator	uator Manufact	Comments
2	Brand H	100XT						
3	Brand G	1000						
4	Brand F	2000 fgs						
5	Brand E	14 turbo						
6	Brand D	230 xls	200	Yes	3 to 1	Yes	Brand C	
7	Brand C	2225846	300	Yes	3 to 1	NO		
8	Brand B	7n6r44						
9	Brand A	Z100	200	Yes	3 to 1	Yes	Brand A	

Manhole Worksheet

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID Number	Plan Sheet #	Easting	Northing	Rim Elevation	Invert Elv II	Invert Elv IE	Invert Elv E	Invert Elv SE	Invert Elv S	Invert Elv SW	Invert Elv W	Invert Elv IW	Manufacturer
2	MH-1	C-20	517999.15	1483092.24	82.96	76.96		76.96						Brand X
3	MH-2	C-20	517999.15	1483492.24	83.54	75.63				75.58				Brand X

Meter Worksheet

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Comments
2	MM-1	C-6	576533.64	1539520.08	58.01	Water Main	
3	RWMM-1	C-6	576937.42	1539598.78	64.84	Reclaimed Water Main	

Fitting Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls								
	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Fitting Type	Comments
2	FM-1	C-3	572399.28	1539339.13	46.27	Force Main	Bend 11 1/4°	
3	FM-2	C-3	574840.74	1539856.91	51.73	Force Main	Bend 22-1/2°	
4	FM-3	C-3	574844.01	1539856.71	52.48	Force Main	Bend 45°	
5	FM-4	C-3	574845.72	1539856.61	52.33	Water Main	Bend 90°	
6	FM-5	C-3	574845.85	1539858.77	51.98	Water Main	Cap	
7	RW-1	C-4	574884.06	1539849.64	51.75	Reclaimed Water Main	Cross	
8	RW-2	C-4	574887.22	1539849.56	48.98	Reclaimed Water Main	Reducer	
9	RW-3	C-4	574904.30	1539849.10	49.39	Reclaimed Water Main	Plug	
10	RW-4	C-4	574907.42	1539849.01	52.32	Reclaimed Water Main	Sleeve	
11	WM-1	C-5	574938.65	1539848.16	54.42	Water Main	Tapping Saddle	
12	WM-2	C-5	572532.38	1539337.10	45.27	Water Main	Tee	
13	WM-3	C-5	572631.00	1539338.00	44.13	Water Main	Wye	
14	WM-4	C-5	572731.00	1539334.00	43.77	Water Main	Tapping Sleeve	

Cleanout Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls						
	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	CO-1	C-6	576533.64	1539520.08	58.01	
3	CO-2	C-6	576937.42	1539598.78	64.84	

Pipes Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls												
	A	C	D	E	F	G	H	I	J	K	L	M
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Type of Shot	Instruction	Material	Pressure Class	Manufacturer	Color
2	CSNG-1	C-4	517827.57	1482195.46	78.83	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A	
3	CSNG-2	C-4	517848.20	1482195.31	78.38	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A	
4	RW-1	C-7	517731.98	1482237.24	80.42	Reclaimed Water Main	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B	
5	RW-2	C-7	517732.848	1482338.1	80.943	Reclaimed Water Main	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B	
6	WM-1	C-9	573309.068	1539372.9	56.10	Water main	Shot on Pipe	Open Cut	PVC	DR18	Brand C	
7	WM-2	C-9	573308.752	1539375	54.66	Water main	Shot on Pipe	Open Cut	PVC	DR18	Brand C	
8	FMDD-1	C-4	504345.94	1488969.2	114.14	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X	
9	FMDD-2	C-4	504360.86	1488970.5	112.74	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X	
10	FMDD-3	C-4	504377.19	1488971.2	106.14	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X	
11	FM-9	C-4	504480.47	1488982.9	105.24	Force Main	Shot on Pipe	Open Cut	PVC	DR18	Brand C	

Well Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls						
	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	PS-1	C-40	517914.346	1482906.562	83.912	

Easements Worksheet

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Boundary Corner Type	Comments
2	Corner-1	C-8	463484.59	1511029.72		Pump Station Tract	N.W. CORNER
3	Corner-2	C-8	463523.24	1511040.01		Pump Station Tract	N.E. CORNER
4	Corner-3	C-8	463480.45	1511015.23		Pump Station Tract	S.W. CORNER
5	Corner-4	C-8	463526.97	1511025.49		Pump Station Tract	S.E. CORNER
6						Easement	
7						Property	

Existing OC Utility Crossing

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Existing Pipe Elevation	Proposed Crossing Elevation	Existing Main Type	Comments
3	Conf-1	C-750	463464.47	1511013.75	100.54	104.88	Water main	
4	Conf-2	C-750	463163.91	1510693.49	98.32	103.57	Storm Main	

Grease Interceptor

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Volume (Gallons)	Comments
2	GI-1	C-400	508387.3	1487203.18	89.70	1000.00	

For ease of calculating pipe deflections in Table 01050-3, begin by providing a unique asset ID (top of pipe shots and fittings) for each utility and type, numbered sequentially along the pipe run (including changes in direction) from start to finish of the pipe in the Table 01050-2. Then branches and services of the same utility type can be numbered. It is recommended that each utility (water, wastewater or reclaimed water) numbering format be distinguishable from the other. This will allow organization and convenient sorting after the individual asset table worksheet tabs are combined in the spreadsheet program prior to copying and pasting to the deflection table spreadsheet.

**TABLE 01050-3
PIPE DEFLECTION TABLE EXAMPLE**

Project Contractor: Progress Mtg Date: Contract # Dwg Sheet # Utility Type Pipe Manufacturer Pipe size & material PVC Manufacturer Deflection County Allowable Deflection 75% Allowable Angle of Offset Allowable Radius of Curvature Laying Length of Pipe	FM National Pipe 16" PVC C905 6 inches 4.5 inches 1.5 degrees 764 feet 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 ft	Length BC ft	Length AC ft	XYZ (w elevation) degrees	XYZ (w elevation) ft	per laying length degrees	per laying length 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 been inputted
 Values in yellow are over spec

*Uses law of cosines to determine angle ABC and Ø.
 $\text{angle } ABC = \arccos((AB^2 + BC^2 - AC^2) / (2 * AB * BC))$
 $180 - \text{angle } ABC = \text{angle } \phi$
 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 law of sines, using the chord length AC and radius R.
 $\text{Since } \sin((\phi/2) * (\pi/180)) = (\text{Chord}/2) / R \text{ and length } AC = \text{Chord}$
 $R = AC / (2 * \sin(\phi * \pi / 360))$
 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 5J-17. 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 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. Only a Surveyor licensed in the State of Florida shall be employed for this Work. All control points shall be protected by the Contractor from disturbance. If the monuments are disturbed, any Work that is governed by these monuments shall be held in abeyance until the monuments are reestablished by the Contractor and approved by the County. The accuracy of all the Contractor's stakes, alignments, and grades is the responsibility of the Contractor. However, the County has the discretionary right to check the Contractor's stakes, alignments, and grades at any time.

- C. Use survey control points to layout such work tasks including but not limited to:
 - 1. Clearing, grubbing, work limits, right-of-way lines and easements.
 - 2. Locations for pipelines and all associated structures and appurtenances.

- D. 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 SURVEYING

- A. Locate and protect existing horizontal and vertical control points shown on the construction Drawings prior to starting any work. If the Surveyor performing the Work finds differences that will effect the Work, the Contractor must immediately report the findings to the County. Establish control points, lines and levels by instrumentation and similar appropriate means. The location of these points should minimize the number of sightings necessary to control the Work and the likelihood of the points being disturbed. Preserve and reference all permanent reference points during Construction. If permanent reference 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 shall be provided to the County.
 - 1. Record locations, with horizontal and vertical data, on project As-Built survey.
 - 2. Make no changes or relocations without prior written notice to the County or without receipt of written approval from the County.
 - 3. Report to the County when any control point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
- B. Cover for water, reclaimed water and force mains shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The locations shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed.
- C. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:
 - 1. Gravity lines: Continuous control, using laser beam technology.
 - 2. Pressure lines: Control stakes set at 50 ft. intervals using Surveyor's level instrument.

3.03 SURVEY DOCUMENTS

- A. The Tables 01050-2 Asset Attribute Data, 01050-3 Pipe Deflection Table, and 01050-4 Gravity Main Table shall be signed, sealed and dated by the Surveyor with each pay request as specified in Section 01027 "Application for Payment" and the requirements of Section 01720 "Project Record Documents."

END OF SECTION

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SECTION 01065
PERMITS AND FEES

PART 1 - GENERAL

1.01 REQUIREMENTS

A. General:

1. Upon Notice of Award, obtain and pay for all appropriate and applicable 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. Provide copies of all applications and supporting documents; and permits received by the Contractor for the Project.
4. Strictly adhere to the specific requirements of the governmental unit(s) or agency (cies) having jurisdiction over the Work. Whenever there is a difference in the requirements of a jurisdictional body and the Contract Documents, the more stringent shall apply.
5. A copy of the permits obtained by the County are furnished in Appendix C "Permits Obtained by County" of these specifications.
 - a. FDEP has exempted this work following a Permit Determination, no FDEP is required for the work included in this project.
6. The Contractor shall review and become familiar with all permits for the Project, complete with all conditions, attachments, exhibits and permit modifications. A copy of all permits for the Project shall be maintained by the Contractor at the project site and shall be available for review upon request.
7. Unless otherwise specified, the cost of work specified in this section, will not be paid for separately but the cost therefore shall be considered incidental to and included in the bid prices of the various Contract items.

B. Building Permit (Orange County):

1. The County will pay the general building permit fee and any related impact fees or assessments to be paid to Orange County for the issuance of that permit only.
2. The Contractor shall pay all fees associated with obtaining Orange County trade permits and any and all inspection fees for the Orange County Building Department providing inspections for this project. The Contractor shall apply for and obtain the building permits from Orange County and schedule and obtain final approval from the building inspectors.
3. Information on Orange County Building Department fees is included in the Instructions to Bidders in Division 0.
4. The Contractor shall be responsible for scheduling all permit inspections and obtaining inspection approval from Orange County, as required by the building and sub-discipline construction permits.

- C. Construction Dewatering Permit: The Contractor shall apply and pay for all fees associated with obtaining Florida Department of Environmental Protection District Office construction dewatering permits, if required. The Contractor shall provide all materials and equipment to comply with the permit requirements at no additional cost to the County.

- D. Stormwater Permit: The Contractor shall apply and pay for all fees associated with obtaining construction stormwater management including but not limited to FDEP Generic Permit for Stormwater Discharge from Large and Small Construction Activities, if required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01070
ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Reference to the following standards of any technical society, organization, or body shall be construed to mean the latest standard, code, or specification or tentative specification adopted and published at the date of advertisement for bids, even though reference has been made to an earlier standard. Such reference is hereby made a part of the Contract the same as if herein repeated in full and in the event of any conflict between any of these specifications, standard codes, or tentative specifications and the Contract Documents, the most stringent shall govern.

AA	Aluminum Association
AASHTO	American Association of State Highway and Transportation Officials
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	American Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	American Standards Association (now ANSI)
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
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWBP	American Wood Preservers Board
AWS	American Welding Society
AWWA	American Water Works Association

CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DOT Spec	Standard Specification for Road and Bridge Construction –
FDOT	Florida Department of Transportation
FAC	Florida Administrative Code
FS	Federal Standard
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NACE	National Association of Corrosion Engineers
NASSCO	National Association of Sewer Service Companies
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NEC	National Electrical Code
NECA	National Electrical Contractor's Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NPT	National Pipe Threads
NSF	National Science Foundation
OSHA	U.S. Department of Labor, Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	United States Products Standards
SAE	Society of Automotive Engineers
SDI	Steel Decks Institute
SJI	Steel Joists Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Structural Steel Painting Council
UL	Underwriter's Laboratories, Inc.
USASI	United States of American Standards Institute (Now ANSI)

B. Units Of Measurement:

CU FT	cubic feet
CU IN	cubic inch(es)
CY	cubic yard(s)
DegC	degree(s) Centigrade
DegF	degree(s) Fahrenheit
F	Fahrenheit
FT	feet, foot
G	gram(s)
GA	gage
GAL	gallon(s)
GPH	gallon(s) per hour
GPM	gallon(s) per minute

GPS	gallon(s) per second
HR	hour(s)
IN	inch(es)
IPS	iron pipe size
KG	kilogram(s)
L	liter(s)
LB	pound(s)
LBF-IN	pound (force) inch
LF	linear foot, linear feet
MIN. min.	minute(s), minimum
ml	milliliter
MO	month(s)
OZ	ounce(s)
QT	quart
RH	relative humidity
SF	square foot, square feet
SQ IN	square inch(es)
YD	yard(s)
YR	year(s)

C. Terminology:

@	at
AB	anchor bolt
ADJ	adjust, adjustable
ADMIN	administration
AFG	above finished grade
AGGR	aggregate
AL	aluminum
ALT	alternate
APPX	appendix
APX	approximate
ART	article
ASPH	asphalt
ASSY	assembly
AUTO	automatic
AUX	auxiliary
AVE	avenue
AVG	average
AWG	American Wire Gauge
BAR	barrier
BCCMP	bituminous coated corrugated metal pipe
BL	base line
BLDG	building
BLKG	blocking
BM	beam

C to C	center to center
CCB	concrete block, masonry
CEM	cement
CIP	cast iron pipe, cast in place
CJ	construction joint
CL	center line, clearance
CM	Construction Manager
CMP	corrugated metal pipe
CO	cleanout
CONC	concrete
CONN	connection
CONST	construction
CONT	continuous
CONTR	contractor
CU, COP	copper
ORR	corridor
CRIT	critical
CTD	coated
CTR	center
CULV	culvert
d	delta
DBL	double
DEM	demolition, demolish
DEPT	department
DET	detail
DIA, D	diameter
DIAG	diagonal
DIM	dimension
DWG	drawing
FEM	female
FUT	future
FV	field verify
FM	force main
FH, HYD	fire hydrant
ID	inside diameter
MAS	masonry
MATL	material
MAX	maximum
MFD	manufactured
MFG	manufacturing
MFR	manufacturer
MH	manhole, metal hallide
MIN	minimum
MISC	miscellaneous
MTL	material

NAT	natural
NATL	national
NOM	nominal
NTS	not to scale
OD	outside diameter
PP	power pole
R	radius
Rd	road
REIN	reinforce
REL A	relief air
REQD	required
REV	revision
RR	railroad
R/W	right-of-way
RWM	reclaimed water main
RY	railway
SAN	sanitary
SCH	schedule
SECT	section
SLV	sleeve
SQ	square
SST	stainless steel
ST	street
STA	station
STD	standard
SURF	surface
SUSP	suspend(ed)
SYM	Symbol, symmetrical
SYS	system
TEMP	Temperature, temporary
TYP	typical
UTIL	utility
W	West
WLD	welded
WM	water main
W/O	without
WT	weight
YD	yard
YR	year
Y W	wye

END OF SECTION

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SECTION 01091
REFERENCE SPECIFICATIONS

PART 1 - GENERAL

1.01 GENERAL

- A. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies that have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of or omission from said standards or requirements.

- B. Assignment of Specialists: In certain instances, specification test requires (or implies) that specific work is to be assigned to specialist or expert entities who must be engaged for the performance of the Work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. They are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the Contractor.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of such referenced documents that are not in conflict with the requirements of these Specifications or applicable codes.

- B. References herein to "Building Code" shall mean the Florida Building Code. The latest edition of the code shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

- C. In case of conflict between codes, reference standards, Drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The Contractor shall bid the most stringent requirements.

D. Applicable Standard Specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Contractor participation in pre-construction conferences, progress meetings and specially called meetings.

1.02 MEETINGS CALLED BY THE COUNTY

- A. The County will schedule and Engineer will administer a pre-construction conference, periodic progress meetings and specific topic meetings throughout the progress of the Work. The County and Engineer will:
 - 1. County will distribute a notification of the meeting to required attendees.
 - 2. Engineer will establish, prepare and County will distribute an agenda with the notification.
 - 3. County will make physical arrangements for the meetings.
 - 4. Engineer will preside at meetings.
 - 5. Engineer will prepare and distribute minutes of meetings including significant proceedings and decisions, within 15 working days after each meeting. Minutes will be forwarded to all participants and to parties affected by decisions made at the meeting.
- B. Representatives of the Contractor, Subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. The meeting location will generally be a central site, convenient for all parties, designated by the County.

1.03 PRE-CONSTRUCTION CONFERENCE

- A. Attendance:
 - 1. County
 - 2. Engineer
 - 3. Contractor and superintendent
 - 4. Subcontractors as appropriate to the agenda
 - 5. Representatives of suppliers and manufacturers as appropriate to the agenda
 - 6. County MBE/WBE representative
 - 7. Other agency representatives (FDEP, EPA, City, etc.)
 - 8. Others as requested by the County or Contractor

B. Suggested Agenda:

1. Distribution and discussion of:
 - a. List of major Subcontractors and suppliers.
 - b. Construction schedules.
 - c. Contact information.
2. Organizational arrangement of Contractor's forces and personnel, and those of Subcontractors, material and equipment suppliers, and the County.
3. Critical work sequencing.
4. Major equipment deliveries.
5. Project coordination:
 - a. Designation of responsible personnel.
 - b. Channels and procedures for communication.
6. Procedures and processing of:
 - a. Field decisions.
 - b. Proposal requests.
 - c. Submittals.
 - d. Change orders.
 - e. Applications for payment/Schedule of Values.
 - f. Contractor quality control.
 - g. Submittal of Shop Drawings, project data and samples.
7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining as built and record documents.
9. Use of premises:
 - a. Office, work, and storage areas.
 - b. County's requirements.
 - c. Housekeeping.
10. Temporary construction facilities.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Rules and regulations.
14. Security procedures.
15. Place, date, and time for regular progress meetings.
16. Completion time for Contract and liquidated damages.

1.04 PROGRESS MEETINGS

- A. The County/Engineer will schedule progress meetings every month and as required by progress of the Work with the first meeting (one) 1-month after the pre-construction meeting. The Engineer will prepare and distribute the meeting minutes within 7 calendar days.
- B. Attendance:
 1. County.
 2. Engineer
 3. Contractor.
 4. Subcontractors as appropriate to the agenda.
 5. Suppliers as appropriate to the agenda.
 6. Others as appropriate.

- C. The Contractor's representative is to attend the project meetings and have the authority to act on behalf of the entity represented on field related matters. Contractor's representative is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics and provide specific information including but not limited to:
1. Status of submittals and actions necessary to expedite them.
 2. Status of activities behind schedule and actions necessary to regain the approved schedule.
 3. Status of materials and equipment deliveries and action necessary to expedite materials and equipment and maintain the approved schedule.
 4. Status of open RFI's and actions necessary to address them.
- D. To the maximum extent practicable, the Contractor is to assign the same personnel to represent the Contractor at Progress Meetings throughout the progress of the Work.
- E. The Contractor is to provide a current Shop Drawing submittal log at each progress meeting.
- F. The Contractor is to provide copies of the updated Progress Schedule at each project meeting in accordance with the General Conditions.
- G. Suggested Agenda:
1. Review and approve minutes from previous meeting.
 2. Review of Work progress since previous meeting to include current As-Builts
 3. Contractor's/Subcontractor's workforce and equipment.
 4. Progressive As-Built Drawings.
 5. Surveyor's submittals:
 - a. As-Built Asset Attribute Data Table (see Table 01050-2).
 - b. Pipe Deflection Table (see Table 01050-3).
 - c. Gravity Main Table (see Table 01050-4).
 6. Field observations, problems and conflicts.
 7. Construction progress and problems which impede construction schedule.
 8. Shop Drawing submittal status.
 9. Requests for Information (RFI) status.
 10. Change order status.
 11. Review of off site fabrication and delivery schedules.
 12. Corrective measures and procedures to regain approved schedule.
 13. Revisions to construction schedule.
 14. Job progress and schedule for succeeding work period.
 15. Coordination of schedules.
 16. Maintenance of quality standards.
 17. Review submittal schedule; expedite as required.
 18. Pending requests for information, changes, and substitutions.
 19. Review proposed changes for effect on construction schedule and completion date.
 20. Pay application status.
 21. Other business.

H. Revision to Minutes:

1. Unless minutes are challenged, in writing, prior to the next regularly scheduled Progress Meeting, they will be accepted as properly summarizing the discussions and decisions of the meeting.
2. Persons challenging minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
3. Challenge to minutes shall be settled as priority portion of "old business" at next regularly scheduled meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

Work completed without approved Shop Drawings and/or samples shall be considered installed at the Contractor's risk.

1.01 SHOP DRAWINGS AND DATA

- A. Shop Drawings defined in the General Conditions, shall complement design and construction Drawings, and shall contain sufficient detail to clearly define all aspects of the Construction. These Drawings shall be complete and detailed.
- B. Contractor and Supplier's catalog sheets, brochures, diagrams, illustrations, and other standard descriptive data shall be clearly marked with specification title and numbers to identify pertinent materials, product, or models. Delete information that is not applicable to the Work by striking or cross-hatching.
- C. If Shop Drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in the letter of transmittal. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, the Contractor shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such Drawings have been reviewed.
- D. Data on materials and equipment shall include, without limitation, materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams, verification of conformance with applicable standards or codes, materials of construction, and similar descriptive material. Materials and equipment list shall, for each item, give the name and location of the Supplier or manufacturer, trade name, catalog reference, size, finish, and all other pertinent data.
- E. For all equipment furnished, the Contractor shall provide a list including the equipment name and address and telephone number of the Supplier's representative and service company so that service and/or spare parts can be readily obtained.
- F. The Contractor will obtain an installation list from suppliers and equipment suppliers who propose to furnish equipment or products for submittal to County/Professional along with the required Shop Drawings. The installation list shall include at least 5 installations where identical equipment has been installed and has been in operation for a period of at least 1-year.

1.02 REVIEW OF SHOP DRAWINGS AND SAMPLES

- A. The County /Professional'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 County/Professional'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 County/Professional, 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 County/Professional 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 County/Professional may return the reviewed drawings without noting an exception.
- D. "Approved As Noted": Contractor shall incorporate County/Professional's comments into the submittal before release to manufacturer. The Contractor shall send a letter to the County/Professional acknowledging the comments and their incorporation into the Shop Drawing.
- E. "Amend and Resubmit": Contractor shall resubmit the Shop Drawing to the County/Professional. The resubmittal shall incorporate the County/Professional's comments highlighted on the Shop Drawing.
- F. "Rejected": Contractor shall correct, revise and resubmit Shop Drawing for review by County/Professional.
- 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 County/Professional on previous submissions. The Contractor shall make any corrections required by the County/Professional.
- 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 County/Professional.

- I. When the Shop Drawings have been completed to the satisfaction of the County/Professional, the Contractor shall carry out the Construction in accordance therewith and shall make no further changes therein except upon written instructions from the County/Professional.
- 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 County/Professional, make all submittals in groups containing all associated items for:
 - 1. Systems.
 - 2. Processes.
 - 3. As indicated in specific Specifications Sections: 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.
- K. Only the County/Professional shall utilize the color "red" in marking Shop Drawing submittals.
- L. 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 County/Professional. 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 County/Professional.
- 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 County/Professional. 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 County/Professional. 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 County/Professional 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 or her 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 County/Professional as specified herein.
- D. The County/Professional's approval is required for substitutions.
- E. The Contract is based on the materials, equipment and methods described in the Contract Documents.
- F. The County/Professional 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 County/Professional 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 County/Professional 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 County/Professional 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 "Project Closeout."

1.11 WARRANTIES, GUARANTEES AND BONDS

- A. Provide as required by Technical Sections of the Specifications and Sections 01700 "Project 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 County/Professional to Contractor or Contractor to County/Professional 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 12 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 7½-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. Capture and provide digital, ortho-rectified, true-color, aerial photographs of the complete project site prior to start of Construction and at final completion. A final 6-inch or less ground pixel resolution is required. If using traditional photography, the photos will need to be captured at an appropriate scale and scanned at a high enough dpi to yield a final ground pixel size of 6-inches or less. If captured digitally, a final 6-inches or less ground sample distance is required. The final orthorectified photos shall use a projection of NAD 27, State Plane West and all vertical reference shall be NAVD 88, US feet. All orthophoto mosaics shall meet a final accuracy of plus or minus 5-feet.

- I. Provide a total of four (4) true-color, color balanced orthophoto mosaic prints. Three (3) prints each of the pre and post construction (final completion) orthophoto mosaics, for a total of six (6). Each orthophoto mosaic print shall be on double-weight paper with glossy finish and shall have overall dimensions of 36-inches x 58-inches. Two (2) copies of each of the digital orthophoto mosaics shall be supplied in Geotiff format on disk for each time period (pre and post construction). The final color balanced, true-color orthophoto mosaics will be projected in NAD 27, State Plane West and all vertical reference shall be NAVD 88, US feet and shall meet a final accuracy of plus or minus 5-feet.
- J. 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.
- K. 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

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 County/Professional 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 County/Professional 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 County/Professional 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 County/Professional. This does not constitute a change order until accepted by the County.
- F. Shop Drawing and submittal data shall be reviewed by the County/Professional 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 County/Professional 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.
- 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 County/Professional. 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 County/Professional. Shop Drawings will be reviewed by the County/Professional. After County/Professional 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. that may be required by the material or equipment Contractor 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	1 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	2 Copy	2 Copies Each Submittal	2 Copies	2 Copies	None	2 Copies
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 County/Professional'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 15 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 County/Professional 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, 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 or Microsoft Project® 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 01370
SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 DEFINITION

- A. Schedule of Values: Schedule that divides the Contract Amount into pay items, such that the sum of all pay items equals the Contract Amount for the Work, or for any portion of the Work having a separate specified Contract Amount.

1.02 REQUIREMENT

- A. The Schedule of Values established as provided in the General Conditions will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to the County. Progress payments on account of Unit Price Work will be based on the number of units completed.
- B. No payment will be made for Work performed on a lump sum contract or a lump sum item until the appropriate Schedule of Values is approved by the County.
- C. The equitable value of Work deleted from a lump sum contract or lump sum item shall be determined from the approved Schedule of Values.

1.03 SUBMITTALS

- A. Submit 3 copies of a Preliminary Schedule of Values within 15-days after the recommended award of the Contract.
- B. Submit 3 copies of a proposed final Schedule of Values within 20-days after receipt of Notice to Proceed as per the General Conditions.
- C. Submit the Schedule of Values, typed, on EJCDC 1910-8-E form or Orange County forms or spreadsheets provided by County. The Contractor's standard form or electronic media printout will be considered for acceptability by the County.
- D. List installed value of each major item of Work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for Progress Payments. Round off values to nearest dollar.
- E. Coordinate listings with the Progress Schedule.
- F. For items on which payments will be requested for stored materials or equipment, list sub-values for cost of stored products with taxes paid.
- G. Submit a sub-schedule for each separate stage of Work specified in Section 01010 "Summary of Work."

- H. The sum of values listed shall equal the total Contract Amount for the Work or the Contract Amount for a part of the Work with a separate Contract Amount provided for by the Contract Documents.
- I. When the County requires substantiating information, submit data justifying line item amounts in question.

1.04 UNIT PRICE CONTRACTS

- A. For unit price contracts, the bid item prices on the Project Bid Schedule shall be used as the basis for the schedule of values. The Contractor shall resubmit the bid item prices in the format described herein, and may, at its option, or if requested by the County, divide the items in the Project Bid Schedule into sub-items to provide a more detailed basis of payment.

1.05 LUMP SUM CONTRACTS

- A. For lump sum contracts, if the Work involves separate facilities, e.g. multiple pump stations, the cost of the Work shall be separated by each facility and into schedule of value items. Break principal subcontract amounts down into these items; The lump sum cost for each facility shall be submitted individually and split into the schedule of values listed in items 1 through 10.
 - 1. Demolition work, equipment removal
 - 2. Bypass pumping or temporary facilities
 - 3. Civil Site work: Paving, Concrete Slabs, and Site Restoration
 - 4. Yard piping, fittings, valves, and appurtenances
 - 5. Chain link fence and Sliding gates
 - 6. Pre-manufactured Building (Guardhouse)
 - 7. Generator, fuel storage tank and related piping
 - 8. Electrical work: control panels, equipment, conduit, wiring, and connections
 - 9. Instrumentation work: devices, equipment, conduit, wire and programming
 - 10. Start-up, training, testing and commissioning.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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 along both sides of the street or 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 as necessary 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.

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 construction record photographs periodically during the course of the Work.

- B. Prints: Date imprinted 8-inch x 10-inch high resolution glossy single weight color print paper; 5 sets, bound in 3-ring binders to be provided to the County with each respective Application for Payment and distributed by the County as follows:
1. County (2 sets)
 2. Engineer (1 set)
 3. Contractor (1 set)
 4. Project Record Data (1 set stored by Contractor to be furnished to County upon Closeout)

PART 3 - EXECUTION

3.01 VIDEO VIEWS REQUIRED

- A. Complete coverage shall include all surface features within 100-feet of the Work area 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 house and business addresses 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.

3.03 PHOTOGRAPHS

- A. A minimum of 3 views (top, upstream, and downstream) each shall generally be taken prior to backfilling pipelines or structures. Photographs shall be provided for:
 1. Utility conflicts/relocations
 2. Manholes
 3. Pump stations
 4. Boring and jacking
 5. Directional drilling pipe entrance and exit
 6. Valve installation
 7. Air release valve installation
 8. Fire hydrant assembly
- B. Photo Identification
 1. Name of Project
 2. Name of Structure
 3. Orientation of View
 4. Date & Time of Exposure
 5. Film numbered identification of exposure

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.01 SITE INVESTIGATION AND CONTROL

- A. Contractor shall verify all dimensions in the field and check field conditions continuously during construction. Contractor shall be solely responsible for any inaccuracies built into the Work due to Contractor's failure to comply with this requirement.
- B. Contractor shall inspect related and appurtenant Work and report in writing to County any conditions which will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor at Contractor's sole cost and expense.

1.02 INSPECTION OF THE WORK

- A. The Work shall be conducted under the general observation of representatives of the County acting on behalf of the County to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The County shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated. Inspection by the County are in addition to the inspections required of Contractor by his or her QC Representatives.
- B. The presence of the County, however, shall not relieve the Contractor of the responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the County. Further, no requirement of this Contract may be waived or modified except by change order or formal (written) substitution approval.
- C. All materials and articles furnished by the Contractor shall be subject to rigid inspection, and no materials or articles shall be used in the Work until they have been inspected and accepted by the County. No Work shall be backfilled, buried, cast in concrete, hidden, or otherwise covered until it has been inspected. Any Work so covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection and no additional payment will be allowed therefore.

- D. The Contractor is responsible for the Quality of his or her own work and shall designate a qualified individual, to be approved by the County, who will ensure that all work is performed in strict accordance with the Contract Documents. This quality representative shall inspect the work for the Contractor and provide to the County and the Contractor a report outlining all work accomplished, all inspections, and all testing performed for all days when work is performed. The objective of this report is to provide "Objective Evidence of Compliance" by the Contractor with the requirements of the Contract.

1.03 TIME OF INSPECTION AND TESTS

- A. Samples and testing required under these Specifications shall be furnished and prepared in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. Except as otherwise provided in the Contract Documents, performance of the required tests will be by the Contractor and all costs therefore will be borne by the Contractor at no cost to the County. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract, the County shall be notified not less than 24-hours in advance to request inspection before beginning any such Work of covering. Failure of the Contractor to notify the County at least 24-hours in advance of any such inspections shall be reasonable cause for the County to order a sufficient delay in the Contractor's schedule to allow time for such inspection, any remedial, or corrective work required, and all costs of such delays, including its impact on other portions of the Work, shall be borne by the Contractor.

1.04 SAMPLING AND TESTING

- A. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, the County reserves the right to use any generally accepted system of inspection which, in the opinion of the County, will ensure the County that the quality of the workmanship is in full accord with the Contract Documents.
- B. Any waiver of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the County shall reserve the right to make independent investigations and tests as specified in the following paragraph and, upon failure of any portion of the Work to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the County to require the removal or correction and reconstruction of any such Work.

- D. In addition to any other inspection or quality assurance provisions that may be specified, the County shall have the right to independently select, test, and analyze, at the expense of the County, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by the County which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by the Contractor.

1.05 RIGHT OF REJECTION

- A. The County shall have the right at all times and places to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the site. If the County or inspector, through an oversight or otherwise, has accepted materials or Work which is defective or which is contrary to the Contract Documents, such material, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected by County.
- B. Contractor shall promptly remove rejected articles or materials from the site of the Work after notification or rejection.
- C. All costs of removal and replacement of rejected articles or materials, as specified herein, shall be borne by the Contractor.
- D. If the Contractor fails to remove or replace defective work after notification to do so, the County may have the work removed and replaced by others and deduct all costs from the Contractor's pay requests.

1.06 TESTING LABS

- A. All geotechnical testing laboratory services for field testing will be paid by the County. The lab(s) shall function as independent lab(s) and report independently to the County and the Contractor. The test lab(s) may not approve or allow any deviation from the Contract Documents.

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 of the Contract.

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 LABORATORY DUTIES: LIMITATIONS OF AUTHORITY

A. Submit 5 copies of inspection reports to the County. The reports shall include the following components:

1. Project title and County's project number
2. Testing laboratory name and address
3. Date of report issuance
4. Name and signature of field technician
5. Date of inspections, sampling, and/or testing
6. Record of weather conditions
7. Identification of product tested and associated specification section
8. Testing location
9. Description of testing performed
10. Observations made regarding compliance with the Contract Documents

B. Laboratory is not authorized to:

1. Release, revoke, alter, or enlarge on requirements of Contract Documents
2. Approve or reject any portion of Work
3. Perform any duties of the Contractor

1.03 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 manufacturer or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. 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 for quality and workmanship 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 due to Contractor's negligence.
- 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.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Work Included: Provide temporary facilities and controls needed for the Work, including, but not necessarily limited to:
 - 1. Temporary utilities such as water, electricity, and telephone;
 - 2. Field office for the Contractor's personnel;
 - 3. Sanitary facilities; and
 - 4. Enclosures such as tarpaulins, barricades, fences, canopies; traffic control and pedestrian control devices.

- B. Related Work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Except that equipment furnished by subcontractors shall comply with requirements of pertinent safety regulations, such as equipment normally furnished by the individual trades in execution of their own portions of the Work are not part of this Section.
 - 3. Permanent installation and hookup of the various utility lines are described in other Sections.

1.02 PRODUCT HANDLING

- A. Maintain temporary facilities and controls in proper and safe condition throughout progress of the Work.

PART 2 – PRODUCTS

2.01 UTILITIES

- A. Water:
 - 1. Provide necessary temporary piping and water supply, and upon completion of the Work, remove such temporary facilities.

- B. Electricity:
 - 1. Provide necessary temporary wiring, and upon completion of the Work, remove such temporary facility.
 - 2. Provide area distribution boxes so located that the individual trades may furnish and use 100-foot maximum length extension cords to obtain power and lighting at points where needed for work, inspection, and safety.

3. All electric power necessary for construction and for testing of Project mechanical and electrical systems will be furnished and paid for by the Contractor. The point(s) of tie-in shall be coordinated with Orlando Utilities Commission.
 - a. All temporary wiring provided by the Contractor must conform to the requirements of the National Electric Code, the Industrial Safety Commission and local requirements. In addition, all wire used shall be fused to adequately protect that wire according to the Code.
 - b. The Contractor shall have an adequate number of outlets and each outlet shall be properly and clearly labeled with the maximum voltage and fuse protection.
 - c. Where temporary lighting is used, outlets shall consist of a weatherproof socket properly insulated and provided with a locking type wire guard.
 - d. All devices shall be properly grounded.

C. Sanitary Facilities:

1. Provide temporary sanitary facilities for use by all of Contractor's personnel.
2. Maintain in a sanitary condition at all times.
3. The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the regulations of the State Board of Health.

2.02 ENCLOSURES

- A. Provide and maintain for the duration of construction all tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of the Work in compliance with pertinent safety and other regulations.

END OF SECTION

SECTION 01560
EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Work specified in this Section consists of designing, providing, maintaining and removing temporary erosion and sedimentation controls as necessary to protect the Work and prevent sedimentation from the Contractor's activities from entering water bodies or enter other parts of the County's or other property owners sites outside the Construction limits.
- B. Temporary erosion controls include, but are not limited to; grassing, mulching, netting, watering and reseeded on-site surfaces and soil and borrow area surfaces, and providing interceptor ditches at end of berms and at those locations which will ensure that erosion during Construction will be either eliminated or maintained within acceptable limits as established by the regulatory agencies having jurisdiction.
- C. Temporary sedimentation controls include, but are not limited to; silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the regulatory agencies having jurisdiction.

1.02 REQUIREMENTS

- A. The Contractor is responsible for providing effective temporary erosion and sediment control measures during Construction or until final controls become effective.
- B. The Contractor shall be responsible for filing Notice of Intent for Construction Activities with regulatory agencies (SJRWMD, SFWMD, and FDEP) as required by law, if thresholds are expected to be exceeded.
- C. The areas of unstabilized soil cover shall be minimized at all times to limit erosion and sedimentation.

1.03 SUBMITTALS:

- A. The Contractor shall prepare and submit an Erosion and Sedimentation Control Plan (Stormwater Pollution Prevention Plan) for County review and approval. The Plan shall be in effect throughout the Construction duration.

PART 2 - PRODUCTS

2.01 EROSION CONTROL

- A. Seed: Scarified Argentine Bahia.
- B. Sod: Bermuda grass, Argentine Bahia grass, Pensacola Bahia grass or St. Augustine. Grassing and Sodding Materials: As specified in Section 981 FDOT Specification for Road & Bridge Construction.
- C. Netting: Polypropylene mesh netting 5/8-inch x 3/4-inch (16 x 19mm) mesh with interwoven curlex fibers as manufactured by American Excelsior Company or equal. Netting: Fabricated of material in conformance with Section 985 FDOT Specification for Road & Bridge Construction.

2.02 SEDIMENTATION CONTROL

- A. Bales: Clean, synthetic hay type. Minimum dimensions of 14-inch by 18-inch by 36-inches at the time of placement.
- B. Netting: Fabricated of material in conformance with Section 985 FDOT Specification for Road & Bridge Construction.
- C. Sediment Control Fencing (Silt Fencing): As manufactured by American Excelsior Company or equal.
- D. Filter stone: Crushed stone conforming to Florida Department of Transportation Specifications.
- E. Concrete block: Hollow, non-load bearing type.
- F. Concrete: Exterior grade not less than 1-inch thick.
- G. Turbidity Barriers: Floating or staked as required.

PART 3 - EXECUTION

3.01 TEMPORARY EROSION CONTROL

- A. See Section 02578 "Solid Sodding."

3.02 SEDIMENTATION CONTROL

- A. Install and maintain silt fences and dams, traps, barriers, and appurtenances as shown on the approved descriptions and working Drawings. Replace deteriorated hay bales and dislodged filter stone. Repair portions of any devices damaged at no additional expense to the County.

- B. Install all sediment control devices in a timely manner to ensure the control of sediment. At sites where exposure to sensitive areas is likely, complete installation of all sediment control devices before starting earthwork.
- C. Use approved temporary erosion control features to correct conditions that develop during Construction that were not foreseen when the Erosion and Sedimentation Control Plan was first approved.

3.03 PERFORMANCE

- A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results that comply with the requirements of the Regulatory agency having jurisdiction, the County or the Professional, the Contractor shall immediately take whatever steps necessary to correct the deficiency at its own expense to protect the Work and any adjacent property to the site, as well as to prevent contamination of any river, stream, lake, tidal waters, reservoir, canal or other water impoundments.
- B. The side slope areas with unstabilized or unprotected soil cover shall be minimized at all times to limit erosion and sedimentation.
- C. Incorporate permanent erosion control features into the Project at the earliest practical time.
- D. Remove temporary erosion and sedimentation controls when the Work is complete and in accordance with the Erosion and Sedimentation Control Plan (Stormwater Pollution Prevention Plan) and the Notice of Intent for Construction Activities filed with regulatory agencies.

3.04 MAINTENANCE OF EROSION AND CONTROL FEATURES

- A. Provide routine maintenance of permanent and temporary erosion control features, at no expense to the County, until the Project is complete and accepted.

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.

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. Sign Panels: New A-B Grade, exterior type, APA DF plywood with inset hardwood edges and mitered corners, standard large sizes to minimize joints.
 - 1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles, minimum $\frac{3}{4}$ -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 $\frac{1}{2}$ -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.
- E. Safety Sign Number Tags
 - 1. Removable aluminum or galvanized steel, with 4-inch high, blue numerals and steel tag hooks.

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 01590
CONSTRUCTION FIELD OFFICE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Contractor provision of temporary utilities to include electricity, lighting, internet connectivity, heat, ventilation, telephone service, water, and sanitary facilities.
- B. Contractor provision of temporary controls to include barriers, enclosures and fencing, and water control.
- C. Contractor provision of temporary facilities to include access roads, parking, and temporary buildings.
- D. Contractor provision of field offices for the County.
- E. Restrictions on the use of existing adjacent facilities.

1.02 TEMPORARY ELECTRICITY

- A. Provide and pay for power service required for Construction and testing from local utility source.
- B. Provide temporary electric feeder from existing electrical service at location as directed by utility company. Power consumption will not disrupt the County's need for continuous service. Coordinate with the County before making taps or disturbing existing service.
- C. Provide separate metering and pay for cost of energy used until substantial completion. If electric service is turned over to and paid for by the County prior to substantial completion, reimburse the County for energy used up to substantial completion.
- D. Provide power outlets for Construction operations, with branch wiring and distribution boxes located as required. Provide OSHA approved flexible power cords as required.
- E. Contractor-installed permanent convenience receptacles may be used during Construction.

1.03 TEMPORARY LIGHTING

- A. Provide and maintain adequate lighting for Construction operations to achieve a minimum lighting level of one (1) watt/sq ft.
- B. Provide and maintain two (2) foot-candle lighting to exterior staging and storage areas after dark for security purposes.

- C. Provide and maintain 0.25-watt/sq ft H.I.D. lighting to interior Work areas after dark for security purposes.
- D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- E. Maintain lighting and provide routine repairs.
- F. Permanent building lighting may be used during Construction.

1.04 TEMPORARY HEAT AND COOLING

- A. Provide and pay for heating and cooling as required to maintain specified conditions for Construction operations or as required for proper conduct of operations included in the Work.
- B. Prior to operation of permanent equipment for temporary purposes, verify that installation is approved for operation, equipment is lubricated and temporary filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
- C. Maintain minimum ambient temperature of 50°F and maximum relative humidity of 50% in areas where Construction is closed in and final finishes are to be placed, unless indicated otherwise in specifications.

1.05 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.06 TEMPORARY WATER SERVICE

- A. Provide, maintain, and pay for suitable quality water service required for Construction operations. Coordinate with the County if water supply is not separately metered. Pay all costs and expenses associated with such use.
- B. Extend branch piping with outlets located so water is available by hoses with threaded connections.

1.07 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures on-site. Maintain daily in clean and sanitary condition. Adjacent County office building toilet facilities are not to be used by Contractor.

1.08 BARRIERS

- A. Provide barriers to prevent unauthorized entry to Construction areas and to protect existing facilities and adjacent properties from damage from Construction operations.
- B. Provide barricades required by governing authorities for public rights-of-way.
- C. Provide protection for plant life designated to remain. Replace damaged plant life.
- D. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

1.09 FENCING

- A. Unless directed otherwise in other sections of the Contract Documents, provide a 6-foot high fence completely around Construction site; provided with hinged vehicular and pedestrian gates with locks. Fencing will be galvanized, 2-inch mesh, chain link with solid top rail. Provide line posts and end posts as needed to maintain stretched and uniform fencing with no sags.
- B. Fencing plan will be approved by the County for each phase of the project. Submit fencing layout diagram prior to the Pre-Construction meeting.
- C. Provide visual fabric barrier at least 6-foot high on all fencing separating parking areas from Construction activities. Submit barrier fabric for approval before starting fencing. Barrier fabric will be capable of retaining physical integrity and color during the entire Construction period.

1.10 ACCESS ROADS

- A. Provide and maintain uninterrupted public access to existing buildings. Construction activities will not interfere with access. If Contractor fails to maintain public access after 2 written notices within a 24-hour period, the County reserves the right to correct such situation and back charge the Contractor.
- B. Construct and maintain temporary roads accessing public thoroughfares to serve Construction area.
- C. Extend and relocate access roads as Work progress requires. Provide detours necessary for unimpeded traffic flow.
- D. Provide and maintain access to fire hydrants, free of obstructions.
- E. Designated existing on-site roads may be used for Construction traffic. Repair or restore any damaged areas caused as a result of Construction activity. Such repair will be to a like-new condition.

1.11 PARKING

- A. Provide temporary surface parking areas to accommodate Construction personnel.
- B. Do not allow Construction vehicle parking on existing pavement unless approved by County.

1.12 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

- A. Remove all temporary utilities, equipment, facilities, and materials prior to submitting Final Application for Payment.
- B. Remove temporary underground installations to minimum depth of 2-feet and re-grade site.
- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore any existing facilities used during Construction to original condition, unless otherwise directed in other sections of Contract Documents. Restore existing landscaping, drainage, paving, etc. to an "as-was" condition, unless otherwise directed in other sections of Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01610
DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section specifies the general requirements for the delivery, handling, storage and protection for all items required in the construction of the Work.
- B. Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means that will prevent damage, deterioration, and loss including theft and protect against damage from climatic conditions. Control delivery schedules to minimize long-term storage of products at the site and overcrowding of construction spaces. In particular, provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss. Damaged or defective items, in the opinion of the County, will be replaced at no cost to the County.

1.02 REQUIREMENTS

- A. The Contractor is responsible for all material, equipment and supplies sold and delivered to the County under this Contract until final inspection of the Work and acceptance thereof by the County.
- B. All materials and equipment to be incorporated in the Work will 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.
- C. All materials and equipment, which in the opinion of the County, have become so damaged as to be unfit for the use intended or specified, will be promptly removed from the site of the Work, and the Contractor will receive no compensation for the damaged materials or equipment or for its removal.
- D. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, the Contractor will replace same without additional cost to the County.

1.03 DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.

- B. The County and the Contractor's project superintendent must be on-site to accept all deliveries shipped directly to the job site. If the project superintendent is not present for a delivery, that delivery may be rejected by the County. If any delivery is rejected due to non-availability of the Contractor's project superintendent, delivery shall be rescheduled at no additional cost to the County.
- C. Schedule delivery to reduce long-term on-site storage prior to installation and/or operation. Under no circumstances will materials or equipment be delivered to the site more than 1-month prior to installation without written authorization from the County.
- D. Coordinate deliveries in order to avoid delay in, or impediment of, the progress of the Work.
- E. Schedule deliveries to the site not more than 1-month prior to scheduled installation without written authorization from the County.
- F. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged, or sensitive to deterioration.
- G. All items delivered to the site will be unloaded and placed in a manner that will not hamper the Contractor's normal construction operation or those of Subcontractors and other Contractors and will not interfere with the flow of necessary traffic.
- H. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible. Maintain packaged materials with seals unbroken and labels intact until time of use.
- I. Immediately on delivery, inspect shipments with the County to ensure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged. If the Contractor does not notify the County regarding the delivery and the County rejects any part of the delivery, there will be no additional cost to the County for the material to be returned. For items furnished by others (i.e. County), perform inspection in the presence of the County. Provide written notification to the County of any problems.
- J. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the County.

1.04 STORAGE AND HANDLING

- A. Provide equipment and personnel to handle products by methods recommended by the manufacturer to prevent soiling or damage to products or packaging, with seals and labels intact and legible.
- B. The Contractor is responsible for securing a location for on-site storage of all material and equipment necessary for completion of the Work. The location and storage layout will be submitted to the County at the Pre-Construction conference.

- C. Manufacturer's storage instructions will be carefully studied by the Contractor and reviewed with the County. These instructions will be carefully followed and a written record of this kept by the Contractor.
- D. All material delivered to the job site will be protected from dirt, dust, dampness, water, and any other condition detrimental to the life of the material from the date of delivery to the time of installation of the material and acceptance by the County.
- E. When required or recommended by the manufacturer, the Contractor will furnish a covered, weather protected storage structure providing a clean, dry, non-corrosive environment for all mechanical equipment valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this Project.
- F. 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.
- G. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within 7-days after written notice to do so has been given, the County retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contract Amount. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

1.05 SPECIFIC STORAGE AND HANDLING

(Additional specific storage and handling requirements may be found in the specification sections addressing the material requirements.)

- A. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) will be stored in a weather tight building to prevent damage. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the County. The building will be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
 - 1. All equipment will be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer. Mechanical equipment to be used in the Work, if stored for longer than 90-days, will have the bearings cleaned, flushed and lubricated prior to testing and startup, at no extra cost to the County.
 - 2. Moving parts will 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 will start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants will be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants will be put into the equipment at the time of acceptance. Prior to acceptance of the equipment, the Contractor will 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 will 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 guaranty the equipment equally in both instances. If such a certification is not given, the equipment will be judged to be defective. It will be removed and replaced at the Contractor's expense.
 4. Electric motors provided with heaters will be temporarily wired for continuous heating during storage. Upon installation of the equipment, the Contractor will start the equipment, at least half load, and once weekly for an adequate period of time to insure that the equipment does not deteriorate from lack of use.
- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 - C. Cement and lime will be stored under a roof and off the ground and will be kept completely dry at all times.
 - D. Brick, block and similar masonry products will be handled and stored in a manner to minimize breakage, chipping, cracking and spilling to a minimum.
 - E. Precast Concrete will be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping, or cracking.
 - F. All structural and miscellaneous steel and reinforcing steel will 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 will be stored with the webs vertical.
 - G. Metals will be stored dry, all under cover and vented to prevent build-up of humidity, all off ground to provide air circulation.
 - H. Lumber will be stacked to provide air circulation. Store materials for which maximum moisture content is specified in an area where moisture content can be maintained.
 - I. Gypsum wallboard systems will be stored to protect all metal studs, furring, insulation boards, batts, accessories and gypsum board to prevent any type of damage to these materials. Rusted material components, damp or wet insulation or gypsum boards will not be accepted.

- J. Acoustical materials will be delivered to the job site in unbroken containers labeled and clearly marked. Materials will not be removed from containers until ready to install, but will be stored in dry area with cartons neatly stacked. Before installation, acoustical board will be stored for not less than 24-hours in the Work area at the same temperature and relative humidity.
- K. Linear items will be stored in dry area with spacers to provide ventilation. Stack linear items to prevent warping, complying with manufacturer's instructions.
- L. Paints and other volatile materials will be stored within approved safety containers. No glass jugs will be permitted. Storage areas will be equipped with not less than 2 fire extinguishers (CO2 type) sufficient to discharge a distance of 25-feet when fully charged and have current tags. No other building materials will be stored in this area. Used rags will be removed daily. Clean rags will be stored in metal closed containers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01650
START-UP AND DEMONSTRATION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope of Work:
 - 1. Demonstrate to Owner and Engineer that the Work functions as a complete and operable system under normal and emergency operating conditions.
 - 2. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems.

- B. Contractor shall provide all chemicals, materials, personnel, equipment and expendables as needed and as specified to perform the required start-up and demonstration tests. Contractor shall provide all chemicals for testing and refill all tanks at the end of testing. Chemicals and materials shall comply with FDEP and AWWA requirements.

- C. Related Work Described Elsewhere:
 - 1. Progress Schedules: Section 01310.
 - 2. Operating and Maintenance Data: Section 01730.
 - 3. Equipment: Division 11.
 - 4. Mechanical: Division 15.
 - 5. Electrical: Division 16.

PART 2 – PRODUCTS

2.01 START-UP PLAN

- A. Submit for approval by the Engineer a detailed start-up plan outlining the schedule and sequence of all tests and start-up activities, including submittal of checkout forms, submittal of demonstration test procedures, start-up, demonstration and testing, submittal of certification of completed demonstration and training. Start-up and commissioning may not begin until the plan is approved by the Engineer.

PART 3 – EXECUTION

3.01 COMPONENT TEST AND CHECK-OUT

- A. Start-up Certification: Prior to system start-up, successfully complete all the testing required of the individual components of the Work. Submit six (6) copies of CHECK-OUT MEMOS for each individual component or piece of equipment, signed by the Contractor or the subcontractor and the manufacturer's representative. All copies of the Operation and Maintenance Manuals must be provided before start-up may begin. These forms shall be completed and submitted before Instruction in Operation to Owner or a request for initiating any final inspections. Insert one (1) copy of this form into the applicable section of each Operation and Maintenance Manual.

- B. Demonstrate to the Engineer and 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.
- C. Coordinate start-up activities with the Owner's operating personnel at the treatment plant site and with the Engineer prior to commencing system start-up.

3.02 START-UP

- 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. Slowly fill each hydrostatic structure in the process flow stream with water.
- C. Initiate start-up and training in accordance with and with the use of the plant operation and maintenance manuals.
- D. Observe the component operation and make adjustments as necessary to optimize the performance of the Work.
- E. Coordinate with Owner for any adjustments desired or operational problems requiring debugging.
- F. Make adjustments as necessary.

3.03 START-UP DEMONSTRATION AND TESTING

- A. After all Work components have been constructed, field tested, and started up in accordance with the individual Specifications and manufacturer requirements, and after all Check-Out Forms have been completed and submitted, perform the Start-Up Demonstration and Testing. The demonstration period shall be held upon completion of all systems at a starting date to be agreed upon in writing by the Owner or the Owner's representative. Prior to beginning the start-up demonstration testing, the Contractor shall submit a detailed schedule of operational circumstances for approval by the Engineer. The schedule of operational circumstances shall describe, in detail, the proposed test procedures for each piece of equipment. Provide similar test procedure forms for each piece of equipment or section of the Work to include all particular aspects and features of that equipment or section of the Work and as specified in the Technical Sections of the Specifications.
- B. The Start-Up Demonstration Testing will be conducted for two (2) weeks. The Work must operate successfully during the two (2) week testing period in the manner intended. If the Work does not operate successfully, or if the start-up is interrupted due to other contracts, the problems will be corrected and the test will start over from day one. The party causing the interruption will be subject to the assessment of actual damages due to delay.
- C. During the start-up demonstration period, operate the Work, coordinate with designated plant operating personnel in the function and operation of the Work, and demonstrate various operational circumstances. As a minimum, these circumstances will include

average and peak daily flows, random equipment or process failures, tank overflows, surcharges, interlocks and bypasses. Demonstrate the essential features of the equipment and its relationship to other equipment. The approved schedule of operational circumstances and Demonstration Test Procedures Forms will be used as the agenda during the Start-Up Demonstration Testing period for all equipment and sections of the Work. Coordination of the demonstration test content and schedule will be accomplished through the Engineer and the County Operations staff.

- D. Contractor shall be responsible for the discharge of all water during start-up testing.
- E. Acceptability of the Work's performance will be based on the Work performing as specified under these actual and simulated operating conditions, to provide water treatment facilities functioning as intended and as defined in the Contract Documents. The intent of the start-up demonstration and testing is for the Contractor to demonstrate to the Owner and the Engineer that the Work will function as a complete and operable system under normal, as well as emergency operating conditions, and is ready for final acceptance.
- F. Demonstrate the essential features of all the mechanical systems including, but not limited to, the following as they apply to the Work. Each system shall be demonstrated once only, after completion of testing.
 - 1. Chemical Feed Systems.
 - 2. Mechanical Systems
 - a. Valves
 - b. Pumps
 - 3. Heating, Air Conditioning, and Ventilating Systems and Controls.
 - a. Air Conditioning/Heating System
 - b. Ventilating System
- G. Demonstrate the essential features of all electrical and instrumentation systems including, but not limited to, the following as they apply to the work:
 - 1. Electrical systems controls and equipment:
 - a. Electrical power equipment.
 - b. Motor control centers.
 - c. Motor control devices.
 - d. Relays.
 - e. Special transformers.
 - f. Starting devices.
 - 2. Supervisory control and data acquisition system.
 - 3. Communications systems.
 - 4. Lighting fixtures (including re-lamping and replacing lenses):
 - a. Exit and safety fixtures.
 - b. Fixtures, indoor and outdoor.
 - c. Floodlighting.
 - 5. Panelboards:
 - a. Distribution panels.
 - b. Lighting panels.
 - c. Main panels, power panels.
 - d. Switchboard.
 - 6. Transfer switch (manual).

7. Wiring devices:
 - a. Face plates.
 - b. Low-voltage controls.
 - c. Outlets: convenience, special purpose.
 - d. Switches: regular, time

H. Upon completion of all operator training, the Contractor shall submit to the Engineer six (6) copies of the Certificate of Completed Demonstration Form, for each item of equipment or system in the Work, signed by the Contractor, Subcontractor, Engineer, and the Owner. Insert one (1) copy of this form in the applicable section of each Operation and Maintenance Manual. A sample Certificate of Completed Demonstration Form will be provided at the Preconstruction Meeting.

1.08 INSTRUCTION OF OWNER'S PERSONNEL

- A. Upon successful completion of the Component Testing and Check out and prior to the Start-up, Demonstration and Testing, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment, and systems. Training of the Owner's personnel will not be considered valid unless it takes place using a system that is fully operational
- B. The operating and maintenance manual shall constitute the basis of instruction. Review contents of manual with Owner's operating and maintenance 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. Contractor shall coordinate with Owner to create a list and schedule indicating the date, time, and instructors that will be present for all training sessions.
- E. The instructors shall provide for and prepare lesson scopes and handouts for up to ten (10) 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.
- F. All instruction sessions shall be recorded with portable DVD recording devices and DVDs supplied by the Contractor. DVD recordings shall be made by the Contractor under the direction of the Owner using new DVDs.
- I. Training for Instrumentation and Controls shall include a minimum of 8 hours onsite for two (2) separate groups of staff and 8 hours at the Eastern Regional Water Supply Facility.

END OF SECTION

SECTION 01700
PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

The term "Project Closeout" is defined to include requirements near the end of the Contract Time, in preparation for Substantial Completion acceptance, occupancy by the County, release of retainage, final acceptance, final payment, and similar actions evidencing completion of the Work. Time of closeout is directly related to "Substantial Completion"; therefore, the time of closeout may be either a single period for the entire Work or a series of time periods for individual elements of Work that has been certified as substantially complete at different dates. This time variation, if any, will be applicable to the other provisions of this section.

1.02 SCOPE OF WORK

- A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
 - 1. Final Cleaning
 - 2. Substantial Completion
 - 3. Final Acceptance

1.03 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 16.
- C. Section 01720 "Project Record Documents"
- D. Section 01740 "Warranties and Bonds"

1.04 PREREQUISITES FOR SUBSTANTIAL COMPLETION.

When the Contractor considers the Work as substantially complete, submit to the County a written notice stating so and requesting an inspection to determine the status of completion. The Contractor will attach to the notice a list of items known to be incomplete or yet to be corrected. Complete the following before requesting the County's inspection for certification of substantial completion.

- A. In the progress payment request that coincides with or is the first request following, the date substantial completion is claimed, show 100% completion or list incomplete items, the value of incomplete Work, and reasons for the Work being incomplete. Inspection procedures include supporting documentation for completion as indicated in these Contract Documents.
- B. Submit a statement showing an accounting of changes to the Contract Sum.
- C. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents in accordance with Section 01740 "Warranties and Bonds."
- D. Obtain and submit lien releases enabling the County's full, unrestricted use of the Work and access to services and utilities.
- E. Consult with County before submitting Record Documents in accordance with Section 01720 "Project Record Documents."
- F. Submit Operation and Maintenance Manuals.
- G. Make final changeover of permanent locks. Submit keys and keying schedule.
- H. Deliver tools, spare parts, extra stock, and similar items.
- I. Complete final cleaning requirements necessary for Substantial Completion.

1.05 FINAL CLEANING.

Complete the following cleaning operations prior to Substantial Completion or Owner occupancy.

- A. Remove from job site all tools, surplus materials, construction equipment, storage sheds, debris, waste and temporary services.
- B. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
- C. Structures:
 - 1. Visually inspect exterior surfaces and remove all traces of soil, waste materials, smudges and other foreign matter.
 - 2. Remove all traces of splashed materials from adjacent surfaces.
 - 3. Ensure exterior surfaces have a uniform degree of cleanliness.
 - 4. Visually inspect interior surfaces and remove all traces of soil, waste materials, smudges and other foreign matter.
 - 5. Remove paint droppings, spots, stains and dirt from finished surfaces.
 - 6. Remove labels that are not permanent labels.
 - 7. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

8. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Leave concrete floors broom clean.
9. Wipe surface of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.
10. Clean permanent filters of ventilating systems and replace disposable filters if units were operated during construction. Clean ducts, blowers and coils if units were operated without filters during construction.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor will submit the proposed format, content and tab structure for all Operating and Maintenance Manuals for the County's review and approval. The tab structure for Operating and Maintenance Manuals will follow specification division format as accepted by the Construction Specification Institute. After the County approves the proposed format, content, and tab structure for the Operating and Maintenance Manuals, the Contractor will create and deliver 5 complete sets.
- B. Operation and Maintenance documentation is required for each piece of mechanical, electrical, communications, instrumentation and controls, pneumatic, hydraulic, conveyance, and special construction. If required by the technical specifications, provide Operation and Maintenance documentation for any other product not listed in the foregoing.
- C. The requirements of this Section are separate, distinct and in addition to product submittal requirements that may be established by other Sections of the Specifications. Owner's manuals, manufacturer's printed instructions, parts lists, test data and other submittals required by other Sections of the Specifications may be included in the Operating and Maintenance Manuals provided that they are approved and are formatted in a manner consistent with the requirements of this Section.
- D. Deliver Operation and Maintenance Manuals directly to the County.
- E. Operating and Maintenance Manual documents must include, but are not limited to, table of contents, approved submittals, manufacturer's operating and maintenance instructions, brochures, Shop Drawings, performance curves and data sheets annotated to indicate equipment actually furnished (e.g. identifying impeller size, model, horsepower, etc), procedures, wiring and control diagrams, records of factory and field tests and device/controller settings and calibration, program lists or data compact discs, maintenance and warranty terms and contact information, spare parts listings, inspection procedures, emergency instructions, and other Operating and Maintenance documentation that may be useful to the County. The material and equipment data required by this Section must include all data necessary for the proper installation, removal, normal operation, emergency operation, startup, shutdown, maintenance, cleaning, adjustment, calibration, lubrication, assembly, disassembly, repair, inspection, trouble-shooting, and warranty service of the equipment or materials.

- F. The Contractor must bind the Operating and Maintenance Manual documents in heavy-duty, 3-ring vinyl-covered binders including pocket folders for folded sheet information. Mark binder identification on both the front and spine of each binder. Binder information must list the project title, identify separate structures or locations as applicable, identify the general subject matter covered in the manual and must include the words "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 1. The Contractor must submit the Operating and Maintenance documents on three-hole punched, 8½-inch x 11-inch sheets or on three-hole punched sheets that are foldable in multiples of 8½-inch x 11-inch. The three-hole punched edge will be the left 11-inch edge.
 - 2. The Contractor may request waivers to the size requirement for specific instances. The Contractor's waiver request must be in writing to the County. The Contractor's waiver request must include a justification for seeking the waiver.

- G. The Contractor must provide an electronic version of the complete and final Operating and Maintenance Manuals in original electronic file format on compact disc or DVD. The Contractor must also provide one (1) electronic pdf file of each bound Operating and Maintenance Manual that represents each Manual's content. The electronic pdf file must match the Operating and Maintenance Manual content and organizational structure.

1.07 SUBSTANTIAL COMPLETION INSPECTION PROCEDURES

- A. Upon receipt of the Contractor's request for inspection, the County will either proceed with inspection or advise the Contractor of incomplete prerequisites.

- B. Following the initial inspection, the County will either prepare the certificate of Substantial Completion, or advise the Contractor of Work which must be performed before the certificate will be issued. The County will repeat the inspection when requested in writing and when assured that the Work has been substantially completed.

- C. Results of the completed inspection will form the initial "punch list" for final acceptance.

1.08 PREREQUISITES FOR FINAL ACCEPTANCE.

Complete the following before requesting the County's final inspection for certification of final acceptance, and final payment. List known exceptions, if any, in the request.

- A. Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates for insurance for products and completed operations where required.

- B. Submit written certification that:
 - 1. The County's final punch list of itemized Work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance.
 - 2. The Contract Documents have been reviewed and Work has been completed in accordance with Contract Documents.

3. Equipment and systems have been tested in the presence of the County and are operational.
4. Work is completed and ready for final inspection.

C. Submit consent of surety.

D. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.09 FINAL ACCEPTANCE INSPECTION PROCEDURES

A. The County will re-inspect the Work upon receipt of the Contractor's written notice that the Work, including punch list items resulting from earlier inspections, has been completed, except for those items for which completion has been delayed because of circumstances that are acceptable to the County.

B. Upon completion of re-inspection, the County will either prepare a certificate of final acceptance or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled, which are required for final acceptance.

C. If necessary, the re-inspection procedure will be repeated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- 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. These standards and procedures are for integration of digital engineering CAD drawings and attribute data into the database environments, while maintaining the integrity and positional accuracy of the data. The requirement for digital submittal of approved construction plans is to provide the County GIS with a parcel and utility base for field maintenance and operations.
- C. The location of the constructed improvements as depicted in the Contract Drawings is required. To insure the Work was constructed in conformance with the Contract Drawings, the following survey documents are required to be prepared and certified by the Surveyor:
 - 1. As-Built Asset Attribute Data Table (see Table 01050-2)
 - 2. Pipe Deflection Table (see Table 01050-3)
 - 3. Gravity Main Table (see Table 01050-4)
 - 4. Boundary Survey and Survey Map Report for pump stations and easements with constructed improvements.

1.02 DEFINITIONS

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.

- A. 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.
- B. Record Documents: All documents as required in subsections 1.04 and 2.02 in this specification section.
- C. Boundary Survey: Boundary survey, map and report certified by a Surveyor shall be provided that meets the requirements of Chapter 5J-17 'Minimum Technical Standards', FAC.

- D. Surveyor: Contractor's Surveyor that is licensed by the State of Florida as a Professional Surveyor and Mapper pursuant to Chapter 472, F.S.
- E. Survey Map Report: As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, pump station and easement boundary issues, locations of constructed improvements outside boundaries, and accuracies obtained.

1.03 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.

1.04 RECORD DOCUMENTS AT SITE

- A. Maintain at the site and always available for County's use one (1) 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 As-built Drawings for submittal to the County.
- C. Store As-Built Documents and samples in Contractor's office apart from documents used for construction. Do not use As-Built document for construction purposes. Label each document "AS-BUILT" in neat large printed letters. File documents and samples in accordance with CSI/CSC format.
- D. Record information concurrently with construction progress. Do not conceal any Work until required information is recorded.

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 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. As-Built Asset Attribute Data Table shall be completed in the Drawings.
 - 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. Three (3) hard copy sets and three (3) digital media sets 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 Specification Section 01050 "Surveying and Field Engineering," Table 01050-2 for an example)
 2. Boundary Survey of pump station and Survey Map Report
 3. Boundary 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 3- 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, pump station 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 (see Specification Section 01050 "Surveying and Field Engineering", Table 01050-4 for an example).
 5. Pipe Deflection Table (see Specification Section 01050 "Surveying and Field Engineering" Table 01050-3 for an example). An electronic blank table will be supplied by the County.
- C. Digital sets 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. Pump station site Boundary Survey and Map Report.
- E. New Boundary Survey to re-establish easement corners, right-of-way monuments, or pump station 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 minimum of 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).

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION MEETING

- A. Pre-construction Meeting: It is recommended that the Surveyor attend the Pre-construction meeting. At the pre-construction meeting the Contractor shall be provided with a blank electronic version of the spreadsheet for the tables: Asset Attribute Data and Pipe Deflection. The Contractor's surveyor shall use these tables to input the data and shall not alter the table format or formulas.

3.02 CONSTRUCTION PROGRESS MEETINGS

- A. Contractor shall provide progressive Record Documents 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. Accepted Shop Drawings, samples, product data, substitution and "or-equal" requests.
 6. Field test records, inspection certificates, manufacturer certificates and construction photographs.
 7. 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 certified statement regarding the constructed improvements being within the specified accuracies as described in Specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies or if not, indicating the variances.
 8. 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.

9. 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.

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 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. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
 - a. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.
2. Provide manuals in paper and electronic formats.
3. Provide manuals for use in instructing Owner's personnel pursuant to Section 01650 Startup and Demonstration.
4. Provide a list of warranties including all applicable equipment and products.

B. Related Requirements Described Elsewhere:

1. General Requirements: Division 1
2. Equipment: Division 11
3. Special Construction: Division 13
4. Mechanical: Division 15
5. Electrical: Division 16

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 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. Paper Operation and Maintenance Manuals:

1. Size: 8½ 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 14 inches x 17 inches.
5. Provide fly-leaf for each separate product, or each piece of operating equipment.
 - a. Provide typed description of projects and major component parts of equipment.
 - b. Provide identified 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.
7. Binders: Commercial quality, three D-ring binders with durable and cleanable white plastic covers. Binders shall be presentation type with clear vinyl covers on front, back, and spine. Binders shall include two sheet lifters and two horizontal inside pockets. Maximum D-ring width: 2 inches. When multiple binders are used, correlate the data into related consistent groupings.

B. Electronic Operation and Maintenance Manuals.

1. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution of 300 dots per inch (dpi) or greater, depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.
2. When multiple files are required the least number of files possible shall be created. File names shall be in the format OMXXXXX-YYYZ-V.pdf, where XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, Z is the letter signifying a resubmittal, A, B, C, etc, and V is a number used only when more than one file is required for an O&M manual.
3. Documents prepared in PDF format shall be processed as follows:
 - a. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.
 - b. Pages shall be rotated for viewing in proper orientation.
 - c. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.
 - d. Embedded thumbnails shall be generated for each completed PDF file.
 - e. The opening view for PDF files shall be as follows:
 - Initial View: Bookmarks and Page
 - Page Number: Title Page (usually Page 1)
 - Magnification: Set to Fit in Window
 - Page: Single Page
 - f. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.
 - g. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the Equipment Name Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.
 - h. Drawings shall be bookmarked individually.
 - i. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.
4. Provide each copy on an individual CD-ROM or DVD labeled with title "OPERATING AND MAINTENANCE INSTRUCTIONS", title of project, identity

of separate structure as applicable and identity of general subject matter covered in the manual.

1.04 CONTENT OF MANUAL

- A. Neat 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, manufacturer, and installer name, addresses, and telephone numbers.
 - 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 equipment including 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 that 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 test, 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 instruction of each procedure.

- E. Copy of each warranty, bond and service contract issued.
 - 1. Provide information sheet for Owner's personnel. Give:
 - a. Contact information including name, address, email address and phone numbers
 - b. Proper procedures in event of failure.
 - c. Instances which might affect validity of warranties or bonds.

1.05 MANUAL FOR MATERIALS AND FINISHES

- A. Content for architectural products, 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 manufacturing 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. Recommended schedule for cleaning and maintenance.
- B. 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.
- C. Additional requirements for maintenance data: Respective sections of Specifications.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. 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 troubleshooting.
 - 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.
 - a. As-installed color-coded piping diagrams.

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, checkout memo, demonstration test procedures, and demonstration test certification.

B. Content for each electric and electronic systems, 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 and panelboards.
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
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 troubleshooting.
 - 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.

C. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

D. Additional requirements for operating and maintenance data: Respective sections of Specifications.

1.07 SUBMITTAL SCHEDULE

- A. Submit two (2) paper copies and two (2) electronic copies of preliminary draft of proposed formats and outlines of contents of Operation and Maintenance Manuals within 90 days after Notice to Proceed.
- B. Submit two (2) paper copies and two (2) electronic 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 (1) 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) paper copies and four (4) electronic 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.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01740
WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

- A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.
- B. General closeout requirements are included in Section 01700: Project Closeout.
- C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual sections of Divisions 2 through 16.

1.03 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the County.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the County.

1.04 SUBMITTALS

- A. Submit written warranties to the County prior to requesting a Substantial Completion Inspection as outlined in Section 01700: Project Closeout. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the County.
- B. When a designated portion of the Work is completed and occupied or used by the County, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the County within 15-days of completion of that designated portion of the Work.
- C. When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier or manufacturer, prepare a written document that contains

appropriate terms and identification, ready for execution by the required parties. Submit a draft to the County for approval prior to final execution.

- D. Refer to individual sections of Divisions 2 through 16 for specific content requirements and particular requirements for submittal of special warranties.
- E. Prior to Substantial Completion Inspection, submit to the County two (2) copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, Subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl-covered loose-leaf binders, with thickness as necessary to accommodate contents and sized to receive 8½-inch by 11-inch three-hole punched paper.
 - 2. Table of Contents will be neatly typed in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification Section, the name of the product or work item, contact name and phone number, warrantee periods and dates.
 - 3. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of the installer, supplier, and manufacturer, warrantee period with dates.
 - 4. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address, and telephone number of the Contractor.
 - 5. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty as necessary for inclusion in each required manual.

1.05 WARRANTY REQUIREMENT

- A. The Contractor will warrant all equipment in the Contractor's one-year warranty period even though certificates of warranty may not be required. For all major pieces of equipment, the Contractor shall submit a warranty from the equipment manufacturer. "Major" equipment is defined as a device having a 5 HP or larger motor or that lists for more than \$1,000.00.
- B. In the event that an equipment manufacturer or supplier is unwilling to provide a one-year warranty commencing at Substantial Completion, the Contractor will obtain from the manufacturer a warranty of sufficient length commencing at the time of equipment delivery to the job site, such that the warranty will extend to at least 1-year past substantial completion.
- C. If an individual specification section requires a particular warranty more stringent than that required by this Section or the General Conditions, the more stringent requirements will govern for the applicable portion of the Work.
- D. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be

removed and replaced to provide access for correction of warranted Work.

- E. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty will be equal to the original warranty with an equitable adjustment for depreciation.
- F. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the County has benefited from use of the Work through a portion of its anticipated useful service life.
- G. County's Recourse: Written warranties made to the County are in addition to implied warranties, and will not limit the duties, obligations, rights, and remedies otherwise available under the law, nor will warranty periods be interpreted as limitations on time in which the County can enforce such other duties, obligations, rights, or remedies.
- H. Rejection of Warranties: The County reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- I. The County reserves the right to refuse to accept Work for the project where a special warranty, certification, or similar commitment is required on such work or part of the Work, until evidence is presented that entities required to counter-sign such commitments are willing to do so.
- J. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors required to countersign special warranties with the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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. Complete or partial demolition and removal of existing structures and equipment includes, but is not limited to, chemical bulk storage and day tanks; piping and pipe supports; valves; mixing pumps; equipment pads; foundations; concrete slabs; and mechanical, electrical, and instrumentation equipment related to the Work as shown on the Drawings and specified herein. Complete demolition and removal of existing caustic building and equipment as shown on Drawings.
3. 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 activities toward maintaining continuous operation of the existing facilities and minimizing operational inconvenience.
4. The Contractor shall be responsible for:
 - a. Approximate locations and dimensions of piping and structures are shown in the demolition plans.
 - b. Capping of all water piping.
 - c. Termination of all electric facilities in accordance with local codes and NEC.
 - d. Final grading and site restoration.
 - e. Disposal of non-salvageable and excess unacceptable materials as specified below.
 - f. All concrete tankage and slabs shall be removed before filling and compacting the depression with clean fill.
 - g. Water service shall not be disturbed, irrigation piping shall not be disturbed, and overhead electric shall not be disturbed.
5. Contractor shall examine the various Drawings, visit the site, and determine the extent of the work, the extent of work affected therein, and all conditions that are required to perform the various operations.

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 Owner prior to commencing the Work. The Contractor shall comply with the requirements of the permits.

- B. Utility Services: Contractor shall notify utility companies or local authorities furnishing gas, water, electrical, telephone, or sewer service to remove any equipment running to the facilities to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submit to the Engineer for approval three (3) copies of the proposed demolition and removal plan for the structures and modifications as shown on the Drawings or as specified herein prior to the start of work. Include in the schedule the coordination of shutoff, capping and continuation of service as required. The demolition and removal plan shall include the following as a minimum:
 - 1. A detailed sequence of demolition and removal work to insure the uninterrupted progress of the Owner's operations and the expeditious completion of the Contractor's work.
 - 2. Evidence (by signature) of approval of the Owner's plant operator of the work plan.
- B. Before commencing demolition work, all modifications necessary to bypass the affected structure will be completed. Contractor shall coordinate with the Owner's personnel to determine the locations of the affected valves and fittings.

1.04 SITE CONDITIONS

- A. The Owner assumes no responsibility for the actual condition of the structures to be demolished or relocated.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable; however, variations within each site may occur prior to the start of demolition work.
- C. No additional payment will be made for pumping or other difficulties encountered due to water.
- D. Certain information regarding the reputed presence, size, character, and location of existing underground structures, pipes, and conduit has been shown on the Drawings. The accuracy of this information is not certain and the location of underground structures shown may be inaccurate and other obstructions than those shown may be encountered. Contractor hereby distinctly agrees that Owner is not responsible for the correctness or sufficiency of the information given; that this information is not to be considered as a part of the Contract; that Contractor shall have no claim for delay or extra compensation due to incorrectness of information regarding obstructions either revealed or not revealed by the Drawings; and that Contractor 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.

1.06 DISPOSAL OF MATERIAL

- A. Salvageable material shall become the property of the Owner if the Owner requests any specific item. Contractor shall dismantle all materials to such a size that it can be readily handled, and deliver any of this salvageable material requested by the Owner to a storage area on site designated by the Owner.
- B. The following type of materials are examples of what the Owner desires to keep or salvage:
 - 1. Equipment and instrumentation as designated by Owner.
- C. Any materials that the Owner rejects shall become the Contractor's property and must be removed from the site within 30-days from demolition.
- D. Concrete, concrete block, and non-salvageable bricks shall be hauled to a waste disposal site by the Contractor.
- E. All other material shall be hauled to a waste disposal site by the Contractor.
- F. The storage or sale of removed items on the site will not be allowed.
- G. Contractor is responsible for the dewatering and disposal of all liquids, fuels and chemicals in pipelines, sumps, tanks, etc..

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 Owner. 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 or 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 Owner at no cost to the Owner.

1.10 UTILITIES

- A. Maintain existing utilities as directed by the Owner 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 Owner. Provide temporary services during interruptions to existing utilities as acceptable to the Owner.
- C. Contractor shall cooperate with the Owner 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 Owner. 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. Existing equipment, piping, buried and non-buried valving, and appurtenances shall be removed as shown or dictated on the Drawings, and/or specified herein.
- B. All equipment piping and appurtenances shall be cleaned, flushed, and drained. Equipment to be retained by the Owner as specified in Paragraph 1.06 above shall be dismantled sufficiently to permit thorough cleaning and draining. All valves shall be left open. All abandoned piping shall be capped and sleeves and openings remaining after removal of the existing equipment, piping, and appurtenances shall be plugged and sealed as shown on the Drawings, and/or specified herein.
- C. Removal of the above ground generator fuel piping shall comply with applicable requirements of FDEP 62-762 and NFPA 30.

3.03 DEMOLITION PROCEDURES

The Contractor shall adhere to the following demolition procedures as referenced on the Drawings:

- A. **DEMOLISH:** 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 as specified in Section 1.06. 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).
- B. **PROTECT:** Where indicated on the Drawings, the designated facilities shall remain intact and protected during the prosecution of the demolition work. If facilities and equipment are not designated for removal/demolition, they shall remain and be protected accordingly.

C. RELOCATE: Where indicated on the Drawings, the designated facilities shall be completely removed, intact, and relocated on site. Connected piping or conduit shall be drained and contents properly disposed.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Provide clearing, grubbing, and stripping within the construction sites, complete as specified herein.
- B. The Contractor shall clear and grub all of the area within the limits of construction and as required to complete the Work. Prior to the beginning of any clearing, the Owner shall accept the width of the area to be cleared.
- C. The Contractor's attention is directed to any soil erosion and sediment control ordinances in force. The Contractor shall comply with all applicable sections of these ordinances.

1.02 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the Engineer for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300: Submittals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CLEARING

- A. Perimeter controls shall be installed prior to initiating clearing in accordance with the approved Erosion Control Plan or SWPPP.
- B. Surface of the ground, for the area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish, and all other objectionable obstructions resting on or protruding through the surface of the ground. Clearing operations shall be conducted so as to prevent damage to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others.

- C. Where construction necessitates the removal of trees, the Contractor shall obtain all required permits. Removal of trees shall be only as directed by the County. As determined by the County, where excavation, tree removal, stripping, or trimming may result in damage to existing trees, shrubs, or bushes, the Contractor shall employ a licensed tree surgeon/service to oversee the Work and provide protection of the trees. The tree surgeon/service shall submit a detailed plan of action to the County prior to any work.

3.02 GRUBBING

- A. Perimeter controls shall be installed prior to initiating grubbing in accordance with the approved Erosion Control Plan or SWPPP.
- B. Grubbing shall consist of the complete removal of all stumps, roots larger than 1½-inches in diameter, matted roots, brush, timber, logs, and any other organic or metallic debris not suitable for foundation purposes which are resting on, under or protruding through the surface of the ground, removal shall be to a depth of 18-inches below the sub grade. All depressions excavated below the original ground surface for or by the removal of such objects shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

3.03 STRIPPING

- A. Topsoil shall be stockpiled as directed by the County. Stockpiled topsoil shall be protected until it is placed as specified. The Contractor shall dispose of any topsoil remaining after all work is in place, unless directed otherwise by the County.

3.04 DISPOSAL OF CLEARED AND GRUBBED MATERIAL

- A. The Contractor shall dispose of all material and debris from the clearing and grubbing operation by hauling such material and debris away to an approved dump. Disposal by burning and burial will not be permitted. The cost of disposal (including hauling) of cleared and grubbed material and debris shall be considered a subsidiary obligation of the Contractor; the cost of which shall be included in the Contract Price.
- B. If the County desires the timber or small trees, the Contractor shall cut and neatly pile it in 4-foot lengths for removal by the County; otherwise, the Contractor shall dispose of it by hauling it away from the project site.

3.05 PRESERVATION OF TREES

- A. Those trees designated for preservation by the County shall be carefully protected from damage. The Contractor shall erect barricades, guards, and enclosures as required for the protection of the trees during all construction operations.

3.06 PRESERVATION OF DEVELOPED PRIVATE PROPERTY

- A. The Contractor shall exercise extreme care to avoid unnecessary disturbance of developed private property as applicable. Trees, shrubbery, gardens, lawns, and other landscaping that, in the opinion of the County must be removed, shall be replaced and replanted to restore the area to the condition existing prior to construction. Such work shall be at no additional cost to the County.
- B. All soil preservation procedures and replanting operations shall be under the supervision of a nursery representative experienced in such operations.
- C. Improvements to the land such as fences, walls, outbuildings, and other structures that, of necessity, must be removed shall be replaced with equal quality materials and labor at no additional cost to the County.
- D. The Contractor shall clean up and restore the construction site/areas adjacent to developed private property immediately after construction is completed.

3.07 PRESERVATION OF AGRICULTURAL PROPERTY

- A. When the route of the construction crosses agricultural property, pastures, fields under cultivation, and related areas, the Contractor shall take care to damage as little of the property as possible.
- B. Upon completion of the construction and review and acceptance by the County, the Contractor shall restore the damaged area to the conditions existing prior to construction at no additional cost to the County. Replanting of pastures and crops shall be in strict accordance with acceptable local agricultural practices as defined by the County.
- C. Should it be necessary to remove fences to facilitate construction, the Contractor shall use temporary restraining devices to prevent the ingress or egress of animals through the section of removed fence. After construction is completed, the Contractor shall restore the fence to its prior location and condition at no additional cost to the County.

3.08 PRESERVATION OF PUBLIC PROPERTY

- A. The appropriate portions of Paragraphs 3.05, 3.06, and 3.07 of this Section shall apply to the preservation and restoration of public lands, parks, rights-of-way, easements, and all other damaged areas.

END OF SECTION

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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 that are to receive stabilizing base for paving and sidewalks to subgrade elevation.
- 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. 4½-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 that 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 or her satisfaction, prior to the submission of his or her bid, all underground 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 or her satisfaction, prior to the submission of his or her 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 that can in any way affect the Work under this Contract. Prior to commencing the excavation, the Contractor shall submit a plan of his or her proposed operations, including maintenance of traffic, to the County for review. The Contractor shall consider, and her or 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 work to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his or her progress. Costs for initial testing shall be paid by the County; however, tests that 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. 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. Sheet piling 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 that 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 or her 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 his or her 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 the Contractor 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 County's right 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. The Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and s/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 contaminants 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 subsequent to backfilling activities shall be coordinated with, and witnessed by the County. 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 that cannot be compacted properly. Common fill shall not contain stones larger than 3½-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 ½-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, ¼ to 1½-inch (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 or her failure to do so.
- D. The Contractor will be required at his or her 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, s/he shall refill to normal grade with fill at his or her 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):

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, 95% 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.

- B. Pipe shall be laid in open trenches unless otherwise indicated on the Drawings or elsewhere in the Contract Documents.
- C. 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.
- D. 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.
- E. 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.
- F. 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 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 and coordinate and install temporary and permanent replacement of traffic signalization and pavement striping and markings.

1.02 REFERENCES

- A. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, 2000 and 2004 editions.
 - 1. Section 300 – Prime and Tack Coats for Base Courses (2000 and 2004 Editions).
 - 2. Section 320 – Hot Bituminous Mixtures – Plant, Methods, and Equipment (2000 and 2004 Editions).
 - 3. Section 327 – Milling of Existing Asphalt Pavement (2000 and 2004 Editions).
 - 4. Section 330 – Hot Bituminous Mixtures – General Construction Requirements (2000 and 2004 Editions).
 - 5. Section 331 – Type S Asphalt Concrete (2000 Edition).
 - 6. Section 334 – Superpave Asphalt Concrete (2004 Edition).
 - 7. Section 901 – Coarse Aggregate (2000 and 2004 Editions).
 - 8. Section 902 – Fine Aggregate (2000 and 2004 Editions).
 - 9. Section 916 – Bituminous Materials (2000 and 2004 Editions).
 - 10. Section 917 – Mineral Filler (2000 and 2004 Editions).
- B. Florida Department of Transportation (FDOT) Design Standards, 2000 and 2004 editions.

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 35°F 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 1 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 Type S 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 331.

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 shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

- B. Type S Asphalt Concrete (Type S-1 or S-3) is required. The equivalent fine Type SP (Superpave) Asphalt Concrete mixture (Traffic Level C) meeting the requirements of FDOT Specification Section 334 may be selected as an alternate at no additional cost to the County. The equivalent mixes are as follows:
 1. Type S-1: Type SP-12.5
 2. Type S-3: Type SP-9.5
- C. Asphalt plant and equipment shall meet the requirements in FDOT Specification Section 320.

2.02 AGGREGATE

- A. Coarse Aggregate, Stone, Slag, or Crushed Gravel shall meet the requirements in FDOT Specification Section 901.
- B. Fine Aggregate shall meet the requirements in FDOT Specification Section 902.
- C. Aggregate gradation shall meet the following:

**Table 02573-1
Bituminous Concrete Mixtures
(Gradation Design Range)**

Type	Total Aggregate Passing Sieves ¹							
	3/4-inch [19.0 mm]	1/2-inch [12.5 mm]	3/8-inch [9.5 mm]	No. 4 [4.75 mm]	No. 10 [2.0 mm]	No. 40 [425 µm]	No. 80 [180 µm]	No. 200 [75 µm]
S-1 ⁴	100	88-98	75-93	47-75	31-53	19-35	7-21	2-6
S-3 ⁴		100	88-98	60-90	40-70	20-45	10-30	2-6
ABC-1		100						0-12
ABC-2		100			55-90			0-12
ABC-3 ²	70-100			30-70	20-60	10-40		2-10
FC-2 ³		100	85-100	10-40	4-12			
FC-3 ⁴		100	88-98	60-90	40-70	20-45	10-30	2-6
1. In inches [mm] or sieves [µm]. 2. 100% passing 1½-inch [37.5 mm] sieve. 3. The County may increase the design range for the No. 10 [200 mm] sieve for lightweight aggregates. 4. The County may retain up to 1% on the maximum sieve size.								

- D. Use clean aggregate containing no deleterious substances. Do not use coarse or fine aggregate which contains more than 0.5% of phosphate.
- E. In laboratory tests, and for the purpose of proportioning the paving mixture, consider all material passing the No. 10 [2.00-mm] sieve and retained on the No. 200 [75 µm] sieve as fine aggregate, and the material passing the No. 200 [75 µm] sieve as mineral filler.

- F. Do not use any screenings in the combination of aggregates containing more than 15% of material passing the No. 200 [75 µm] sieve. When two screenings are blended to produce the screening component of the aggregate, one of such screenings may contain up to 18% of material passing the No. 200 [75 µm] sieve, as long as the combination of the two does not contain over 15% material passing the No. 200 [75 µm] sieve. Screenings may be washed to meet these requirements.

2.03 ASPHALT CEMENT

- A. Superpave PG Asphalt Binder or Recycling Agent shall meet the requirements in FDOT Specification Section 916.
- B. Mineral Filler shall meet the requirements in FDOT Specification Section 917.
- C. Marshall design mix shall be in accordance with the following:

**Table 02573-2
Marshall Design Properties For Bituminous Concrete Mixes**

Mix Type	Minimum Marshall Stability (lbs.)	Flow* (0.01 in)	Minimum VMA (%)	Air Voids (%)	Minimum Effective Asphalt Content (%)	VFA Voids Filled with Asphalt (%)
S-1	1,500	8-13	14.5	4-5	**	65-75
S-3	1,500	8-13	15.5	4-6	**	65-75
ABC-1	500	7-15	15	5-16	6.0	-
ABC-2	750	7-15	15	5-14	5.5	-
ABC-3	1,000	8-13	14	4-7	**	65-78
FC-2	-	-	-	-	-	-
FC-3	1,500	8-13	15.5	4-6	**	65-75
* The maximum Flow value during production shall not exceed one point more than shown in the Table.						
** The ratio of the percentage by weight of total aggregate passing the No. 200 sieve to the effective asphalt content expressed as a percentage by weight of total mix shall be in the range of 0.6 to 1.2.						

2.04 BITUMINOUS MIXTURE

- A. Use a bituminous mixture composed of a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and bituminous material. Ensure that no more than 20% by weight of the total aggregate used is silica sand or local materials as defined in FDOT Specification Section 902. Size, grade, and combine the several aggregate fractions in such proportions that the resulting mixture meets the grading and physical properties of the verified mix design.

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 350°F 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 PREPARATION OF APPLICATION SURFACES

- A. Prior to the laying of the mixture, clean the surface of the base or pavement to be covered of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.
- B. Where an asphalt mix is to be placed on an existing pavement or old base that is irregular, and wherever the plans indicate, bring the existing surface to proper grade and cross-section by the application of patching or leveling courses.
- C. Where an asphalt mix is to be placed over a newly constructed surface treatment, sweep and dispose of all loose material from the paving area.

- D. Paint all structures that will be in actual contact with the asphalt mixture, with the exception of the vertical faces of existing pavements and curbs or curb and gutter, with a uniform coating of asphalt cement to provide a closely bonded, watertight joint.
- E. Apply a prime and tack coat on newly constructed bases and apply a tack coat, as specified in FDOT Specification Section 300, on existing pavement structures that are to be overlaid with an asphalt mix and between successive layers of all asphalt mixes.

3.03 PLACING MIXTURE

- A. Lay all asphaltic concrete mixtures, including leveling courses, other than adjacent to curb and gutter or other true edges, by the string line method to obtain an accurate, uniform alignment of the pavement edge.
- B. For each paving machine operated, use a separate crew, each crew operating as a full unit. The Contractor's Certified Paving Technician in charge of the paving operations may be responsible for more than one crew but must be physically accessible to the County at all times when placing mix.
- C. Check the depth of each layer at frequent intervals, and make adjustments when the thickness exceeds the allowable tolerance. When making an adjustment, allow the paving machine to travel a minimum distance of 32-feet to stabilize before the second check is made to determine the effects of the adjustment.
- D. In limited areas where the use of the spreader is impossible or impracticable, the Contractor may spread and finish the mixture by hand.
- E. Straightedge and back-patch after obtaining initial compaction and while the material is still hot.
- F. Upon arrival, dump the mixture in the approved mechanical spreader, and immediately spread and strike-off the mixture to the full width required, and to such loose depth for each course that, when the Work is completed, the required weight of mixture per square yard [square meter], or the specified thickness, is secured. Carry an excess amount of mixture ahead of the screed at all times. Hand-rake behind the machine as required.
- G. Construct each course in layers of the thickness as shown on FDOT Design Standards Index No. 513.
- H. Before starting any rolling, check the surface; correct any irregularities; remove all drippings, fat sandy accumulations from the screed, and fat spots from any source; and replace them with satisfactory material. Do not skin patch. When correcting a depression while the mixture is hot, scarify the surface and add fresh mixture.

3.04 APPLICATION OF LEVELING COURSES

- A. Before spreading any leveling course, fill all depressions in the existing surface more than 1-inch deep by spot patching with leveling course mixture, and then compact them thoroughly.
- B. Place all courses of leveling by the use of two (2) motor graders; equip one with a spreader box. Use other types of leveling devices after they have been approved by the County.
- C. When the total asphalt mix provided for leveling exceeds 50-lb/yds² [27-kg/m²], place the mix in two or more layers, with the average spread of any layer not to exceed 50-lb/yd² [27-kg/m²]. When using Type S-3 Asphaltic Concrete for leveling, do not allow the average spread of a layer to be less than 50-lb/yd² [27-kg/m²] or more than 75-lb/yd² [40-kg/m²]. The Contractor may vary the rate of application throughout the Project as directed by the County. When leveling in connection with base widening, the County may require placing all the leveling mix prior to the widening operation.

3.05 COMPACTING MIXTURE

- A. The coverage is the number of times the roller passes over a given area of pavement. Regardless of the rolling procedure used, complete the final rolling before the surface temperature of the pavement drops below 160°F.
- B. Seal Rolling: Provide two (2) coverages with a tandem steel-wheeled roller (either vibratory or static), weighing 5 to 12-tons, following as close behind the spreader as possible without pick-up, undue displacement, or blistering of the material. Use vibratory rollers in the static mode for layers of 1-inch or less in thickness.
- C. Intermediate Rolling: Provide five (5) coverages with a self-propelled pneumatic-tired roller, following as close behind the seal rolling operation as the mix will permit.
- D. Final Rolling: Provide one (1) coverage with a tandem steel-wheeled roller (static mode only), weighing 5 to 12-tons, after completing the seal rolling and intermediate rolling, but before the surface pavement temperature drops below 160°F.
- E. Operate the self-propelled, pneumatic-tired roller at a speed of 6 to 10-mph. For each roller, do not exceed an area of coverage of 4,000 yd²/hour; if rolling Type S Asphaltic Concrete, do not exceed an area of coverage of 3,000 yd²/hour.
- F. Use a sufficient number of self-propelled pneumatic-tired rollers to ensure that the rolling of the surface for the required number of passes does not delay any other phase of the laying operation and does not result in excessive cooling of the mixture before completing the rolling. In the event that the rolling falls behind, discontinue the laying operation until the rolling operations are sufficiently caught up.

- G. Use hand tamps or other satisfactory means to compact areas which are inaccessible to a roller, such as areas adjacent to curbs, headers, gutters, manholes, etc.
- H. Use self-propelled pneumatic-tired rollers to roll all patching and leveling courses. Where placing the initial leveling course over broken concrete pavement, use a pneumatic-tired roller that weighs at least 15-tons. For Type S-3 Asphaltic Concrete leveling courses, use a steel-wheeled roller to supplement the traffic rollers. On other leveling courses, use a steel-wheeled roller to supplement the traffic rollers on all passes after the first pass.
- I. Do not allow the rollers to deposit gasoline, oil, or grease onto the pavement. Remove and replace any areas damaged by such deposits as directed by the County. While rolling is in progress, test the surface continuously, and correct all discrepancies to comply with the surface requirements. Remove and replace all drippings, fat or lean areas, and defective construction of any description. Remedy depressions that develop before completing the rolling by loosening the mixture and adding new mixture to bring the depressions to a true surface. Should any depression remain after obtaining the final compaction, remove the full depth of the mixture, and replace it with sufficient new mixture to form a true and even surface. Correct all high spots, high joints, and honeycombing as directed by the County. Remove and replace any mixture remaining unbonded after rolling. Correct all defects prior to laying the subsequent course.
- J. Use a self-propelled pneumatic-tired roller on the first structural layer placed on a milled surface. Compact with a minimum of three passes.

3.06 JOINTS

- A. Place the mixture as continuously as possible. Do not pass the roller over the unprotected end of the freshly laid mixture except when discontinuing the laying operation long enough to permit the mixture to become chilled. When thus interrupting the laying operation, construct a transverse joint by cutting back on the previous run to expose the full depth of the mat.
- B. For all layers of pavement except the leveling course, place each layer so that longitudinal construction joints are offset 6-inches to 12-inches laterally between successive layers.
- C. When laying fresh mixture against the exposed edges of joints (trimmed or formed as provided above), place it in close contact with the exposed edge to produce an even, well-compacted joint after rolling.

3.07 SURFACE REQUIREMENTS

- A. Obtain a smooth surface on all pavement courses placed, and then straightedge all intermediate and final courses with a 15-foot rolling straightedge. Furnish a 15-foot [4.572-m] manual straightedge, and make it available at the job site at all times during the paving operation for checking joints and surface irregularities.

- B. Produce a finished surface of uniform texture and compaction with no pulled, torn, or loosened portions and free of segregation, sand streaks, sand spots, or ripples.

3.08 ACCEPTANCE REQUIREMENTS

- A. Upon completion of the final surface or friction course, the County will test the finished surface with a 15-foot rolling straightedge. Correct all deficiencies in excess of 3/16-inch.
- B. If correction is made by removing and replacing the pavement, remove the full depth of the course and extend at least 50-feet on either side of the defective area for the full width of the paving lane.
- C. If correction is made by overlaying, cover the length of the defective area and taper uniformly to a featheredge thickness at a minimum distance of 50-feet on either side of the defective area. Extend the overlay the full width of the roadway. Maintain the specified cross slope. The County may adjust, as necessary, the mix used for the overlay for this purpose.
- D. The maximum deficiency from the specified thickness as follows:
 - 1. For pavement of a specified thickness of 2½-inches or more: ½-inch
 - 2. For pavement of a specified thickness less than 2½-inches: ¼-inch
- E. Where the deficiency in thickness is: (1) in excess of 3/8-inch for pavement of less than 2½-inches in specified thickness, or (2) in excess of ¾-inch for pavement of specified thickness of 2½-inches or more, correct the deficiency either by replacing the full thickness for a length extending at least 50-feet from each end of the deficient area.
- F. For any case of excess deficiency of the pavement, if approved by the County for each particular location, correct the deficient thickness by adding new surface material, and compact it to the same density as the adjacent surface. The County will determine the area to be corrected and the thickness of new material added.

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.

1.02 QUALITY ASSURANCE

- A. Codes and Standards: Comply with applicable sections of FDOT Specifications and local governing regulations.
- B. The mixture, placement, and curing of all concrete work shall be in accordance with FDOT 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, as specified under Section 01570: Maintenance of Traffic.
- B. Utilize flagman, barricades, warning signs, and warning lights as required.

1.05 GUARANTEE

- A. All restored areas within the public right-of-way 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 shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

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. Fibermesh Reinforcement: Fibermesh reinforcement fibers shall be 2-inches to 3-inches collated polypropylene fibers. Fibers shall be in strict accordance with the manufacturer recommendations and within the time as specified in ASTM C94, Type III 4.13 and applicable building codes.
- C. Concrete Materials: Comply with requirements of FDOT Section 347 for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- D. Epoxy Resin Grout: Type N as specified in FDOT Section 926.
- E. Aggregate, brick, or other material required to match existing driveway or walk shall be as approved by the County.

2.03 CONCRETE MIX, DESIGN, AND TESTING

- A. Comply with requirements of applicable FDOT 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 form work 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 which 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 $\frac{1}{4}$ 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 $\frac{1}{2}$ -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:
 - (1) Provide premolded joint filler for expansion joints abutting concrete curbs, catch basin, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.
 - (2) Locate expansion joints at 12-feet on center for concrete walks unless otherwise indicated.
 - (3) Extend joint fillers full-width and depth of joint, and not less than $\frac{1}{2}$ -inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
 - (4) 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.
 - (5) 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.
 - (6) 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 $\frac{1}{3}$ -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 $10\frac{1}{2}$ -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:

Protect and cure finished concrete paving and walks, complying with applicable requirements of FDOT 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 02578

SOLID SODDING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Establishing a stand of grass by furnishing and placing grass sod. Included are fertilizing, watering, and maintenance as required to assure a healthy stand of grass. Solid sodding shall be placed on all slopes greater than 4:1, within 10-feet of all proposed structures, and in all areas where existing grass or sod (regardless of its condition) is removed or disturbed by Contractor's operation unless otherwise specified or shown on the Drawings.

1.02 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. A certification of sod quality by the producer shall be delivered to the County ten days prior to use.

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 GRASS SOD

- A. Grass sod for the road rights-of-way shall be of variety to match the existing adjacent area and shall be well matted with grass roots. The sod shall be taken up in rectangles, preferably 12-inch by 24-inch, shall be a minimum of 2-inches in thickness, and shall be live, fresh, and uninjured at the time of planting.
- B. Grass sod for restoration of new construction sites and/or areas disturbed by construction on existing sites shall be St. Augustine well matted with grass roots. The sod shall be taken up in rectangles, preferably 12-inch by 24-inch, shall be a minimum of 2-inches in thickness, and shall be live, fresh, and uninjured at the time of planting.

- C. It shall be reasonably free of weeds and other grasses and shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. The sod shall be planted as soon as possible after being dug and shall be shaded and kept moist until it is planted.

2.03 FERTILIZER

- A. Commercial fertilizers shall comply with the state fertilizer laws.
- B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid, and (3) water-soluble potash contained in the fertilizer.
- C. The chemical designation of the fertilizer shall be 6-6-6. At least 50% of the nitrogen shall be derived from organic sources. At least 50 % of the phosphoric acid shall be from normal super phosphate or an equivalent source, which will provide a minimum of two units of sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or other container.

2.04 WATER FOR GRASSING

- A. The water used in the sodding operations shall be by the Contractor as approved by the County.

PART 3 - EXECUTION

3.01 PREPARATION OF GROUND

- A. The area over which the sod is to be placed shall be scarified or loosened to a depth and then raked smooth and free from debris. Where the soil is sufficiently loose and clean, the County, at its discretion, may authorize the elimination of ground preparation.

3.02 APPLICATION OF FERTILIZER

- A. Before applying fertilizer, the soil pH shall be brought to a range of 6.0 – 7.0.
- B. The fertilizer shall be spread uniformly over the area to be sodded at the rate of 700-pounds per acre, or 16-pounds per 1,000 square feet, by a spreading device capable of uniformly distributing the material at the specified rate. Immediately after spreading, the fertilizer shall be mixed with the soil to a depth of approximately 4-inches.
- C. On steep slopes, where the use of a machine for spreading or mixing is not practicable, the fertilizer shall be spread by hand and raked in and thoroughly mixed with the soil to a depth of approximately 2-inches.

3.03 PLACING SOD

- A. The sod shall be placed on the prepared surface, with edges in close contact and shall be firmly and smoothly embedded by light tamping with appropriate tools.
- B. Where sodding is used in drainage ditches, or on slopes of 4:1 or greater, the setting of the pieces shall be staggered to avoid a continuous seam along the line of flow. Along the edges of such staggered areas, the offsets of individual strips shall not exceed 6-inches. In order to prevent erosion caused by vertical edges at the outer limits, the outer pieces of sod shall be tamped so as to produce a featheredge effect.
- C. On slopes greater than 2:1, the Contractor shall, if necessary, prevent the sod from sliding by means of wooden pegs driven through the sod blocks into firm earth at suitable intervals.
- D. Sod which has been cut for more than 72-hours shall not be used unless specifically authorized by the County after the inspection thereof. Sod which is not planted within 24-hours after cutting shall be stacked in an approved manner, maintained, and properly moistened. Any pieces of sod that, after placing, show an appearance of extreme dryness shall be removed and replaced by fresh, uninjured pieces.
- E. Sodding shall not be performed when weather and soil conditions are, in the County's opinion, unsuitable for proper results.

3.04 WATERING

- A. The areas on which the sod is to be placed shall contain sufficient moisture, as determined by the County, for optimum results. After being placed, the sod shall be kept in a moist condition to the full depth of the rooting zone for at least 2-weeks. Thereafter, the Contractor shall apply water as needed until the sod roots and starts to grow for a minimum of 60-days (or until final acceptance, whichever is latest).

3.05 MAINTENANCE

- A. The Contractor shall maintain the sodded areas in a satisfactory condition, at his or her expense, until final acceptance of the Project. Such maintenance shall include repairing of any damaged areas and replacing areas in which the establishment of the grass stand does not appear to be developing satisfactorily.
- B. Replanting or repair necessary due to the Contractor's negligence, carelessness, or failure to provide routine maintenance shall be at the Contractor's expense.

END OF SECTION

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SECTION 02784
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This section specifies black PVC coated chain-link fence, nominally 8-foot high with 3 strands of barbed wire at a 45-degree angle, complete with gates to be constructed around the area indicated on the Drawings.

1.02 QUALITY ASSURANCE

- A. Chain link fences and gates shall be constructed in accordance with specified standards, as well as all pertinent codes and regulations. Where provisions of pertinent codes conflict with the specifications, the more stringent provisions shall govern.
- B. Chain link fences and gates shall be manufactured by established, reputable manufacturers that have been engaged in the manufacture of chain link fencing for at least 10-years.

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 layout drawings of all fence and gate installations along with details and manufacturer's literature of all fence and gate materials in the Project.
- C. The Contractor shall submit all motor data, connection diagrams, wiring diagrams, and O&M instructions for all gate operators in the Project.

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. Fabric: The fabric shall be aluminum coated steel chain link, 96-inches high, No. 9-gauge wire woven in a 2-inch mesh. The fabric shall conform to the requirements of ASTM Designation A392. The aluminum coating shall be a minimum of 0.40-ounces per square foot of wire surface for No. 9-gauge fabric. The fabric shall have a minimum tensile strength of 75,000-psi. The weight of the coating shall be determined by the strip test as defined in ASTM Designation A428. The fabric shall be coated with an ultra violet stable black PVC coating which meets ASTM standards F688 Class I.
- B. Post and Other Appurtenances: All posts and other appurtenances used in the construction of this fence shall be hot dipped galvanized with a minimum of 1.8-ounces per square foot of surface. Pipe sections shall conform to the requirements of ASTM Designation A120. All posts, rails, and fittings shall be coated with an ultra violet stable black PVC coating which meets ASTM standards F688 Class I.
- C. Sizes of Posts, Gate Frames, and Rails:

COMPONENT	DIMENSIONS	
	Nominal Diameter	NPS Pipe Schedule
1. End, corner & pull posts	3-inch	40
2. Gateposts (one leaf width 8-feet or less)	3-inch	40
3. Intermediate posts	2-3/8-inch	40
4. Gate Frames	1-5/8-inch	40
5. Braces	1-5/8-inch	40
6. Top Rails	1-5/8-inch	20

D. Gates

1. Swing Gates: Gates shall be complete with latches, stops, keepers, and hinges. Gate frames shall be constructed of round tubular members continuously welded at all corners or assembled with fittings. Welds shall be painted with aluminum or zinc based paint prior to application of PVC coating. Gate filler shall be of the same fabric as specified for the fence and shall be attached securely to the gate frame with No. 9 tie wires at intervals not exceeding 12-inches. Hinges shall be of adequate strength for the gate and with large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gates shall be easily operable by one person. Latches, stops, and keepers for all gates, along with 1-inch stainless steel chain and padlock, shall be provided.
2. Gate padlocks shall be the County standard, case brass, shackle-case hardened steel, 1-inch links with 12-inch chain, 606 finish and keyed alike when more than one.

- E. Top Rail: The top rail shall be provided with couplings approximately every 20-feet. Couplings are to be the outside sleeve type, at least 6-inches long.

- F. Barbed wire shall be 2-strand, 12 1/2 –gauge wire with 14 gauge, 4-point barbs at 5 inches center. Barbed wire shall conform to ASTM A-121, zinc coated, and black PVC coated.
- G. Concrete: Concrete shall have a minimum compressive strength of 2,500-psi at 28-days.
- H. Hardware: Miscellaneous hardware shall be of steel, malleable iron or ductile iron of standard design and conform to the requirements of the Chain Link Fence Manufacturer's Institute. All parts shall be galvanized except ties and clips may be aluminum.

PART 3 - EXECUTION

3.01 ARRANGEMENT

- A. Posts: Posts shall be uniformly spaced, not to exceed 10-feet on centers. Intermediate posts shall have waterproof tops, which have integrally cast openings through which the top rails shall pass. Terminal posts shall consist of end, corner, and pull posts.
- B. Braces: Braces shall be provided at each gate, corner, pull, and end post.
- C. Top Rails: The top rails shall pass through the line post tops and form a continuous brace from end to end of each stretch of fence. The top rail shall be securely fastened to the terminal posts by heavy pressed steel brace bands and malleable end connections.
- D. Bottom Tension Wire: The bottom tension wire shall be No. 7-gauge aluminum coated spring coil or crimped wire. Minimum weight of aluminum coating shall be 0.40-ounces per square foot of wire surface. The tension wire shall be stretched taut between terminal posts and securely fastened to each intermediate post 2-inches above the finish grade line. Tension wire shall be attached to the fence fabric with aluminum hog rings every 24-inches.
- E. Stretcher Bars: Stretcher bars shall be no less than 3/16-inch by 3/4-inch in cross section and shall have minimum length 2-inches longer than the fabric height. Stretcher bars shall be used for attaching the fabric to all terminal posts by threading through the fabric and being attached to the posts with No. 9-gauge tension bands, or other positive mechanical means, spaced at 24-inch centers. One (1) stretcher bar shall be provided for each gate and end post and 2 for each corner and pull post.
- F. Ties and Clips: Fabric shall be fastened to all intermediate posts with 9-gauge tie wires, spacing not to exceed 12-inches apart. Fabric shall be tied to top rail with 9-gauge tie wires, spacing not to exceed 24-inches on centers.

3.02 INSTALLATION

- A. Post Setting: Line posts shall be set in holes 12-inches in diameter, 42-inches deep with 36-inch post embedment. Terminal posts shall be set in holes 15 inches in diameter, 42

inches deep, with 36-inch post embedment. After the post has been set and plumbed, the hole shall be filled with concrete. The exposed surface of the concrete shall be crowned to shed water.

- B. Terminal and Gateposts: Terminal and gateposts shall be set as specified above and shall be braced to the nearest post with a galvanized horizontal brace used as a compression member and a galvanized 3/8-inch steel truss rod and turnbuckle used as a tension member.
- C. Fabric: Fabric shall not be stretched until concrete footings have cured a minimum of 3-days. Chain link fabric shall be placed on the side designated by the County and shall be stretched taut approximately 2-inches above finish grade and securely fastened to all posts. Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

END OF SECTION

SECTION 02850

PLANT MOTORIZED GATE

PART 1 - GENERAL

1.01 SCOPE

- A. This section covers design, furnishing, and installation of a motorized entrance gate which includes, but is not limited to, security control panels, power supplies, gate and gate operators, gate control panels and Plant Control System (PCS) interface. The gate shall consist of two opposing sliding cantilevered gates with motorized operators as shown on the drawings and specified herein.
- B. The motorized gate shall be compatible with OWNER existing Plant Control System (PCS) interface. The System Supplier shall be responsible to provide all equipment specified herein, and shall subcontract the gate and gate control system to an OWNER approved, certified installer. Gate operator system shall be provided with Electronic Card Access System (ECAS) as per Orange County's standards with all the accessories as stated in this specification and as shown on instrumentation drawings.
 - 1. A desk mounted control panel which contains auto/manual open gate swing arm switches is located inside the guardhouse that allows the guard to open (and hold open) all gate swing arms and the main gate. When the gate swing arm switch is in auto mode, the gate swing arms are actuated by security badge reader and Lenel system.
 - 2. Main Gate may also be opened by Plant Control System (PCS). Provide a key switch for the HySecurity control unit to select normal/night mode. When in night mode, the gate will close and disables the Gate Manual Open switch in the gate house.
 - 3. All exiting from the plant will automatically open main gate and exit gate swing arm via vehicle detector loops
- C. All associated equipment, devices, cabling (fiber-optic and copper), system configuration, and controls necessary for proper operation shall be included.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The System Supplier shall furnish all installation drawings, tools, equipment, conduit, wiring, materials, and supplies and shall perform all labor to complete the work as specified, and in compliance with all applicable codes, standards, and regulations.
- B. System Supplier shall coordinate with CONTRACTOR and any sub-contractors (including electrical) to provide all additional conduit and wiring required for a complete operable system beyond the use of conduit marked for security use as shown on drawings.

- C. The System Supplier shall review the specifications and supply equipment that meets the functional requirements indicated, and shall furnish and install additional or differing components if required.

2.02 SUPPLIER

A. Supplier's Qualifications

- 1. The design, equipment, installation, and installation supervision furnished under this section shall be provided by a manufacturer or supplier who has been engaged in the business of supplying these types of equipment for at least 5 years.

B. Governing Standards

- 1. All wiring and components shall meet the applicable requirements of the NEC.

C. Nameplates

- 1. Major components of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address, and type or style and catalog number of the item. Name plates shall be as specified in the Equipment, Valve, and Piping Identification section.

D. Tags

- 1. Keys and locks, where required, shall be furnished with tags bearing stamped identification number. Cable and conduit runs, wiring circuits, and all spare parts supplied to maintain the equipment shall be furnished with tags. Tags shall be as specified in the Equipment, Valve, and Piping Identification section.

E. Power Requirements

- 1. Primary power supply to all components will be 208 volt, 60 Hz., single phase. The System Supplier shall be responsible for meeting all additional power supply requirements and shall furnish any transformers or other power supply equipment needed.

2.03 SUBMITTALS

- A. Complete wiring diagrams; assembly and installation drawings; detailed specifications; and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The equipment submittals shall include the following:

- 1. A complete description of all components, including certification of listing by UL.
- 2. Complete sequence of operation for all functions of the equipment.
- 3. Complete wiring diagram for all components and interfaces to equipment supplied under other sections or by the Owner.
- 4. Location drawings for all components.
- 5. A listing of the manufacturer's representatives responsible for installation and servicing.
- 6. Conduit and cabling to all equipment locations.

2.04 ELECTRIC MOTORIZED GATE

- A. The facility gate system shall be furnished as a complete package by the System Supplier consisting of a vehicular motorized slide gate as shown on the drawings and as specified herein. The gate system shall include the slide gate, automatic gate operator, and all required structural and safety equipment. Facility ingress shall be by through the Plant Control System (PCS) initiated by the SCADA operator at the Eastern Regional WSF or by the ECAS system at the Site entrance. Facility egress shall be by road imbedded proximity vehicle detector. The gate controller and gate operation shall be integrated with the Plant Control System (PCS).
- B. Slide Gate. The slide gate shall meet the following mechanical specifications:
1. The slide gate shall be the Traditional Georgian Cantilever type.
 2. Gates shall have 2"x 4" rectangular frame with a 2" vertical upright every four feet; 3/16" stainless steel aircraft table "X" bracing throughout.
 3. Gates shall have two (2) 2"x 1-1/2" stringers set in frame with 1" pickets set 3-1/8" o.c with a between space of 2-1/8".
 4. The slide gate construction shall be a non-ornamental, aluminum design. Gate shall conform to UL 325 standards. Field verify actual gate size.
 5. Gate will be coated with approximately 4-6 mil coat of TCI TG polyester powder coating. Verify color with OWNER.
 6. Provide crawl bar to eliminate crawl space under gate frame.
- C. Slide Gate Operator.
1. Gate operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 4000 pounds. Gate panel velocity shall not be less than 1.7 feet per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly. The "soft stop" feature of the gate operator shall be controlled by two adjustable hydraulic brake valves (one for each direction). The "soft start" feature shall allow the pump to start at zero pressure, then progressively increase the pressure, over a period not less than two seconds, to 1,000 PSI. The gate operator shall be interfaced to the PCS for remote operation and override.
- D. Operator Code Requirements. The gate operator shall meet the following regulatory requirements.
1. Operators shall be built to UL325 standards. Installer shall ensure the automated gate installation conforms to the latest revisions of UL 325 and ASTM F2200.
 2. Current safety standards require the use of multiple external sensors to be capable of reversing the gate in either direction upon sensing an obstruction.
 3. Current safety standards require gate operators to be designed and labeled for specific usage classes. HySecurity Model 222 EX gate operators are to be used on

Class III and Class IV installations only.

- E. Functionality. The gate operator shall include the following specifications components and functionality.
1. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
 2. Limit switches: Fully adjustable, toggle types, with plug connection to control panel for gate open and gate closed.
 3. Vehicle Detection Loops: Entrance gate will have one inside and one outside obstruction loops. Exit gate will have one free exit loop, one inside obstruction and one outside obstruction loop. All loops to use HY5A loop detector.
 4. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories. Enclosure shall be NEMA Type 4X stainless steel.
 5. Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 psi.
 6. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
 7. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
 8. Hydraulic fluid: High performance type with a viscosity index greater than 375.
 9. A zero to 2000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
 10. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.
 11. Pump motor: Shall be a single phase, 60Hz, 208 VAC, 2 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater. All components shall have overload protection and NEMA Type 4X local disconnect/enclosure.
 12. Heater with thermostat control for damp humid climates.
 13. Gate controller: HySecurity Smart Touch Controller Board with 128K memory or and approved equal containing:
 - a. Inherent entrapment sensor;
 - b. Built in "warn before operate" system;
 - c. Built in timer to close;
 - d. Liquid crystal display for reporting of functions;
 - e. 19 programmable output relay options;
 - f. Anti-tailgate mode;
 - g. Built-in power surge/lightening strike protection;
 - h. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.
 14. Required external sensors installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
 - a. Provide two sets of UL approved EMX IRB photo safety beam with NEMA Type 4X enclosure or approved equal for each slide gate. One set to protect the open direction of gate travel and one set to protect the close direction of gate travel. Install eye no further than 5-inches from the face of the gate and between 21 and 27.5 inches from the roadway surface so that if the beam for the eye is blocked

- the gate will not operate.
- b. Siren operated sensor for fire department emergency ingress. Fire department to specify sensor frequency.
15. The gate operator shall be HySecurity Model 222EX 1.7 Heavy Duty Industrial Slide Gate Operator or approved equal.

F. Warranty. The gate and gate operator warranty is:

1. System Supplier one (1) year warranty on all labor and materials.
2. Manufacturers warranty on gate operator for five (5) years
3. Manufacturers warranty on gate drive wheels for two (2) years
4. Manufacturers warranty on all labor for one (1) year.
5. Manufacturers warranty to commence upon OWNER'S approval of satisfactory installation and startup.

2.05 SLIDE GATE CONTROLS AND ELECTRONIC CARD ACCESS SYSTEM (ECAS)

- A. An electric operated gate with Electronic Card Access System (ECAS) will be provided.
- B. The card access shall utilize County's existing ECAS pass cards and shall not require new access cards. Card entry system shall be provided at the main gate. ECAS and gate controller shall be connected into the new security control system that is provided by the I & C supplier as per I-drawings.
- C. HID 5355-A-G-K ProxPo card reader with a copper connection from the reader to the local gate control equipment. The copper connections shall be installed in a ¾" aluminum conduit.
1. Lenel LNL-2220 Intelligent Dual Reader Controller (inside panel unit) 12 VDC or 24 VDC @ 700mA, size (6" (152 mm) W x 8" (203 mm) L x 1" (25 mm), (5 year lithium battery or 3 months full run) 6 MB standard cardholder flash memory, 50,000 of event memory, maximum of 32 devices.
 2. Lenel LNL-1320 Dual Reader Interface Module (outside panel unit) (Series 2 supports OSDP readers) 12/24 VDC, 2 reader interface, W/M, 8 inputs, 6 (5A) form C relays, RoHS, CE, C-Tick and UL294 certified cutsheet URL: http://www.lenel.com/sites/default/files/HW_LNL-1320-series2.pdf.
 3. ALLEGION AptiQ MTK!% Multi-Technology reader with keypad MTK15 or HID MultiCLASS SE RPK40 Wall Switch Keypad Reader Model 921PTNNEK00000.
 4. IFS International Fiber Systems d1300 fiber modules RS-485 2-wire Delta Transceiver, MM 2 fibers.
 5. Phoenix Contact Trio Power 2.5A 24V Power Supplies.
- D. Outdoor enclosure.
- E. FDC Aluminum Mounting Pedestal (Or Accepted Equal) for keypad (NWRP only).

- F. Three each - Vehicle loops sawn and sealed in existing asphalt pavement for safety and/or free exit operation.
- G. Radio controlled Miller safety edge (Or Accepted Equal).
- H. UL approved EMX IRB Photo Safety Beam set (Or Accepted Equal) and Aluminum Housing.
- I. Siren Operated Sensor and key switch for Emergency Access. Provide Siren Operated Systems, SOS VIII or equal. Knox Key Switch for emergency override, 3500 series by Knox Company or equal
- J. Gate supplier shall sub-contract to the I&C supplier (Curry Controls) for providing the gate security control panels, gate junction boxes, etc. as per Orange County's standards and as shown on I-drawings. All the equipment required for security control panel, gate junction boxes, etc. are listed in the I-drawings. Gate supplier shall coordinate with the sub-contractor for a complete and workings security gate system. Gate supplier shall coordinate with Electrical Contractor for all the interconnection conduit/cable requirements before bidding and notify the Engineer if any deviation is proposed from the design drawings. Gate supplier shall still be solely responsible for the operation of a complete gate package system.

2.06 OPERATION, MAINTENANCE AND INSTRUCTION MANUALS

- A. Operation, Maintenance and Instruction Manuals for the equipment and systems shall be furnished in accordance with Section 01720 – Project Record Documents and Section 01730 – Operating and Maintenance Data.
 - 1. All settings that are installed in Controller shall be documented and provided for a separate manual to be placed in the PLC panel.

2.07 MANUFACTURERS' FIELD SERVICES AND TRAINING

- A. Equipment manufacturers or suppliers shall provide the services of a factory-trained manufacturer's representative or agent and maintenance personnel as required to participate in installation, check-out, and testing of equipment and systems, and in the training of Owner plant operating personnel as required by Section 01650 – Startup and Demonstration and this section. The representative shall have complete knowledge of proper installation, operation, and maintenance of the equipment and systems supplied.
- B. The manufacturer's representative or agent shall visit the site or classroom designated by the Owner, for the minimum person-days listed below, travel time excluded.
 - 1. Full time as required. The System Supplier shall provide on-site supervision of installation.
 - 2. 3 days. Inspection, checking, and adjustment of equipment, including submittal of Manufacturer's Certificate of Proper Installation in accordance with 01650 – Startup

- and Demonstration.
3. 2 days. Participate in Functional Tests, Start-Up Tests, and Demonstration Tests and in preparation of required certifications in accordance with 01650 – Startup and Demonstration.
 4. 2 days. Participation in Manufacturer’s Training Services of Owner’s Personnel.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be installed in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.
- B. After completion of the installation, the System Supplier shall clean the inside and the outside of the security equipment and shall remove any dirt and debris from the site.

3.02 CABLE

- A. Cable shall be installed in accordance with Section 16050. The conductors shall be installed in conduits or junction boxes separate from conductors of other systems. Conduit fill shall meet applicable NEC requirements.
- B. Raceways
 1. Conduit shall be installed in accordance with section 16050. Exposed conduit systems shall be rigid steel. Concealed conduit systems shall be PVC schedule 40.

3.03 FIELD QUALITY CONTROL, CHECKOUT AND TESTING

- A. The Contractor shall perform field quality control, checkout, and testing, and shall submit required documentation in accordance with Section 01650 – Startup and Demonstration, and any special field testing requirements as may be listed below or elsewhere in this section of these project specifications. Shop testing, if required, is addressed elsewhere in this section.
- B. Prior to starting any on-site testing the Contractor shall submit a testing protocol to the PM in accordance with the requirements of Section 01650. The protocol shall address preparation, calibration, testing procedures, measurement, and documentation for the required Functional, Start-Up, and Demonstration tests.

END OF SECTION

SECTION 02854

ENTRANCE BARRIER ARM GATE WITH CARD ACCESS SYSTEM

PART 1 – GENERAL

1.01 SCOPE

- A. This Section covers pre-wired barrier arm gate operator, complete with all pumps, valves, cylinders, and electrical devices to move gate arm and limit its travel in both directions.
- B. Arm and Fence Gates shall be controlled as follows:
 - 1. Entry Arm gate shall be opened by the Guard/Guardhouse control and by the Card Reader and Employee Card.
 - 2. Exit Arm gate shall be opened by the Guard/Guardhouse control and by embedded loop sensor in pavement.
 - 3. Fence Gate is controlled by PCS, Key Switch and Siren overrides.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Cast in place concrete: See section 03300.
- B. Electrical service and connections: See Division 16..

1.03 SUBMITTALS

- A. Shop drawings: Drawings and data shall be submitted in accordance with the Submittals section 01300. Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator. Drawings shall also show the size and location of the concrete mounting pad. Underground electrical runs including vehicle detection loops shall be shown on shop drawings.
- B. Installation instructions: Submit two copies of manufacturer's installation instructions.
- C. Test reports:
 - 1. Submit affidavits from the manufacturer demonstrating that the gate mechanism has been tested to 200,000 cycles without breakdown.
 - 2. Each operator shall bear a label indicating that operator mechanism has been tested. Operators are tested for full power and pressure of all hydraulic components, full stress tests of all mechanical components and electrical tests of all overload devices.

1.04 SUPPLIERS AND INSTALLERS QUALIFICATION

- A. The design and equipment furnished under this Section shall be provided by a manufacturer or supplier specializing in the manufacture of hydraulic gate operators of

the type specified, with a minimum of ten years experience. The card access system equipment supplier shall be Lenel.

- B. Installer: The installation supervision personnel must have a minimum of three years experience installing similar equipment.

1.05 CODES AND REGULATORY REQUIREMENTS

- A. Operators shall be built to UL 325 standards and listed by a testing laboratory. Complete all electrical work according to local codes and National Electrical Code. All fieldwork shall be performed in a neat and professional manner to journeyman standards.
- B. Vehicle gates should never be used by pedestrians. Separate pedestrian gates need to be provided when foot traffic is present.
- C. Current safety standards require gate operators to be designed and labeled for specific usage classes. The gate operator to be submitted needs to be listed for use in all UL 325 Usage Classes, I, II, III, and IV.
- D. NOTE: To be compliant with UL 325 and Industry safety guidelines, additional entrapment protection devices may need to be installed with this gate operator if the moving arm will travel within 24 inches of a stationary object.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store products upright in original shipping containers, covered, ventilated, and protected from all weather conditions. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

1.07 WARRANTY

- A. Provide five-year warranty against all defects in materials or quality of labor. Defective materials shall be replaced with comparable materials furnished by manufacturer at no cost to Owner.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Manufacturer of the barrier arm gate operator shall be HySecurity model Strong Arm 14 F UPS (HTG 320-2 DC ST) with Smart Touch Controller or equal.

2.02 OPERATION

- A. Operation shall be by means of a hydraulic cylinder pulling a crank arm that rotates the output through 90 degrees. Travel time not to exceed 2 seconds from fully closed to fully open position. Maximum arm length shall be 14'. Operator body and chassis shall be made of 10-gauge steel with a cover of 14-gauge steel to allow operation in strong winds

without operator twisting. Operation to fully open and fully closed positions shall be limited by cam-operated switches that accurately read position of the shaft and arm. Spring counterbalance shall not be required. Gears, sprockets, or belts shall not be incorporated in operator. Standard finish of the operator chassis and body shall be Safety Yellow. All models include 2 brake valves to gradually stop and hold the arm without applying a shock load to the arm or operator assembly. Manual operation, in case of power failure, shall be accomplished by the use of a "pull to release" bypass valve that unlocks the operator and allows the arm to be moved by hand.

B. Standard components shall include as a minimum:

1. Chassis shall be 10-gauge steel plate, welded, and edges ground smooth.
2. Cover shall be 14-gauge galvanized sheet steel with all joints welded, filled, and ground smooth.
3. Output shaft shall be 1¼" diameter, high strength steel alloy.
4. Crank arm shall be made of ¾" plate steel.
5. Heavy duty sealed 1¼" bearings with 4 bolt flanges.
6. Adjustable physical stop limiting close travel to prevent arm from sagging below a level position.
7. Counterweights shall be used for any arm 20 feet and longer; utilize a yoke assembly to evenly distribute load.
8. Hydraulic hose shall be ¼" synthetic, rated to 2750 PSI.
9. Arm striping shall be reflective orange and white diagonal stripes 6" in width.
10. Safety Yellow finish over a pretreatment produces enduring finish proven to withstand 1000-hour salt spray test.

C. Minimum standard electrical components:

1. Pump motor: ¾ HP minimum, 56C, 24V DC motor.
2. Motor shall have internal overload protection.
3. Electrical enclosure shall be rated NEMA 1 and have a hinged door.
4. Controls: Controller Board with 256K memory containing:
 - a. Bi-directional traffic mode;
 - b. Built in "warn before operate" system;
 - c. Built in timer to close;
 - d. Liquid crystal display for reporting of functions;
 - e. 26 programmable output relay options;
 - f. Anti-tailgate mode;
 - g. Built-in power surge/lightening strike protection;
 - h. Menu configuration, event logging, and system diagnostics easily accessible with a PC and software; and
 - i. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.
5. Control circuit shall be 24 VDC.
6. Low voltage sensor to protect batteries from over discharge. Last operation can be programmed for fail secure or fail open.
7. AC power loss operation can be programmed to open immediately or stay open after next normal operation or remain in normal operation until batteries are low.
8. Permanently sealed, maintenance free, lead acid batteries in separately insulated and ventilated enclosure.

9. Limit switches shall be adjustable to control maximum travel.
- D. Control devices: card reader, key switch, pushbuttons, vehicle obstruction loop detectors, and various Emergency vehicle open devices as dictated by local code or keypads.
- E. External sensors for stopping or reversing the gate travel: photo-eyes.
- F. Other features:
 1. Heater with thermostat for cold or damp climates.
 2. "Warn before operate buzzer".
 3. HY-5A plug in type vehicle detectors.
 4. 1 3/4" x 4 1/2" fiberglass arm.
 5. Arm Length (in 2' increments): 12', 18', 18' and Arm Material: Fiberglass.
 6. Voltages: 115 single phase.

2.04 FACTORY TESTING

- A. At the factory, fully assemble and test each gate operator to assure smooth operation, sequencing, and electrical connection integrity. Apply physical loads to the operator to simulate field conditions. Tests shall simulate physical and electrical loads equal to the fully-rated capacity of the operator components.
- B. Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity. Check welded corners and edges to ensure they are square and straight.
- C. Inspect painted finish for completeness and gloss. Touch up imperfections prior to shipment.
- D. Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

PART 3 – EXECUTION

3.01 SITE EXAMINATION

- A. Locate concrete mounting pad in accordance with approved shop drawings and in compliance with local building codes.

3.02 INSTALLATION

- A. Install gate operator in accordance with the manufacturer's printed instructions, current at the time of installation. Coordinate locations of operators with contract drawings, other trades and shop drawings.
- B. Installer shall insure that the electric service to the operator is at least 20 AMPS. Operator wattage is 1500.

3.03 FIELD QUALITY CONTROL

- A. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when equipment is placed in operation in accordance with the Startup Requirements section and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.
- B. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed. The following need to be tested for the installed equipment:
 - 1. Test gate operator through ten full cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper "at rest" gate position.
 - 2. All anchor bolts shall be fully concealed and fully tightened in the finished installation.
- C. Owner, or Owner's representative, shall complete "punch list" with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer.

3.04 CONTINUED SERVICE AND DOCUMENTATION

- A. The manufacturer's representative is responsible for training Owner's personnel on how to safely shut off electrical power and release and manually operate barrier arm. Additional demonstration of the general maintenance of the gate operator and accessories also need to be provided. Manufacturer needs to provide one copy of "Installation and Reference" manual for the owner's use. Manuals will identify parts of the equipment for future procurement; provide maintenance personnel direct contact information and the technical support sections.

END OF SECTION

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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 1½-in of the face of the concrete. The part of the tie to be removed shall be at least ½-in diameter or be provided with a wood or metal cone at least ½-in diameter and 1½-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 1½-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 watertightness 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.
- B. Furnish only all deformed steel reinforcement required to be entirely built into concrete masonry unit construction.

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 1½ 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 – ¾-in
 - b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1½-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 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. (Non-extruding 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. 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. Pre-molded Joint Filler:

1. Pre-molded joint filler - Structures. Self-expanding cork, pre-molded joint filler shall conform to ASTM D1752, Type III. The thickness shall be $\frac{3}{4}$ -in unless shown otherwise on the Drawings.
2. Pre-molded 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 $\frac{3}{4}$ -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 pre-molded 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 1½-in of expansion.
2. Dowel Bar Sleeves: Provide Greenstreak two component Speed Dowel System, to accept 1-in diameter x 12-in 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.; Concreive 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 ½-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 pre-molded 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 expansion joints as shown on the Drawings.
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 SCOPE OF WORK

- A. Furnish all labor and materials required and install cast-in-place concrete complete 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. Concrete Joints and Joint Accessories are included in Section 03250.
- 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 including the following:
 - 1. Sources of cement, pozzolan, and aggregates.
 - 2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
 - 3. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 - 4. Water-reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 - 5. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range, and conformity to ASTM standards. Identify proposed locations of use.
 - 6. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type and manufacturer of cement. Provide either a. or b. below for each mix proposed.
 - a. Standard deviation data for each proposed concrete mix based on statistical records.
 - b. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28 day cylinder strength test results for each mix. Provide results of 7 and 14 day tests if available.

7. Sheet curing material. Product data including catalogue cut, technical data, and conformity to ASTM standard.
8. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate, and conformity to ASTM standards. Identify proposed locations of use.

B. Samples:

1. Fine and coarse aggregates if requested by the Engineer.

C. Test Reports:

1. Fine aggregates – sieve analysis, physical properties, and deleterious substance.
2. Coarse aggregates – sieve analysis, physical properties, and deleterious substances.
3. Cements – chemical analysis and physical properties for each type.
4. Pozzolans – chemical analysis and physical properties.
5. Proposed concrete mixes – compressive strength, slump and air content.

D. Certifications:

1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
3. Certify curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

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 C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
7. ASTM C150 - Standard Specification for Portland Cement
8. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
13. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
14. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

15. ASTM C1017 – Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

B. American Concrete Institute (ACI):

1. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 318 - Building Code Requirements for Structural Concrete.
5. ACI 350 - Environmental Engineering Concrete Structures.
6. 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. Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes and standards. The most stringent requirement of the codes, standards and this Section shall apply when conflicts exist.
- B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.
- C. Well in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required. Prior to the placement of any concrete containing a high-range water-reducing admixture (plasticizer), the Contractor, accompanied by the plasticizer manufacturer, shall discuss the properties and techniques of batching and placing plasticized concrete.
- D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.
- F. Testing of the following materials shall be furnished by Contractor to verify conformity with this Specification Section and the stated ASTM Standards.
 1. Fine aggregates for conformity with ASTM C33 – sieve analysis, physical properties, and deleterious substances.
 2. Coarse aggregates for conformity with ASTM C33 – sieve analysis, physical properties, and deleterious substances.
 3. Cements for conformity with ASTM C150 – chemical analysis and physical properties.
 4. Pozzolans for conformity with ASTM C618 – chemical analysis and physical properties.
 5. Proposed concrete mix designs – compressive strength, slump and air content.

G. Field testing and inspection services will be provided by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid by the Owner. Testing of the following items shall be by the Owner to verify conformity with this Specification Section.

1. Concrete placements – compressive strength (cylinders), compressive strength (cores), slump, and air content.
2. Other materials or products that may come under question.

H. All materials incorporated in the work shall conform to accepted samples.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cement: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.

B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.

C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to uniform moisture content before using. Do not use frozen or partially frozen aggregates.

D. Admixtures: Store in closed containers to avoid contamination, evaporation or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.

E. Pozzolan: Store in weather-tight buildings, bins, or silos to provide protection from dampness and contamination.

F. Sheet Curing Materials: Store in weather-tight buildings or off the ground and under cover.

G. Liquid Curing Compounds: Store in closed containers.

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. Cement: U.S. made portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:

2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:
 - 1. Class A,B,C,D Concrete - Type II with the addition of fly ash resulting in C₃A being below 5 percent of total cementitious content, Type III limited to 5 percent C₃A or Type V.
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 herein.
- E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures and shall be suitable for use in contact with potable water after 30 days of concrete curing.
 - 1. Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 - 2. Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 - 3. High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in nonsegregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations. Where walls are 14-in thick or less and the wall height exceeds 12-ft a mix including a plasticizer must be used.
 - 4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.
- G. Pozzolan (Fly Ash): Pozzolan shall be Class C or Class F fly ash complying with ASTM C618 except the Loss on Ignition (LOI) shall be limited to 3 percent maximum.

- H. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compound shall be approved for use in contact with potable water after 30 days (non-toxic and free of taste or odor). Curing compound shall comply with Federal, State and local VOC limits.

2.03 MIXES

- A. Development of mix designs and testing shall be by an independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
 - 1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.

- F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10-in.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1
CONCRETE MIX REQUIREMENTS

Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)
A	2500	C150 Type II	C33	57	440 min.
B	3000	C150 Type II	C33	57	480 min.
C	4000	C150 Type II	C33	57	560 min.
D	5000	C150 Type II	C33	57	600 min.

Class	W/Cm Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range Inches
A	0.62 max.	--	3.5 to 5	Yes	*	1-4
B	0.54 max.	--	3.5 to 5	Yes	*	1-3
C	0.44 max.	25% max	3.5 to 5	Yes	*	3-5
D	0.40 max.	--	3.5 to 5	Yes	*	3-5

NOTES:

- (1) Minimum compressive strength in psi at 28 days
 - (2) ASTM designation
 - (3) Size Number in ASTM C33
 - (4) Cementitious content in lbs/cu yd
 - (5) W/Cm is Water-Cementitious ratio by weight
 - (6) AE is percent air-entrainment
 - (7) WR is water-reducer admixture
 - (8) HRWR is high-range water-reducer admixture
- * HRWR used at contractor's option except where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.

PART 3 - EXECUTION

3.01 MEASURING MATERIALS

- A. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water, and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTING

- A. Batch plants shall have a current NRMCA Certification or equal.
- B. Concrete shall be ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- C. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- D. Keep the water tank valve on each transit truck locked at all times. Any addition of water above the appropriate W/Cm ratio must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- E. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.

- F. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- G. Re-tempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
- H. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- I. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.
- J. Temperature and Mixing Time Control:
 1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees F.
 2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
 3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.
 4. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the values shown in Table 2.

TABLE 2
MAXIMUM TIME TO DISCHARGE OF CONCRETE

<u>Air or Concrete Temperature (whichever is higher)</u>	<u>Maximum Time</u>
80 to 90 Degree F (27 to 32 Degree C).....	45 minutes
70 to 79 Degree F (21 to 26 Degree C).....	60 minutes
40 to 69 Degree F (5 to 20 Degree C).....	90 minutes

If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.03 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
 - 1. The gradation of aggregate.
 - 2. The proportion of fine and coarse aggregate.
 - 3. The percentage of entrained air, within the allowable limits.
- B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10-ft away, shall be pleasing in appearance, and at 20-ft shall show no visible defects.

3.04 PLACING AND COMPACTING

- A. Placing:
 - 1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
 - 2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
 - 3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
 - 4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
 - 5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.
 - 6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.

7. Slabs:
 - a. After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
 - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.
8. Formed Concrete:
 - a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-in lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7-ft and the maximum free fall of concrete shall not exceed 15-ft.
9. Underwater concreting shall be performed in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Tremie pipes shall be in the range of 8 to 12-in in diameter and be spaced at not more than 16-ft on centers nor more than 8-ft from an end form. Where concrete is being placed around a pipe, there shall be at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system including details by the Engineer.

B. Compacting:

1. Consolidate concrete by vibration, puddling, spading, rodding, or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc, shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.
2. All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30-in apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.

4. Concrete Slabs: Concrete for slabs less than 8-in thick shall be consolidated with vibrating screeds; slabs 8 to 12-in thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
 - a. Frequency returns to normal.
 - b. Surface appears liquefied, flattened and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into surface, but has not disappeared.

3.05 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods:
 1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
 - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling, or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
 - b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
 - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.
 2. Specified applications of curing methods.
 - a. Slabs for Water Containment Structures: Water curing only.
 - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.
 - c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.

- d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
 - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.
 - f. Surfaces of Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
- D. Cold Weather Concreting:
- 1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
 - 2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12 hour intervals (minimum).
 - 3. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
 - 4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
 - a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (eg: 5 days at an average 70 degrees F = 350 degree-days).
 - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
 - 5. Salt, manure or other chemicals shall not be used for protection.
 - 6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.
- E. Hot Weather Concreting:
- 1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs/sqft/hr).
 - 2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.

- a. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
 - b. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
 - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

3.06 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30 percent of its specified design strength, nor before reaching the following number of day-degrees of curing (whichever is the longer):

TABLE 3
MINIMUM TIME TO FORM REMOVAL

<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.05D above).

- B. Shores shall not be removed until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.07 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.

- B. Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls.
 - 1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28 day test results are low.
 - 2. When the average 28 day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7 day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- C. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations and furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner. Curing boxes shall be acceptable to the Engineer.
- D. Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater the specified range, the concrete shall be rejected.
- E. Air Content: Test for air content shall be made on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173.
- F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- G. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Owner.
- H. See Specification Section 03900 for Leak Testing.

3.08 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.
- B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced.

3.09 PATCHING AND REPAIRS

- A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified by the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.

- D. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- E. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.10 SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

TABLE 4
CONCRETE SCHEDULE

<u>Class</u>	<u>Design Strength (psi)</u>	<u>Description</u>
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavements
C	4,000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams and all other structural concrete
D	5,000	Prestressed concrete

END OF SECTION

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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 "Kure-N-Seal", by Sonneborn, Minneapolis, 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 1½ 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.

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 Damp-proofing: 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

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 cementitious 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 Surfacing and Polymer Concretes
2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacing 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. Non-shrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- E. Non-shrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

- A. Non-shrink 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. Non-shrink Cementitious Grout:

1. Non-shrink 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. Non-shrink 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 non-shrink 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 30×10^{-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 ½-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 affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼-in 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 of 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 non-shrink 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 non-shrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable non-shrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable non-shrink grout for general purpose non-shrink 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 non-shrink 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 Shear.
 - 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:
 - 1) Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
 - 2) Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
 - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
 - 4) Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
 - 5) Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
 - 6) Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
 - 7) Effective Shrinkage (ASTM C883): Passes Test.
 - 8) Color: Gray.
 3. Approved manufacturers include: Sika Corporation, Lyndhurst, NJ - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, OH - Concrecive 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:
 - 1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
 - 2) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
 - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days.
 - 4) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
 - 5) Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
 - 6) Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
 - 7) Color: Concrete grey.
 3. Approved manufacturer's include:
 - a. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.
 - b. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.

D. Repair Mortar:

1. General:
 - a. Repair mortar 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:
 - 1) Compressive Strength (2 hours 50 percent RH) – 150 psi minimum
 - 2) Compressive Strength (28 days 50 percent RH) – 150 psi minimum
 - 3) Bond Strength (pull off method) – 100 percent concrete substrate failure
 - 4) 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
 - 1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
 - 2) Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.
 - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
 - 4) Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
 - 5) Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent maximum at 7 days.
 - 6) Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
 - 7) 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 - Concessive 1380 or equal.
 - b. For very thin applications; Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod LV; Master Builders Inc., Cleveland, OH - Concessive 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

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SECTION 05500
MISCELLANEOUS METAL

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Concrete joint accessories are included in Section 03350.
- B. Masonry reinforcement, ties and accessories are included in Division 4.
- C. FRP Doors and frames are included in Section 08100.
- D. Painting is included in Division 9.
- E. Louvers are included in Division 10.
- F. Sluice gates, slide gates, operators and appurtenances, including wall thimbles, are included in Division 11.
- G. Pipe hangers and sleeves are included in Division 15.
- H. Equipment anchor bolts are included in the respective Sections of Divisions 11, 14, and 15.

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. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.
- B. Samples:
 - 1. Submit samples as requested by the Engineer during the course of construction.

C. Design Data:

1. Submit calculations or test data demonstrating that the railings will resist the loads specified in the 2010 Florida Building Code at the post spacing provided.
2. Submit manufacturer's load and deflection tables for grating.

D. Test Reports:

1. Certified copy of mill test reports on each aluminum proposed for use showing the physical properties and chemical analysis.

E. Certificates:

1. Submit certification that the railing system is in compliance with OSHA requirements and the 2010 Florida Building Code.
2. Certify that welders have been qualified under AWS, within the previous 12 months, to perform the welds required under this Section.

1.04 REFERENCE STANDARDS

A. Aluminum Association (AA):

1. ABH-21 Aluminum Brazing Handbook
2. ASD-1 Aluminum Standards and Data
3. DAF-45 Designation System for Aluminum Finishes
4. SAA-46 Standards for Anodized Architectural Aluminum

B. American Society for Testing and Materials (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 - Standard Specification for Gray Iron Castings.
3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. ASTM A536 - Standard Specification for Ductile Iron Castings.
15. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
16. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
18. ASTM B429 – Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Iron and Steel Institute (AISI):

1. Specification for Structural Steel Buildings.

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code Steel.
2. AWS D1.2 – Structural Welding Code Aluminum.

E. Federal Specifications:

1. FS-FF-B-575C – Bolts, Hexagonal and Square

F. Occupational Safety and Health Administration (OSHA).

G. 2010 Florida Building Code. (FBC).

H. 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 work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.
- C. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Repair items which have become damage or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

1.07 PROJECT/SITE REQUIREMENTS

- A. Field measurements shall be taken at the site, prior to fabrication of items, to verify or supplement indicated dimensions and to ensure proper fitting of all items.

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. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

- A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:
 - 1. Structural Steel – Wide flange shapes: ASTM A992
 - 2. Structural Steel – Other Shapes; plates; rods and bars ASTM A36
 - 3. Structural Steel Tubing ASTM A500, Grade B
 - 4. Welded and Seamless Steel Pipe ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
 - 5. Steel Sheets ASTM A366
 - 6. Gray Iron Castings ASTM A48, Class 35
 - 7. Ductile Iron Castings ASTM A536, Grade 65-45-12
 - 8. Aluminum Extruded Pipe ASTM B429, Alloy 6063 T6
 - 9. Aluminum Extruded Shapes ASTM B221, Alloy 6061 T6
 - 10. Aluminum Sheet and Plate ASTM B209, Alloy 6061 T6

11. Stainless Steel Plates, Sheets, and Structural Shapes	
a. Exterior, Submerged or Industrial Use	ASTM A240, Type 316 (Type 316L for welded)
b. Interior and Architectural Use	ASTM A240, Type 304
12. Stainless Steel Bolts, Nuts, and Washers	ASTM A276, Type 316
13. Titanium Bolts, Nuts, and Washers	ASTM F468, F467
14. Hastelloy C-276 Bolts	ASTM B574
15. Carbon Steel Bolts and Studs	ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
16. High Strength Steel Bolts, Nuts and washers	ASTM A325 (mechanically galvanized per ASTM B695, Class 50, where noted)
a. Elevated Temperature Exposure	Type I
b. General Application	Type I or Type II
17. Galvanizing	ASTM A123, Zn w/0.5 percent minimum Ni
18. Galvanizing, hardware	ASTM A153, Zn w/0.5 percent minimum Ni

2.03 ANCHORS, BOLTS AND FASTENING DEVICES

- A. Anchor bolt material shall be ASTM A307, Grade A (hot dip galvanized butts and washers where noted), or ASTM F1554, Grade 36- Standard headed anchor bolts.
- B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.
- C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel, wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwick-bolt III; ITW Ramset; Redhead trubolt, or equal.
- D. Compound masonry expansion anchors shall be lead expansion sleeve type anchors complete with nuts and washers. Anchors shall be precision die-cast zinc alloy with a minimum of two lead alloy expansion sleeves. When the length or embedment of the

bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Star Expansion Industries, Star Slugin or equal.

- E. Adhesive capsule anchors shall be a two-part stud and capsule chemical resin anchoring system. Capsules shall contain premeasured amounts of polyester or vinyl ester resin, aggregate and a hardener contained in a separate vial within the capsule. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Adhesive capsule anchors shall be Hilti, HVA Adhesive Anchor; Molly, Parabond; Rawlplug, Rawl Chem-Stud or equal.
- F. Adhesive anchors, for fastening to hollow concrete block or brick, shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT C-20 System or equal.
- G. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.
- H. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- I. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.06 ACCESS HATCHES

- A. Access hatches shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-in aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 lbs/sq ft with a maximum deflection of 1/150th of the span. Hatches shall have a 1/4-in aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1-1/2-in drainage coupling to the channel frame. Access hatches shall be Types as indicated on the Drawings by Bilco Company, New Haven, CT or equal.

2.07 MISCELLANEOUS ALUMINUM

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.
- D. Angle frames for hatches, beams, grates, etc, shall be complete with welded strap anchors attached.
- E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 304 stainless steel. Plates shall have a mill finish.
- F. Stair treads for aluminum stairs shall have abrasive non-slip nosing as approved.
- G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
- H. Miscellaneous aluminum items shall have a cleaned and degreased mill finish.

2.08 MISCELLANEOUS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.
- E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.
- F. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be shop coated with primer.
- G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

2.09 MISCELLANEOUS STAINLESS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.
- C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.
- D. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- E. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.

- F. Install adhesive capsule anchors using manufacture's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.
- H. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- I. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- J. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
- K. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- L. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

END OF SECTION

SECTION 09900

PAINTING

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for surfaces listed herein and not otherwise excluded. All surfaces described, whether new or existing, shall be included within the scope of this Section.
- B. The work includes painting and finishing of interior and exterior exposed items and surfaces such as ceilings, walls, floors, miscellaneous metal, doors, frames, transoms, roof fans, construction signs, guardrails, posts, pipes, fittings, valves, equipment, and all other work obviously required to be painted unless otherwise specified herein or on the Drawings. Minor items omitted in the schedule of work shall be included in the work of this section where within the general intent of the specifications as stated herein. The following major items of the Project shall be coated:
1. Interior of cast-in-place concrete, concrete block walls, concrete ceilings and concrete floors; and exterior concrete block and stucco walls.
 2. Exposed ferrous surfaces of equipment, pumps, motors, tanks and ferrous or galvanized metal fittings and accessories.
 3. Exposed surfaces of PVC components of piping, fittings, valves, electrical conduit and equipment.
 4. Exposed exterior surfaces of all metallic piping, fittings and valves located on the interior and exterior of buildings and structures. This shall include new piping, fittings and valves for the Project.
 5. Embedded aluminum or aluminum in contact with dissimilar metals or in contact with corrosive atmospheres.
- C. The following surfaces or items are not required to be field painted:
1. Portions of metal other than aluminum embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in or in contact with concrete shall be coated to prevent electrolysis.
 2. Brass, bronze, and aluminum other than exposed tubing.
 3. Piping buried in the ground or embedded in concrete.
 4. Ducts, pipes and other miscellaneous items covered with insulation or plastic coated.
 5. Stainless steel angles, tube, pipe, etc. unless specified or shown to be coated.
 6. Fiberglass.
 7. Aluminum or fiberglass handrails, walkways, toeboards, windows, louvers, grating, checker plate, hatches, and stairways.

8. Finish hardware.
9. Products with polished chrome, aluminum, nickel or stainless steel finish.
10. Plastic switch plates and receptacle plates.
11. Electrical switchgear and motor control centers.
12. Any code-requiring labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

1.02 SUBMITTALS

- A. Submit to the Engineer as provided in the General Conditions and Section 01300, shop drawings, manufacturer's specifications and data on the proposed paint systems and detailed surface preparation, application procedures and dry film thickness.
- B. Submit documentation of paint contractor's and coating applicator's experience applying the specified coatings.
- C. When the proposed products will be in contact with treated or raw water in potable water treatment facilities, Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.
- D. Schedule of Painting Operations:
 1. Contractor shall submit for approval a complete Schedule of Painting Operations within 90 days after the Notice to Proceed. This Schedule is imperative so that the various fabricators may be notified of the proper shop prime coat to apply. It shall be the Contractor's responsibility to properly notify and coordinate the fabricators' surface preparation and painting operations with these Specifications.
 2. This Schedule shall include for each surface to be painted, the brand name, the volume solids, the coverage and the number of coats the Contractor proposes to use in order to achieve the specified dry film thickness, and color charts. When the Schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gages may be utilized by the Owner's representative to verify the proper application while Work is in progress.
- E. Color Samples: Manufacturer's standard color charts for color selection by Owner.
- F. Samples-Painting:
 1. Paint colors will be selected by Owner. Compliance with all other requirements is the exclusive responsibility of the Contractor.
 2. Samples of each finish and color shall be submitted to the Owner or Engineer for approval before any work is started.
 3. Samples shall be prepared so that an area of each sample indicates the appearance of the various coats. For example, where three (3) coat work is specified, the sample shall be divided into three (3) areas:
 - a. One (1) showing the application of one (1) coat only.

- b. One (1) showing the application of two (2) coats.
- c. One (1) showing the application of all three (3) coats.
- 4. Such samples when approved in writing shall constitute a standard, as to color and finish only, for acceptance or rejection of the finish work.
- 5. For piping, valves, equipment and miscellaneous metal work, provide sample chips or color charts of all paint selected showing color, finish and general characteristics.
- 6. Rejected samples shall be resubmitted until approved.

1.03 DELIVERY, HANDLING AND STORAGE

- A. Deliver all materials to the job site in original, unopened packages and containers bearing manufacturer's name and label in accordance with Section 01610: Materials and Equipment. Provide labels on each container with the following information:
 - 1. Name or title of material.
 - 2. Fed. Spec. number if applicable.
 - 3. Manufacturer's stock number, date of manufacture and expiration date (shelf life).
 - 4. Manufacturer's formula or specification number.
 - 5. Manufacturer's batch number.
 - 6. Manufacturer's name.
 - 7. Generic type.
 - 8. Contents by volume, for major pigment and vehicle constituents.
 - 9. Application instructions: thinning, ambient conditions, etc.
 - 10. Color name and number.
- B. Containers shall be clearly marked to indicate any hazards connected with the use of the paint and steps which should be taken to prevent injury to those handling the product.
- C. Material Safety Data Sheets shall be kept on-site and made readily available for all personnel.
- D. All containers shall be handled and stored in such a manner as to prevent damage or loss of labels or containers. Containers shall be kept sealed and ready for use. All materials shall be stored in a cool, dry area out of the direct sunlight and away from any ignition source. Contractor shall refer to the manufacturer's literature and material safety data sheets for additional storage requirements.
- E. Storage of paint materials and related equipment shall comply with the requirements of pertinent codes and fire regulations. In addition, all safety precautions noted on the manufacturer's Material Safety Data Sheets and other literature shall be strictly followed. Proper containers outside of buildings shall be provided by the Contractor and used for painting wastes. No plumbing fixtures shall be used for this purpose.

1.04 QUALITY ASSURANCE

- A. Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.
- B. Provide undercoat paint produced by the same manufacturer as the finish coats. Undercoat and finish coat paints shall be compatible. Use only thinners approved by the paint manufacturer, and use only within recommended limits.
- C. Painting shall be accomplished by experienced painters specializing in industrial painting familiar with all aspects of surface preparations and applications required for this project. The paint contractor shall have a minimum of 10 years experience in industrial painting . The applicator of System 3 shall have a minimum of five (5) years documented experience in the application of of polymer-based floor coatings to concrete floors.
- D. All work shall be proved to be in first class condition and constructed in accordance with the Drawings and specifications. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the Owner.
- E. Holiday Testing: Each coat shall be holiday tested at the recommended 100-125 volts DC per mil in accordance with the latest edition of the following standards: NACE SP0188-2006, NACE Standard RP0490, ASTM G62.

1.05 WARRANTY AND GUARANTEES

- A. All paint and coatings work performed under these specifications shall be guaranteed by the coatings applicator for 100 percent of the total coated area for both materials and labor against failures during the warranty period.
- B. Failure under this warranty shall include flaking, peeling, or delaminating of the coating due to aging, chemical attack, or poor workmanship; but it shall not include areas which have been damaged by unusual chemical, thermal, or mechanical abuse.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. All paint shall be manufactured by one of the suppliers listed herein and shall be their highest grade of paint.
- B. The following coating systems list a product by name to establish a standard of quality; other products of the same generic types may be submitted to the Engineer for approval. When other than the specified coating system is proposed, the Contractor shall submit on a typewritten list giving the proposed coatings, brand, trade name, generic type and

catalog number of the proposed system for the Engineer's approval. Contractor shall submit sufficient data substantiated by certified tests, conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named. Provide list and data to the Engineer for approval within 30 days after the Notice to Proceed. The type and number of tests performed shall be subject to the Engineer's approval.

- C. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Shop paint shall be of the same type and manufacture as used for field painting by the Contractor.
- D. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.
- E. Rags shall be clean painter's rags, completely sterilized.

2.02 COLOR CODING FOR PIPES AND EQUIPMENT

- A. Color coding shall consist of color code painting and identification of all exposed conduits, trough items and pipelines for the transport of gases, liquid and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and all operating accessories which are integral to be whole functional mechanical pipe and electrical conduit system. See Section 09905 Piping and Equipment Identification System.
- B. All hangers and pipe support floor stands shall be painted. The system shall be painted up to but not including the flanges attached to the mechanical equipment or the flexible conduit connected to electrical motors. Colors shall be designated by Owner.
- C. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to but not including, the fixed flanges or connections on the equipment.
- D. The color code establishes, defines and assigns a definite color for each category of pipe. Pipelines that are not listed on the Schedule of Color Code Paints shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract.

2.03 FABRICATED EQUIPMENT

- A. Unless otherwise indicated all fabricated equipment shall be shop primed and field finished.
- B. All items to be shop primed shall be thoroughly cleaned of all loose material prior to priming. If, in the opinion of the Engineer, any prime coating has been improperly applied or if material contrary to these Specifications has been used, that coating shall be

removed by sandblasting to white metal and reprimed in accordance with these Specifications.

- C. All shop prime coats shall be of the correct materials and applied in accordance with these Specifications. The Contractor shall remove any prime coats not in accordance with these Specifications by sandblasting and apply the specified prime coat at no additional cost to the Owner.
- D. Shop primed surfaces shall be cleaned thoroughly and retouched with the specified primer before the application of successive paint coats in the field. Touch areas on ferrous metal surfaces shall be given spot sand blast to SSPCSP-10 and reprime.
- E. Contractor shall be responsible for taking whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. If, in the opinion of the Engineer, a shop finish coat does not give the protection quality of other Work of similar nature the Contractor shall apply the coat or coats of paint as directed by the Engineer to accomplish the desired protection quality.
- G. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned by the Contractor.

2.04 COATING SYSTEMS

- A. System 1 – Interior Concrete and Masonry, Non-Immersion. Excludes all floors and slabs, and the bottom five feet of walls within the chemical buildings and pump rooms. Examples of this classification include the following surfaces:
 - 1. Examples of this classification include the following surfaces:
 - a. Masonry and plaster.
 - b. Concrete block walls.
 - c. Concrete walls, columns and supports.
 - d. Concrete ceilings and beams.
 - 2. Surface Preparation: Allow new concrete and mortar to cure 28 days. Level protrusions and mortar spatter.
 - 3. Filler: One coat of one of the following, or equal:
 - a. Tnemec Series 215 Surfacing Epoxy at 52 square feet per mixed gallon.
 - 4. Finish: Two (2) coats of one of the following, or equal:
 - a. Tnemec Series N69 Hi-Build Epoxoline II at 5.0 mils dry thickness per coat.
- B. System 2 – Exposed Concrete and Masonry, Non-Immersion.
 - 1. Examples of this classification include the following surfaces:
 - a. Exterior, aboveground concrete and concrete block wall surfaces of new and existing structures.

2. Surface Preparation: As specified in Paragraph 3.02 herein and in addition the following:
 - a. New concrete and masonry surfaces shall be prepared by filling cracks, voids and other surface imperfections, removing mortar droppings, cleaning and high pressure water blasting.
 - b. Existing concrete surfaces shall be prepared by high pressure water blasting or abrasive blast cleaning to remove existing deteriorated or disbanded coatings as required for adhesion of the new coating system.
3. Prime Coat for New Concrete Structures: Cement base waterproofing:
 - a. Thoro Systems Thoroseal: One (1) coat, 2 lbs per square yard.
4. Prime Coat for New Masonry Structures: Single-component cementitious acrylic masonry block filler:
 - a. Tnemec Series 130-6602 Envirofill at 80-100 sf/gal.
5. Prime Coat for Previously Coated Structures: Two component waterborne epoxy primer.
 - a. Tnemec Series 151 Elasto-grip at 300 sf/gal.
6. Finish Coats: High quality elastometric coating.
 - a. Tnemec Series 156 Envirofill; two coats at 5.0 mils DFT per coat.
7. Total minimum system finish coating thickness shall be 10.0 mils DFT over the primer or sealer.

C. System 3 – Concrete Floors and Masonry Walls, Chemical Resistant.

1. Examples of this classification include the following surfaces:
 - a. Concrete and masonry surfaces that are subject to splashing, spillage and fumes of chemicals.
 - b. Concrete floors and slabs, bottom 5 feet of concrete columns and masonry walls in hypochlorite and fluoride buildings.
2. Applicator shall have a minimum of five (5) years documented experience in the application of polymer-based floor coatings to concrete floors.
3. Surface Preparation: As specified in Paragraph 3.02 herein and in addition the following:
 - a. New concrete and masonry shall be cured for at least 28 days before lining is applied. New masonry surfaces shall be prepared by filling cracks, voids and other surface imperfections using a epoxy concrete filler, removing mortar droppings, cleaning and high pressure water blasting.
 - b. Concrete surfaces, including those with bug holes less than 1 inch [25 mm] in any dimension, shall be prepared using an epoxy concrete filler or as recommended by the material manufacturer and acceptable to Engineer.
 - c. Contractor shall repair all concrete surfaces that have spalls, voids, and cracks and shall remove all fins and other surface projections to produce a flush surface for application of the coating system. Grind concrete at edges of metal drains, troughs, and sumps to accommodate application of new coatings. Remove all loose old coatings, and scarify all surfaces by abrasive blasting, mechanical grinding or blastrac cleaning. Feather edges of old sound coatings to blend with

the new coating. Ensure all surfaces are clean, dry and abraded prior to application of any repair or coating materials.

- d. All concrete surfaces to be lined shall be cleaned in accordance with ASTM D4258 and abrasive blasted in accordance with ASTM D4259. Before the lining is applied, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue.
- e. Follow materials manufacturer's written instructions. All concrete and masonry surfaces shall be ready to receive the lining/coatings as determined by the materials manufacturer and accepted by the Engineer.
4. Repair all voids, spalls and areas of lost concrete. Fill control joints.
 - a. Flo-rock Florogel Epoxy Patch.
5. Prime Coat:
 - a. Crawford Laboratories Floropoxy 4700 Epoxy Primer. One application at 8 mils. Squeegee applied, backroll with nap roller at manufacturer's recommend spread rate.
6. Midcoat:
 - a. Crawford Laboratories Novolac Epoxy. Squeegee applied, backroll with nap roller at manufacturer's recommend spread rate.
7. Finish Coat:
 - a. Crawford Laboratories Novolac Epoxy. Squeegee applied, backroll with nap roller at manufacturer's recommend spread rate.

D. System 3 – Metals, Immersion (Interior and Exterior) and Non- Immersion (Interior)

1. Consist of interior and exterior metal surfaces (immersion) and interior metal surfaces that do not come in direct contact with water or corrosive atmospheres.
2. Examples of this classification include the following surfaces:
 - a. Pumps, motors, equipment and appurtenances.
 - b. Aboveground piping, fittings, valves and metal electrical conduit.
 - c. Miscellaneous steel plates, shapes, hardware, etc.
 - d. Galvanized steel surfaces.
 - e. Other surfaces obviously requiring field coating or as specified to be field coated in Division 11 or in Section 09905: Piping and Equipment Identification Systems.
3. Surface Preparation: As specified in Paragraph 3.02 herein and, in addition, the following:
 - a. Non-immersion metals shall be abrasive blast cleaned to SSPC-SP6. Immersion metals shall be abrasive blast cleaned to SSPC-SP10.
 - b. All bare metals or areas that were shop primed that have been damaged shall be abrasive blast cleaned to the appropriate, commercial blast cleaning standards.
 - c. Shop primed items, stored on site for a prolonged period prior to coating, shall be prepared for coating following the coating manufacturer's recommendations prior to applying touch-up and subsequent coats. Surface preparation may include brush-off abrasive blasting or spot blasting to the appropriate, commercial blast cleaning standards, for areas where the primer has been damaged and bare metal is showing.

- d. Non-ferrous metals shall be degreased and cleaned by washing with a water based dispersant. Rinse thoroughly with clean water after cleaning.
- 4. System 3 Coating System (Immersion)
 - a. Prime Coat for Ferrous and Non-Ferrous Metals: NSF Part 61 approved, two-part epoxy polyamide primer. Tnemec Series 140-1255 (Beige) Pota-Pox Plus at 4.0 mils DFT.
 - b. Finish Coat for Non-Ferrous Metals: NSF Part 61 approved epoxy coating. Tnemec Series 140-WH02 (Tank White) Pota-Pox Plus at 4.0 mils DFT.
 - c. Finish Coats for Ferrous Metal: NSF Part 61 approved, two component, cross linked epoxy. Tnemec Series 140 Pota-Pox Plus: Two coats at 5.0 mils DFT per coat.
 - d. Total minimum system finish coating thickness shall be 14.0 mils DFT for ferrous metals and 8.0 mils DFT for non-ferrous metals.
- 5. System 3 Coating System (Non-Immersion)
 - a. Prime Coat for Ferrous and Non-Ferrous Metals: Two component, cross-linked epoxy primer. Tnemec Series 69 Hi-Build Epoxoline II at 4 mils DFT.
 - b. Finish Coat for Non-Ferrous Metals: Two-part epoxy. Tnemec Series 69 Hi-Build Epoxoline II at 3.0 mils DFT.
 - c. Finish Coat for Ferrous Metal: Two component, cross-linked epoxy. Tnemec Series 69 Hi-Build Epoxoline II at 5.0 mils DFT.
 - d. Total minimum system finish coating thickness shall be 9 mils DFT for ferrous metals and 7 mils DFT for non-ferrous metals.
- E. System 4 Exposures – Plastic Piping, Valves, Fittings and Conduit, Interior and Exterior
 - 1. Class 7 exposures consist of PVC or fiberglass piping and structural shapes or electrical systems requiring color coding, and for protection of exposed, exterior plastic components from the elements, and shall include the following:
 - a. PVC and fiberglass piping, fittings, valves and electrical conduits requiring color coding in accordance with Section 09905: Piping and Equipment Identification System.
 - b. Exposed exterior plastic piping, valve and fitting components subject to UV degradation and weathering by the elements.
 - 2. Surface Preparation: As specified in Paragraph 3.02 herein, including cleaning and washing with detergent to remove all dirt and foreign material, and light surface abrasion using medium grade sandpaper. Remove dust, dirt and debris with clean rags prior to coating.
 - 3. System 4 Coating System:
 - a. Prime Coat: Two component epoxy. Tnemec Series 66 Hi-Build Epoxoline at 3.0 mils DFT.
 - b. Finish Coats for exterior surfaces: Tnemec Series 73 Endurashield at 3.0 mils DFT.
 - c. Finish coat for interior exposure: Tnemec Series 66 Hi-Build Epoxoline at 3.0 mils DFT.
 - d. Total minimum system finish coating thickness shall be 6 mils DFT.

F. System 5 Exposures – Aluminum

1. System 5 exposures consist of aluminum surfaces embedded or in contact with concrete, mortar or plaster, or aluminum in contact with dissimilar metals which may cause corrosion due to electrolysis, and shall include the following:
 - a. Aluminum surfaces in contact with concrete, mortar or plaster, such as hatch cover frames, stair stringers, portions of grating and frames, floor plate and frames, etc.
 - b. Aluminum surfaces in contact with dissimilar metals which may cause corrosion due to electrolysis.
2. Surface Preparation: As specified in Paragraph 3.02 herein, including solvent cleaning in accordance with SSPC-SP1 standards for solvent cleaning and scarification.
3. System 5 Coating System:
 - a. Prime Coat: Two component polyamide epoxy. Tnemec Series 66 Hi-Build Epoxoline at 3.0 mils DFT.
 - b. Finish Coats for Aluminum Exposed to View: Two-component, high build, acrylic urethane. Tnemec Series 73 Endurashield at 3.0 mils DFT.
 - c. Finish Coat for Aluminum Not Exposed to View: Polyamide cured coal tar epoxy. Tnemec Series 46H-413 Hi-Build Tneme-Tar applied at 16.0 mils DFT.
 - d. Total minimum system finish coating thickness shall be 19.0 mils DFT for areas not exposed to view or 6.0 mils for areas exposed.

G. System 6 Exposures – Metals Exterior Exposed

1. System 6 exposures consist of exterior metal surfaces exposed to the weather and environment.
 - a. Pumps, motors, equipment, and appurtenances
 - b. Above ground piping, fittings, valves, and metal conduit
 - c. Miscellaneous metal surfaces
 - d. Ladders, stairways, structural steel
 - e. Roof mounted equipment, hatches, fans, etc.
 - f. Galvanized and non-ferrous metal surfaces
 - g. Other surfaces obviously requiring field painting
2. Surface Preparation: As specified in paragraph 3.02 herein and, in addition, the following:
 - a. All bare metals or areas that were shop primed that have been damaged shall be abrasive blast cleaned to SSPC-SP6, commercial blast cleaning standards.
 - b. Shop primed items, stored on site for a prolonged period prior to coating, shall be prepared for coating following the coating manufacturer's recommendations prior to applying touch-up and subsequent coats. Surface preparation may include brush-off abrasive blasting or spot blasting to SSPC-SP6, commercial blast cleaning standards, for areas where the primer has been damaged and bare metal is showing.
 - c. Non-ferrous metals shall be degreased and cleaned by washing with a water based dispersant such as Carboline Surface Cleaner #3. Rinse thoroughly with clean water after cleaning.

3. System 6 Coating System
 - a. Prime coat for ferrous and non-ferrous metal: Two part epoxy primer. Tnemec Series 69 Hi-Build Epoxoline II at 4.0 mils DFT.
 - b. Intermediate coat for ferrous metal: Two part epoxy. Tnemec Series 69 Hi-Build Epoxoline at 3.0 mils DFT.
 - c. Finish coat for ferrous and non-ferrous metal: High Build Acrylic Polyurethane. Tnemec Series 73 Endura-Shield at 3.0 mils DFT.
 - d. Total minimum system finish shall be 7.0 mils for non-ferrous metal and 10.0 mils for ferrous metal surfaces.

PART 3 – EXECUTION

3.01 SHOP PAINTING

- A. Surface Preparation – All ferrous metal to be primed in the shop shall have all rust, dust and scale, as well as all other foreign substances, removed by sandblasting or pickling in accordance with SSPC-SP5 or SP8, respectively. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Under no circumstances will cleaned metal be allowed to sit overnight before priming, or pretreatment and priming. All nonferrous metals shall be solvent cleaned prior to the application of primer. In addition, galvanized surfaces which are to be topcoated shall first be degreased then primed. All non-ferrous metal surfaces shall also be scarified prior to topcoating.
- B. Materials Preparation:
 1. Mix and prepare painting materials in strict accordance with manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt and other foreign materials.
 2. No thinners shall be used except those specifically mentioned and only in such quantity as directed by the manufacturer in his instructions. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or cleanup solvent shall be used for all clean-up. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.
- C. Applications:
 1. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Coating systems shall be as specified herein.
 2. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied.
 3. All paint and coatings materials shall be stored under cover and at a temperature within 10°F of the anticipated application temperature and at least 5°F above the dew point.
 4. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

5. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps and brush marks. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness.
 6. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.
 7. Equipment manufacturer or supplier shall provide touch-up paint for items with shop applied finish coats.
 8. Where specified in the individual sections, primer coat(s) shall be applied in the shop by the equipment manufacturer. The shop coats shall be as specified and shall be compatible with the field coat or coats.
- D. Certification: The Contractor shall obtain from the equipment manufacturer or supplier, prior to shipment of equipment, a written certification that surface preparation, coating brand, material, DFT and application method complied with this Section.

3.02 PREPARATION OF SURFACES

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and concrete block surfaces to receive polyamide cured equipment of all marks before application of finish. Review all completed surface preparation with Owner's representative prior to applying coatings.
- B. All metal welds, blisters, etc., shall be ground and sanded smooth in accordance with SSPC-SP-3 or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2. All weld spatter shall be removed and all fabricated metal with sharp edges shall be ground smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, grease and dirt shall be removed by use of approved solvents, wire brushing or sanding.
- C. All plastic pipe surfaces shall have surfaces lightly sanded before painting.
- D. Exposed Pipe: Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated pipe which is inadvertently installed in exposed locations shall be sandblasted clean before priming and painting. After installation all exterior, epoxied flanged joints shall have the gap between adjoining flanges sealed with a single component Thiokol caulking to prevent rust stains.
- E. Primed or Coated Surfaces and Nonferrous Surfaces: All coated surfaces shall be cleaned prior to application of successive coats. All nonferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.
- F. Shop-Finished Surfaces: All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon

detection. Abraded or corroded spots on shop-coated surfaces shall be "Hand Cleaned" and then touched up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up in the opinion of the Engineer shall be repainted. Cut edges of galvanized sheets and exposed threads and cut ends of galvanized piping, electrical conduit, and metal pipe sleeves, not to be finished painted, shall be "Solvent Cleaned" and prepared in accordance with SSPC-SP2 or SSPC-SP3 guidelines and then primed with a zinc phosphate metal primer such as Carboline Carbocoat 150 Universal Primer.

- G. Galvanized and Zinc-Copper Alloy Surfaces: These surfaces to be painted shall be "Solvent Cleaned" and treated as hereinafter specified. Such surfaces not to be painted shall be "Solvent Cleaned".
- H. Aluminum embedded or in contact with concrete shall be prepared in accordance with SSPC-SP7 guidelines and must be painted with one coat of aluminum epoxy mastic such as Carboline Carbomastic 15 .
- I. Ductile Iron: Reference the NAPF 500-03 surface preparation standard for ductile iron pipe and fittings in exposed locations receiving special external coating and/or special internal linings for applicable surface preparation guidelines.

3.03 WORKMANSHIP

A. General:

1. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular re-paint condition will be compatible with the existing painted surface. Sample re-painted areas on the actual site will be required to insure this compatibility. Finished repainted areas shall be covered by the same guarantee specified for remainder of Work.
2. At the request of the Engineer, samples of the finished Work prepared in strict accordance with these Specifications shall be furnished and all painting shall be adequate for the purpose of determining the quality of workmanship. Experimentation with color tints shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.
3. Protection of equipment, fittings and accessories shall be provided throughout the painting operations. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other Work from all damage during the operation and until the finished job is accepted.
4. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally

furnished by the manufacturer shall cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture, however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

5. All safety equipment shall be painted in accordance with OSHA Standards as approved.
6. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint.
7. Only skilled painters shall be used on the Work and specialists shall be employed where required.
8. Work shall be done in a safe and workmanlike manner.

B. Field Priming:

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule.
2. Equipment which is customarily shipped with a baked-on enamel finish or with a standard factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coats or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish.

C. Field Painting:

1. All painting at the site shall be designated as Field Painting.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 50 degrees F., in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.
3. Successive coats of paint shall be tinted so as to make each coat easily distinguishable from each other with the final undercoat tinted to the approximate shade of the finished coat.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted and all exterior trim shall be back-primed before installation.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. All exterior concrete and masonry paint shall be performed at one continuous manner structure by structure. Materials subject to weathering shall be

- prime coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
6. All materials shall be brush painted unless spray painting is specifically approved by the Engineer.
 7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.
 8. Before final acceptance of the Work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
 9. The aluminum Work noted on the Drawings or in the Painting Schedule except all structural walkways, supports, railings, toeboards, grating and checkered plate shall be field painted.
 10. Any pipe scheduled to be painted and having received a coating of tar or asphalt-compound shall be painted with two coats or equal before successive coats are applied per the schedule.

3.04 CLEANUP

- A. The premises shall at all times be kept free from accumulation of waste material and rubbish caused by employees or Work. At the completion of the painting remove all tools, scaffolding, surplus materials, and all rubbish from and about the buildings and leave Work "broom clean" unless more exactly specified.
- B. Upon completion, remove all paint where it has been spilled, splashed, or splattered on all surfaces, including floors, fixtures, equipment, furniture, etc., leaving the Work ready for inspection.

END OF SECTION

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SECTION 09905

PIPING, VALVE, AND EQUIPMENT IDENTIFICATION SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The work included under this Section consists of providing an identification system for piping systems and related equipment.
- B. Related Work Described Elsewhere:
 - 1. Submittals: Section 01300.
 - 2. Painting: Section 09900.
 - 3. Equipment: Division 11
 - 4. Mechanical: Division 15.
 - 5. Electrical: Division 16.

1.02 QUALITY ASSURANCE

- A. Standards: ANSI Standard A13.1, Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Submit manufacturer's descriptive literature, illustrations, specifications, and other pertinent data in accordance with Section 01300.
- B. Schedules:
 - 1. Provide a typewritten list of all tagged valves giving tag color, shape, letter code and number, the valve size, type, use, and general location.
 - 2. Provide a complete list of materials to be furnished and surfaces on which they will be used.
- C. Samples:
 - 1. Provide a sample of each type valve of tag supplied.
 - 2. Provide a sample of each type of identification tape supplied.
 - 3. Provide manufacturer's color charts for color selection by Engineer.

1.04 PRODUCTS DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Except for locally mixed custom colors, deliver sealed containers with labels legible and intact.
- B. Storage of Materials:
 - 1. Store only acceptable project materials on project site.
 - 2. Store in suitable location.

3. Restrict storage to paint materials and related equipment.
4. Comply with health and fire regulations.

1.05 JOB CONDITIONS

- A. Environmental Requirements:
 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
 2. Do not apply finish in areas where dust is being generated.
- B. Protection: Cover or otherwise protect finished work of other trades and surfaces not to be painted.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Materials for painting shall conform to the requirements of Section 09900: Painting.
- B. Materials selected for coating systems for each type surface shall be the product of a single manufacturer.
- C. Aboveground piping shall be identified by self-adhesive pipe markers equal to those manufactured by W. H. Brady Company or approved equal.
 1. Markers shall be of wording and color as shown in Table 09905-A.
 2. Lettering shall be:
 - a. 2¼-inches high for pipes 3 inches diameter and larger.
 - b. 1 1/8-inches high for pipes less than 3 inches diameter.
 3. Flow arrows shall be:
 - a. 2¼-inches by 6 inches for pipes 3 inches diameter and larger.
 - b. 1 1/8-inches by 3 inches for pipes less than 3 inches diameter.
- D. Buried piping shall be identified by identification tape installed over the centerline of the pipelines.
 1. Identification Tape for Steel or Iron Pipe: Identification tape shall be manufactured of inert polyethylene film so as to be highly resistant to alkalies, acids, or other destructive agents found in soil, and shall have a minimum thickness of 4 mils. Tape width shall be 6 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2 feet for entire length of tape. Tape shall be Terra Tape Standard 250, or approved equal.
 2. Identification Tape for Plastic or Non-Magnetic Pipe: Identification tape shall be manufactured of reinforced polyethylene film with a minimum overall thickness of 4 mils and shall have a 0.35 mil thick magnetic metallic foil core. The tape shall be highly resistant to alkalies, acids, and other destructive agents found in soil. Tape width shall be 3 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a

minimum of once every 2 feet for entire length of tape. Tape shall be TerraTape Sentry Line 1350, or approved equal.

3. Tape background colors and imprints shall be as follows:

<u>Imprint</u>	<u>Background Color</u>
"Caution Sewer Line Buried Below"	Green
"Caution Electrical Line Buried Below"	Red
"Caution Water Line Buried Below"	Blue
"Caution Telephone Line Buried Below"	Orange
"Caution Reuse Line Buried Below"	Purple
"Caution Compressed Air Line Buried Below"	Dark Green
"Caution Chemical Line Buried Below"	Yellow

4. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX; Allen Systems, Inc., Wheaton, IL; or approved equal.

E. Locating Wire:

1. All buried pipe shall be installed with insulated locating wiring capable of detection by a cable locator and shall be wrapped with nylon straps to top centerline of the pipe.
2. Locating wire shall be 10 gauge solid copper, continuous with no splices, and be color-coded to match the utility installed.

F. Aboveground Valve Identifications: A coded and numbered tag attached with brass chain and/or brass "S" hooks shall be provided on all valves.

1. Tag Types: Tags for valves on pipe shall be brass or anodized aluminum. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which it is installed. Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.
2. Coding: In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the valve service and number. All color and letter coding shall be approved by the Engineer. Valve service shall either be as listed in Table 09905-A, or by equipment abbreviation if associated with a particular piece of equipment. Valve numbering, if required, shall be as approved by the Engineer and/or Owner.

G. Buried valves shall have valve boxes protected by a concrete pad. The concrete pad for the valve box cover shall have a 3-inch diameter, bronze or stainless steel disc embedded in the surface as shown on the Drawings. The disc shall have the following information neatly stamped on it:

1. Size of valve, inches.
2. Type of valve:
 - a. GV – Gate Valve
 - b. BFV – Butterfly Valve
 - c. PV – Plug Valve
3. Valve Services – See Table 09905-A for abbreviations.
4. Direction to open and number of turns to fully open.

PART 3 – EXECUTION

3.01 COLOR CODING FOR PIPES AND EQUIPMENT

- A. Piping color codes and code labels for pipe identification shall conform to Table 09905-A.
- B. General Notes and Guidelines:
 - 1. Pipelines, equipment, or other items that are not listed here shall be assigned a color by the Owner and shall be treated as an integral part of the Contract.
 - 2. Color coding shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, or semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit system.
 - 3. All moving parts, drive assemblies, and covers for moving parts that are potential hazards shall be Safety Orange.
 - 4. All safety equipment shall be painted in accordance with OSHA Standards.
 - 5. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to, but not including, the flanges attached to pumps and mechanical equipment assigned another color.
 - 6. All pipe hangers and pipe supports shall be painted, unless specified otherwise due to material of construction.
- C. All pipe hangers, pipe supports, and accessories shall be painted to match their piping. The system shall be painted up to, but not including, the face of flanges or the flexible conduit connected to electrical equipment. Structural members used solely for pipe hangers or supports shall be painted to match their piping. 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 be coated in accordance with Section 09900.
- D. All systems that are an integral part of the equipment, that is, originating from the equipment and returning to the same piece of equipment, shall be painted between and up to, but not including, the face of flanges or connections on the equipment.
- E. All insulated surfaces, unless otherwise specified, shall be given one (1) coat of sizing, one (1) prime coat, and one (1) finish coat.

F. System code lettering and arrows shall conform to the requirements of ANSI A 13.1 marked on piping as follows:

1. Legends shall be of the following color for the respective pipe color:

<u>Key to Classification of Predominant Colors For Piping</u>	<u>Color of Letters, if not Otherwise Specified</u>
(F) Fire Protection: Red	White
(D) Dangerous: Yellow	Black
	Orange
(S) Safe: Green	Black
	White
	Black
	Light Gray
	Dark Gray
	Aluminum
(P) Protective: Blue	White

2. All piping containing or transporting corrosive or hazardous chemicals shall be identified with labels every 10 feet and with at least two (2) labels in each room. Otherwise, markers shall be placed no more than 20 feet apart with at least one (1) marker on every straight run and additional markers at turns and where pipes pass through walls.

3. An arrow indicating direction of flow shall be placed adjacent to each marker.

3.02 FABRICATED EQUIPMENT

A. Unless otherwise indicated or specifically approved, all fabricated equipment shall be shop primed and finished. See Section 09900: Painting.

B. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage.

C. Where specified in other Sections of these Specifications for mechanical equipment, the Contractor shall apply field coats of paint in accordance with Section 09900. If the shop finish coating is unsatisfactory due to poor adhesion or other problems with primer or finish coats, coatings shall be removed and replaced by sandblasting, priming and finishing in accordance with Section 09900 and this Section.

D. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned. Equipment contaminated by grit in critical areas, such as bearings, gears, seals, etc., shall be replaced at no cost to the Owner.

3.03 INSTALLATION OF IDENTIFICATION TAPE

- A. Identification tape shall be installed for all buried pipelines and conduits in accordance with the manufacturer's installation instructions and as specified herein.
- B. Identification tape for piping shall be installed at two (2) locations:
 - 1. One (1) foot below finished grade along centerline of pipe, and;
 - 2. Directly on top of the pipe.

**TABLE 09905-A
COLOR CODES AND ABBREVIATIONS**

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Sodium Hypochlorite	C	Yellow	Black
Hydrofluorosilicic Acid	F	Light Blue with Red Band	Black
Drain	DR	Dark Gray	White
Water Main	WM	Dark Blue	White
Sample Line	SA	Gray	Black

- 1. Note: Yellow shall be the Tnemec Series 1028 (Gloss) – Canary Yellow (14YW). Dark Blue shall be Tnemec Series 1028 (Gloss) Purple Haze (12SF). The Owner will provide color selection for all other colors.

END OF SECTION

SECTION 10400

SIGNAGE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior signage
 - 2. Plastic safety signs.
 - 3. Hazardous Chemical Storage signs for tanks and building.
 - 4. Safety Shower and Eyewash signs.

1.02 SUBMITTALS

- A. Product data sheets for each item specified.
- B. Samples:
 - 1. Interior room number and name signs.
 - 2. Color sample chart for each type of sign indicated.
- C. Provide a comprehensive list of all room names and numbers for each building space as well as quantities and locations for all other signs specified.

1.03 QUALITY ASSURANCE

- A. Each door to each occupied space shall have a room sign installed.
- B. All room signage and life safety signage shall be in Braille per the Florida Building code, 423.14.

1.04 FLORIDA ACCESSIBILITY CODE FOR BUILDING CONSTRUCTION

- A. Signage shall conform with the Accessibility Requirements Manual from the Florida Department of Community Affairs, Florida Board of Building Codes and Standards.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Interior identifying devices and exterior building letters shall be as manufactured by one of the following:
 - 1. Rick's Quality Printing & Signs
 - 2. Vital Signs of Orlando, Inc.
 - 3. Sign Design of Florida, Inc.

4. Environmental Graphics, Inc.
5. Innerface Architectural Signage
6. Commercial Signs & Graphics
7. Signs Plus
8. APCO Graphics, Inc.
9. ASI Sign Systems
10. Best Sign Systems

B. Safety Signage: Provide signs similar to MySafetySign.com.

2.02 INTERIOR SIGNAGE

A. Basis of Design: IM System, RI-66-A by APCO.

B. General:

1. Graphic Process: Raised letters and Braille, formed as an integral part of the sign face.
2. Size: 6 inches by 6 inches with radius corners.
3. Mechanically fastened.
4. Colors: Letters and background colors as selected by Architect from manufacturer's standard colors.
5. Letters: Letters and numbers shall have width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 and 1:10. Letters and numbers shall be raised 1/32-inch, uppercase, sans serif or simple sans serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be 5/8-inch high minimum and 2 inches high maximum.
6. Characters and backgrounds must be eggshell, matte, or other non-glazed surface.

C. Capacity signs for all rooms with a capacity of 49 persons or more.

1. Provide capacity signs reading "MAXIMUM CAPACITY."
2. Provide at least two signs per room.

D. Maximum Occupancy Signage: Signs reading "MAXIMUM OCCUPANCY xx."

E. Toilet Room Accessibility Signs: Provide one sign depicting International Men/Women Symbol at each accessible toilet room.

F. Interior Room Name and Number Signs: Layout of room name and number shall be as directed by the Architect.

1. Layout of room name and number shall be as directed by the Architect.

G. Storage Signs: Provide at electrical, mechanical, kiln room, and fire riser rooms to read NO STORAGE ALLOWED.

- H. Evacuation signage:
 - 1. Provide evacuation signs indicating a graphic diagram of primary and secondary evacuation routes posted inside, adjacent to the primary exit door. Provide at all room with occupancy of 6 or greater.
 - 2. Colors: Black building plan on white background with evacuation route in red.
- I. Safety Sign:
 - 1. Plastic sheet with printed message.
 - 2. Refer to Owner for exact text of each sign.
 - 3. Mounting: Tamperproof 316 stainless steel screws and bolts for substrate intended.
- J. Hazardous Chemical Warning Signs:
 - 1. Door-mounted hazardous warning signs shall be provided for each door for chemical supply/feed room.
 - 2. Wall-mounted or post mounted warning signs shall be provided for each chemical or fuel fill station.
 - 3. Tank mounted warnings signs shall be provided for each chemical storage tank.
 - 4. Hazardous warning signs shall be diamond-shaped with four color quadrants conforming to NFPA 704. These signs shall be 10-inch square overall size and shall be equivalent to Seton Name Plate Co. "Metal-backed butyrate (BMB)".

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Mount interior signage with concealed mechanical fasteners recommended by manufacturer. Safety signage to be screwed at each corner.
- C. Provide mounting and installation kits for mounting building letters.
- D. Install interior signage in accordance with approved shop drawings, Accessibility Requirements Manual from the Florida Department of Community Affairs.
- E. Secure Work true to line and level. Allow for building expansion.
- F. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- G. Isolate incompatible material as necessary to prevent deterioration.
- H. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the

particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

1. Mounting Height: Mount accessible signage at 60-inches above finished floor to the center line of the sign.

END OF SECTION

SECTION 13121
PREFABRICATED STEEL BUILDINGS

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall furnish all labor, materials, equipment, and incidentals as required for the provision and proper installation of pre-engineered, prefabricated steel structure for a permanent guardhouse as shown on the Drawings and specified herein.
- B. The building manufacturer shall supply plans and calculations which shall be stamped by a Registered Professional Engineer for the State of Florida and shall be responsible for obtaining all building permits and certificates of occupancy required for the guardhouse. The building manufacturer shall be responsible for obtaining any state building approvals and third party inspections if required by the State of Florida or local municipality.
- C. All anchor bolts, gaskets, sealants, and other accessories and appurtenances, required for a complete and operating installations shall be included whether specifically mentioned or not.

1.02 QUALITY ASSURANCE

- A. All pre-engineered steel structures shall be supplied by an experienced firm who has continually engaged in the manufacture and/or fabrication of portable steel structures, shelters and enclosures. Firms not listed in this specification must clearly document a minimum of five (5) years experience with similar projects of equal scope of design.
- B. Contractor shall assure that all field dimensions are taken accurately and communicated properly to the manufacturer, that other trades will not affect a proper installation of the steel structure, and that all manufacturer's instructions and recommendations are followed.
- C. The manufacturer shall maintain a continuous quality control program and upon request shall furnish to the engineer design drawings and/or calculations, applicable certifications, catalog information, and color samples.

1.03 SYSTEM DESCRIPTION

- A. Factory-fabricated, pre-engineered structures shall be designed to withstand the wind load as defined on the drawings and direct exposure for outdoor installation.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All equipment and parts must be properly protected against any damage during a prolonged period during delivery and at the site as specified.
- B. All 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 and the units and equipment are ready for operation.
- C. The building manufacturer shall provide the spreader bars, and any onsite rigging, from the spreader bars to the building base required for offloading, and placement of the station in the final position on the concrete foundation/pad at the job site.

1.05 SHOP DRAWINGS AND SUBMITTALS

- A. Submit complete shop drawings and product data for all prefabricated steel structures as required by this scope of work
- B. Submittal shall include elevations, section, floor plan, electric schedule, service entrance locations, and anchor clip detail.
- C. Submit design drawings that are prepared, signed, and sealed by a Florida licensed professional engineer/architect and a complete set of design calculations for the building in conformance with ASCE 7, which shall be signed and sealed by a Florida Registered Professional Engineer. Design drawings and calculations shall meet or exceed Florida Building Code requirements.
- D. Shop drawings shall show all materials as required and include all dimensions, connections, fasteners, structural supports, adjustments, openings, anchors, tolerances, assembly and installation details as required, including:
 - 1. Manufacturer's standard details and catalog.
 - 2. Data demonstrating compliance with referenced standards.
 - 3. Installation instructions and manufacturer certification that materials comply with specified requirements and are suitable for the intended application.
 - 4. Warranty documents.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Building shall be of welded steel construction with all intersecting welded connections ground smooth. Overall height shall be as indicated on the drawings. Model number to be Durasteel PC-108SL as manufactured by Porta-King Building Systems.
- B. Structural corners and uprights to be 3"x3"x.120 structural ASTM A500 Grade B welded tubing.

C. Building shall be weather proof and air-conditioned.

2.02 COMPONENTS

A. Wall and Ceiling Panels:

1. Wall panels shall be 14 gauge galvanized steel on exterior and 16 gauge galvanized steel on interior. Wall panels to be mechanically fastened to framework to allow field replacement of damaged panels. Overall wall thickness shall be 3-inch.
2. Provide R-13 wall insulation and R-19 ceiling insulation.
3. Ceiling to be a steel finished composite panel, painted to match total building.

B. Finish:

1. All interior and exterior surfaces shall be electrostatically painted with rust inhibitive epoxy primer and shall have a finish coat of air-dry industrial acrylic paint.
2. Interior and exterior surfaces shall be painted with a color approved by the Owner.
3. Panic: Provide doors with panic stainless steel hardware.

C. Floor Structure:

1. Floor structure to be an integral part of the building with 1-1/2" solid waterproof insulating core fit tight against panels and fastened to bottom structural base frame. Shall meet Florida Building Code requirements.
2. Provide R-12 floor insulation.
3. Finished floor shall be maintenance-free aluminum treadplate floor covering.

D. Doors:

1. Doors to be of anodized aluminum 1-3/4" tubular construction and half-glazed. Bottom portion to include smooth anodized aluminum panel finish.
2. Sliding door to be ceiling suspended in overhead track assembly and shall be fully weather-stripped.
3. Doors shall be fitted with keyed entry high security locks.

E. Windows and Glazing:

1. Windows shall have anodized aluminum frames and inserts and to be industrial quality.
2. Windows shall be glazed with 5/8" tinted, insulated, tempered safety glass.
3. Two windows shall be active window panel to slide horizontally on stainless steel, ball-bearing rollers to facilitate communication with drivers
4. Windows shall include inside positive locking device.
5. Exterior window sill height to be 38" (inside sill height 34" from finished floor).

F. Counter:

1. Furnish 22" deep, full-width painted steel counter, 32" a.f.f.
2. Counter shall have two, 2" openings.

G. Electrical:

1. Power to the building shall be furnished from the existing service at the treatment facility.
2. Electrical service to include one (1) three phase, 100 amp 120/208 volts, 3 phase, 4 wire load center with 40 ampere main breaker, prewired in conduit, with one 208v circuit and four 20 ampere 115v circuit capacity.
3. Provide two spare 20A branch circuit breakers.
4. Provide one – 115v duplex outlet and one-208v outlet.
5. Conduits and electrical boxes and fixtures to be surface mounted.
6. All electric work shall be in compliance with the National Electrical Code. All electrical components shall bear the UL label.
7. Lights to be T-8 fluorescent type fixture with acrylic lens and wall switch. Insulation value: R-14
8. Battery-operated emergency lighting will be installed inside the building. Backup power will be provided by the plant generator.
9. Include one thru-wall HVAC unit (208v, 11,600C/11,600H BTU).
10. Provide empty conduit runs with pull wire to run communication lines.

H. Exterior Roof:

1. Provide a standing seam metal galvalumed pitched roof with 6" overhang, 6" high fascia and gutters.
2. Roof color shall be approved by the Owner.

- I. The building design shall be provided by the pre-engineering company per the provided notes.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Upon receipt of material at job site, the Contractor shall inspect all materials for shipping damage. Any damage is to be noted on the shipping receipt/packing list and reported promptly to the shipper.

3.02 INSTALLATION

- A. Installing contractor to coordinate and verify that other construction trades and materials have been installed per the contract drawings, and, that they are accurate in location, alignment, elevation, and are plumb and level.

- B. Install prefabricated building on a flat and level concrete pad in accordance with the manufacturer's installation drawings and instructions supplied by the manufacturer/supplier.
- C. Install materials accurately in location and elevation, level, and plumb. Field fabricate as necessary for accurate fit. Verify that concrete is level and true to plane and of correct dimensions to receive structure. Correct any deficiencies before proceeding.
- D. Contractor to determine and specify anchor tabs, as required to meet Florida Building Code requirements. Layout anchor bolt pattern according to manufacturer's drawings.
- E. Erect structures true to line and plumb, free of twist and warp.
- F. Install and test accessories in accordance with manufacturer's instructions.
- G. Adjust components for proper operation.

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SECTION 13300
INSTRUMENTATION AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. The Contractor shall furnish, install and place into service operating process instrumentation, control systems and panels including accessories, related to this facility, all as shown on plans and specified herein.
1. Existing plant systems must remain operational during construction, unless approved by the Owner and Engineer. Nighttime and/or other off hours work may be required to support plant operations and shall be included in the Contractor's bid.
 2. The instrument contractor is responsible to "As-Built" all existing control panels and to provide all demolition and modification as necessary for the installation of the new I/O in the existing local control panels.
 3. Equipment rendered obsolete by this contract must be removed from the existing panels. Equipment previously abandoned must also be removed from the panels. Functioning equipment present in these panels must remain functional and will be included on the instrument contractor's "As-Built" drawings. No existing equipment, with the exception of the field wires and panel, may be reused as part of the new control system. New power supplies, surge suppressors, terminal strips, etc. for all I/O to be connected to the new control system must be provided new. The instrument contractor is responsible to provide completed panels that are clean, functional and present a professional appearance.
 4. All new wires in control panels must be permanently tagged and shown on the as-built drawings. This includes all spare and abandoned wires and cables. Spare and abandoned cables are to be taped and left coiled in the panels for future use. Cable and wire numbers are to be assigned by the contractor, documented and controlled to prevent duplicate numbers. The Contractor shall turn over to the owner, at the project conclusion, a cable and wire list showing assigned numbers and their physical location in the plant.
 5. See electrical drawings and specifications for additional work required of the instrument contractor as part of this project to supply demolition instructions, relocation and modification instructions for equipment not necessarily shown on the instrument drawings.
 6. Contractor's Integrator shall modify the existing PLC system/program, SCADA screens, and Report generation requirements at the existing Eastern Regional Plant – Control room and local plant.
 7. Contractor shall provide travel expenses for FAT period as stated in section 3.01.B.
 8. All instruments and control devices and installation shall comply with Orange County Utilities standard documents as applicable.

9. Preliminary and critical software design review meeting shall be conducted by the software engineer/Contractor with Owner and Engineer to insure design compliance with all specification hardware and software requirements as well as the discussion of the preliminary control strategy of the system.
- B. Work Includes: Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for a complete Instrumentation and Control System. Major parts are:
1. Instrumentation including primary elements, transmitters, and control devices.
 2. Control Panel Modifications.
 3. PLC and I/O Rack Control Panels Modifications.
 4. Software Modifications.
 5. Acceptance Testing, including 30-day system acceptance test.
- C. Instrument and Control (I&C) Supplier work scope:
1. For I&C equipment and ancillaries provide the following:
 - a. Completing detail design.
 - b. Required Submittals.
 - c. Equipment and ancillaries.
 - d. Instructions, details, and recommendations to, and coordination with, Contractor for proper installation.
 - e. Verify readiness for operation.
 - f. Verify the correctness of final power and signal connections.
 - g. Adjusting and calibrating.
 - h. Starting up.
 - i. Testing and coordination of testing.
 - j. Training.
 2. Verify following work not by I&C Supplier is provided:
 - a. Correct type, size, and number of signal wires with their raceways.
 - b. Correct electrical power circuits and raceways.
 - c. Correct size, type, and number of I&C related pipes, valves, fittings, and tubes.
 - d. Correct size, type, materials, and connection of process mechanical piping for in-line primary elements.
 3. For equipment not provided under I&C Supplier, but directly connected to equipment required by I&C Supplier:
 - a. Obtain from Contractor, manufacturer's information on installation, interface, function, and adjustment.
 - b. Coordinate with Contractor to allow required interface and operation with I&C System.
 - c. For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed with manufacturer's recommendations.
 - d. Test to demonstrate required interface and operation with I&C System.
 - e. Examples of items in this category, but not limited to the following:
 - 1) Valve operators, position switches, and controls.
 - 2) Chemical feed pump and feeder speed/stroke controls.
 - 3) Automatic samplers.
 - 4) Motor control centers.

- 5) Adjustable speed drive systems.
 - f. Examples of items not in this category:
 - 1) Internal portions of equipment provided under Division 16, Electrical, that are not directly connected to equipment under I&C System.
 - 2) Internal portions of I&C Systems provided as part of package systems and that are not directly connected to equipment provided under I&C System.
 - 4. Wiring external to equipment provided by I&C Supplier:
 - a. Special control and communications cable: Provided by I&C Supplier.
 - 5. Signal Verification
 - a. All proposed and existing control signals shall be verified from field device to the Eastern Regional control room for accuracy and scaling.
 - b. Furnish testing form to document each signal. Each form shall be signed and sealed by a Florida Registered Professional Engineer
- D. Software Engineering work scope:
- 1. Configuration of PLCs, including:
 - a. Correct I/O mapping and scaling.
 - b. Ladder logic implementing defined control strategies.
 - c. SCADA interface mappings.
 - d. Specifications/documents including: System External Specification, System Internal Specification, I/O Checklist, Factory Acceptance Test Plan, and Site Acceptance Test Plan.
 - e. As-built documentation
 - 2. Start-up support, including system testing.
 - 3. System training.
 - 4. Computer-based SCADA system (Proficy iFIX SCADA). Coordinate with Owner for software version requirements and match the current version installed at Eastern Regional Plant. I&C Supplier shall update the graphics, database, and historical reports at the Eastern Regional to support the monitoring and operation of theWSFs.

1.02 SINGLE INSTRUMENT SUPPLIER

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The Contractor shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, connection, to calibrate, to place into operation of all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein. The I&C supplier shall have a maintenance repair facility within a 150 mile radius of the project.
- B. The single instrument and controls supplier shall demonstrate his or her ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: system engineering, documentation including panel assembly, schematics and wiring diagram, programming, field testing, calibration and start-up, operator instruction and maintenance training.

The foregoing shall enable the Contractor and the Owner to be assured that the full responsibility for the requirements of this Section shall reside in an organization which is qualified and experienced in the water management field and its process technology on a functional systems basis.

The single I&C supplier shall have a UL approved shop and shall build all panels according to UL 508A.

Instrumentation and Controls supplier shall be **Curry Controls**.

- C. The single software engineering supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: ladder logic programming, computer-based SCADA system configuration, documentation, field testing, start-up, and operator instruction.

1.03 INSTALLATION WORK

- A. Nothing in this part of the Specifications shall be construed as requiring the Contractor to utilize personnel supplied by his or her assigned instrument manufacturer's organization, or any division thereof, to accomplish the physical installation of any elements, instruments, accessories or assemblies specified herein. However, the Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and assemblies; portions of their work shall be supervised or checked as specified in Part 3, herein.

1.04 PREPARATION OF SUBMITTAL OF DRAWINGS AND DATA

- A. It is incumbent upon the Contractor to coordinate the work specified in these Sections so that a complete I&C system for the facility shall be provided and shall be supported by accurate Shop and record Drawings. As a part of the responsibility as assigned by the Contractor, the Single I&C supplier shall prepare and submit through the Contractor, complete organized Shop Drawings, as specified in Part 2.02, herein. Interface between instruments, motor starters, etc. shall be included in his Shop Drawing submittal.
- B. During the period of preparation of this submittal, the Contractor shall authorize direct, informal liaison between his or her Single I&C supplier and the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as specified may be authorized informally by the Engineer, but these shall not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to or variation from these Specifications.
- C. In addition, I&C supplier/programmer shall also provide fully documented version of PLC programming and HMI programming on the CD.

1.05 ADDITIONAL TECHNICAL SERVICES

- A. At no separate additional cost to the Owner, the Contractor shall provide the following services of qualified technical representatives of the Single I&C supplier (See Part 3, herein).
 - 1. To supervise installation and connection of all instruments, elements, and components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps, valves, and chemical feeders;
 - 2. To make all necessary adjustments, calibrations and tests; and
 - 3. To instruct plant operating and maintenance personnel on instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site, and shall be during the Owner's normal working days and hours.

1.06 GUARANTEE

- A. The Contractor shall guarantee all equipment and installation, as specified herein, for a period of two (2) years following the date of completion of the work. To fulfill this obligation, the Contractor shall utilize technical service personnel designated by the Single I&C supplier to which the Contractor originally assigned project responsibility for instrumentation. Services shall be performed within four (4) hours after notification by the Owner.

1.07 ADDITIONAL PROVISIONS

- A. The applicable provisions of the following Sections under Electrical Work shall apply to work and equipment specified herein, the same as if stated in full, herein:
 - 1. Codes and Standards
 - 2. Equipment, Materials and Workmanship
 - 3. Testing
 - 4. Grounding
 - 5. Equipment Anchoring
 - 6. Conductor and Equipment Identification
 - 7. Terminal Cabinets and Control Compartments
 - 8. Process Control Devices

1.08 NEWEST MODEL COMPONENTS

- A. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of Shop Drawings unless otherwise specified to match existing equipment. All technical data publications included with submittals shall be the most recent issue.

1.09 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The instrumentation drawings were developed from past record drawings and information supplied by the Owner.

- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and instrumentation and control systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the Contractor's failure to fulfill this requirement.

1.10 RELATED WORK

- A. Division 16: Electrical.
- B. Division 11: Equipment.
- C. Division 13: Special Construction.

PART 2 – PRODUCTS

2.01 INSTRUMENTATION CRITERIA

- A. Designation of Components: In these Specifications and on the Drawings, all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of Automation Standard ANSI/ISA S5.1-1973. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, data sheets, and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace these prescribed above, used, herein and on the Drawings.
- B. Signal Characteristics: Signals shall be electrical, as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes DC, except as noted. Signals within enclosures may be 1-5 volts DC.
- C. Matching Style, Appearance And Type: All instruments to be panel mounted at the control panels shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one (1) manufacturer.
- D. Accuracy And Repeatability: The overall accuracy of each instrumentation system or loop shall be as prescribed in the Specifications for that system or loop. Each system's accuracy shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracy s" of certain designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual electronic instrument shall have a minimum accuracy of ± 0.7 percent of full scale and a minimum repeatability of ± 0.4 percent of full scale unless otherwise specified. Instruments which do not conform to or improve upon these criteria are not acceptable.

- E. Signal Isolators, Converters And Power Supplies: Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to insure adjacent component impedance match or where feedback paths may be generated. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to insure sufficient power to each loop component.
- F. Alternative Equipment Or Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the Engineer. Any changes inherent to a proposal alternative shall be at no additional cost to the Owner. The required approval shall be obtained in writing by the I&C Subcontractor through the Contractor prior to submittal of Shop Drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative equipment (other than direct, equivalent substitutions) and alternative methods shall not be proposed.

2.02 DETAILED SYSTEMS DRAWINGS AND DATA

- A. Content: The Contractor shall submit detailed Shop Drawings and data prepared and organized by the Single I&C supplier designated at the time of bidding. The quantity of submittal sets required shall be six (6). These Drawings and data shall be submitted as a complete bound package at one time within 80 calendar days after date of Notice to Proceed and shall include:
 - 1. Drawings showing definite diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA Standard S5.4, each having the format of ISA Standard S5.1 as used on the Project Drawing. (Each system or loop diagram shall be drawn on a separate Drawing sheet.)
 - 2. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:
 - a. Component function description used herein and on the Drawings;
 - b. Manufacturer's model number or other product designation;
 - c. Project tag number used herein and on the Drawings;
 - d. Project system loop of which the component is a part;
 - e. Project location or assembly at which the component is to be installed;
 - f. Input and output characteristics;
 - g. Scale range and units (if any) and multiplier (if any);
 - h. Requirements for electric supply (if any);
 - i. Requirements for air supply (if any);
 - j. Materials of component parts to be in contact with, or otherwise exposed to, process media;
 - k. Calibration curves as required;
 - l. Special requirements or features.

- A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
3. Drawings showing both schematic and wiring diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each control panel shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the Engineer, piping and wiring diagrams shall be prepared and submitted for review by the Engineer; the diagrams shall consist of component layout Drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves, and chemical feeders. The Contractor shall furnish all necessary equipment supplier's Shop Drawings to facilitate inclusion of this information by the I&C system supplier. Schematic and wiring diagram criteria shall be followed as established in NEMA Standards Publication ANSI/NEMA ICS-1-1978, "Industrial Control and Systems."
 4. Assembly and construction Drawings for each control panel and for other special enclosed assemblies for field installation. These Drawings shall include dimensions, identification of all components, surface preparation and finish data, nameplates, and the like. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
 5. Installation, mounting and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
 6. Complete and detailed bills of materials. A master Bill of Materials listing all field mounted devices, control panels and other equipment that shall be shipped to the job site. A Bill of Materials for each control panel listing all devices within the panel.
 7. Modifications to existing equipment. A complete description of all proposed modifications to existing instrumentation equipment, control panels, control devices, cabinets, etc., shall be submitted with the Shop Drawings complete with detailed Drawings of the proposed modifications.
- B. Organization And Binding: The organization of initial Shop Drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting "as built" conditions. Accordingly, the initial multiple-copy Shop Drawing submittal shall be separately bound in 3-ring binders of the type specified under Part 2.03, herein, for the Technical Manuals.

2.03 TECHNICAL MANUALS

- A. Five (5) final sets of technical manuals shall be supplied for the Owner, and one (1) final set shall be supplied for the Engineer, as a condition of acceptance of the project. Each set shall consist of one (1) or more volumes, each of which shall be bound in a standard size, three-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3.0 inches.
- B. Initially, two (2) sets of these manuals shall be submitted to the Engineer for favorable review after return of favorably reviewed Shop Drawings and data required under Part 3, herein. Following the Engineer's review, one (1) set shall be returned to the Contractor with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the Engineer fifteen (15) days prior to start-up of systems. The Engineer shall distribute the copies.
- C. In addition to updated Shop Drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection, operating, troubleshooting, maintenance, and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance, and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with complete parts lists and ordering instructions.

2.04 SPARE PARTS

- A. The Contractor shall include, as part of the bid package, a list of recommended spare parts covering items required under Section 13300 except PLC's of these Specifications. The total price of these spare parts shall not be less than \$5,000.00 and this sum shall be a part of the Contractor's total bid price. PLC spare parts are covered in the PLC section of this Specification, and the \$5,000.00 cited above shall be in excess of the PLC spare parts as listed in 2.08 this specification. The Single I&C Supplier in fact shall be responsible for delivery of the spare parts, as directed by the Owner after plant start-up. Prior to delivery of the spare parts, the Owner shall have the option of adding or exchanging any originally enumerated component based on current list prices for each item. The Contractor shall also submit a list of recommended equipment for maintaining and calibrating equipment furnished under Section 13300.
- B. The Single I&C supplier in fact shall be responsible for delivery of the spare parts, as directed by the Owner either during or after start-up. Prior to delivery of the spare parts, the Owner shall have the option of adding or exchanging any originally enumerated component based on current list prices for each item.

2.05 CONTROL PANELS

- A. General: Control panels shall be modified to include the following:
 - 1. Bent Oaks
 - a. GSR Fill valve testing and integration into SCADA system

2. Oak Meadows
 - a. Deleting generator vibration switch alarm.
 - b. Testing reconnected existing equipment. Generator, starters, ATS
 - c. Integrate new starter trouble signals using spare I/O.
 - d. Integrate digital interface of generator
 - e. Test all automation and confirm existing controls are unaffected by this new work.
3. New drives at Western Regional

B. Signal And Control Circuit Wiring:

1. Wire Type and Sizes: Conductors shall be flexible stranded copper wire; these shall be U.L. listed Type THHN and shall be rated 600 volts. Wire for control signal circuits and alarm input circuits shall be 16 AWG. All instrumentation cables shall be shielded No. 20 AWG with a copper drain wire. All special instrumentation cable such as between sensor and transmitter shall be supplied by the I&C supplier.
2. Wire Insulation Colors: Conductors supplying 120 volt AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 volt AC control circuit conductors shall be red. All wires energized by a voltage source external to the control board(s) shall have yellow insulation. Insulation for all DC conductors shall be blue.
3. Wiring Installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel mounted components. Wiring run from components on a swing-out panels to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts. Wiring to rear terminals on panel mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments. Shields of shielded instrument cable shall only be grounded on one side of each cable run. The side to be grounded shall always be in the field as applicable. Care shall be exercised to properly insulate the ungrounded side, to prevent ground loops from occurring. Conformance to the above wiring installation requirements shall be reflected by details shown on the Shop Drawings for the Engineer's review.
4. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all Shop Drawings. These numbers shall be marked on all conductors at every terminal using permanently marked heat-shrink plastic. Instrument signal circuit conductors shall be tagged with unique multiple digit numbers. Black and white wires from the circuit breaker panelboard shall be tagged including the one (1) or two (2) digit number of the branch circuit breaker and panel number.

5. Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be General Electric Type CR 151A1 with mounting rack, equivalent by Cinch-Jones or equal.

- C. PLC Control Panel Requirements: All input/output hardware and interface equipment shall be provided by the computer & PLC system supplier for all specified inputs and outputs. Input/output hardware shall be plug-in modules (or equivalent I/O assembly and associated printed circuit board) in associated I/O rack assemblies.

Signal and control circuitry to individual input/output modules shall be arranged such that any one module failure shall not disable more than one control loop within any group of controlled equipment (eg. one pump out of a group of three pumps, etc.) The latest revision of the programming software shall be installed as of substantial completion.

All analog and discrete inputs and outputs shall be optically or transformer isolated for voltage surge protection and shall meet peak common mode and 3 kV surge to ground withstand capability (SWC) test as specified by ANSI C37.90A197A (IEEE Standard 472-1974).

In the event a standard manufacturers product does not satisfy the above surge requirements, additional protective circuitry to suppress contact bounce and to protect transients from being recognized as data. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which are movable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. PLC shall be a standard Quantum using ladder logic and NOE module. Latest firmware shall be installed on the processor. Input/output modules shall have individual indicators that show the on/off status of each input or output device connected to it.

1. Analog Input: The analog input subsystem shall accept 4-20 MA (1-5 volts across 250 ohms) signals which shall be multiplexed into one or more amplifiers and ADC's by one or more analog input multiplexers. The analog input multiplexers shall be of the solid state differential type and shall employ successive approximation or dual slope integration to digitize the sampled analog signals into a 12 bit binary value; with an accuracy of $\pm 0.05\%$ of full scale. Input power supply shall be 24 volts DC from the I/O power supply subsystem where power is not supplied by the associated field instrument.
2. Discrete Input: Dry Contact: The input subsystem shall sense the open or closed status of contacts at each scan interval. Sensing power shall be 24 volts DC from the I/O power supply subsystem. Powered input: The input subsystem shall sense the status of 120VAC inputs at each scan interval. Power for inputs is derived from the source system or equipment. Coordinate with Owner and other drawings for the requirements of either dry contact or powered input and provide accordingly.
3. Analog Output: The analog output subsystem shall accept incremental signals from the process controller. A solid state digital to analog converter (DAC) shall be provided for each analog output. The incremental signals from the process controller

- shall increment or decrement the 4-20 MA output signal from each DAC. A 24 volt DC power supply shall be provided for analog outputs from the I/O power supply subsystem. The output of each DAC shall be continuously maintained and shall have a drift rate no greater than 2% in 24 hours. Each DAC shall have a 12 bit resolution and an accuracy of $\pm 0.05\%$ full scale.
4. Discrete Output: The discrete output subsystem shall be of the solid state type and shall generate maintained or momentary outputs as required to operate interposing relays provided in related circuitry. Diode protection (in addition to surge protection) shall be provided on all discrete outputs. The output contacts shall be rated 24 VDC/120 VAC, 5A SPDT. Match Orange County standard for discrete output (120VAC).
 5. Power Supplies: Input/output (I/O) subsystem power supplies shall be provided for each PLC control panel and shall be sized to power all 2-wire and 4-wire discrete and analog DC circuits under full-load conditions including allowances for specified spares. The incoming power source to the I/O subsystem power supplies shall be 115 VAC from the associated panelboard. Transformation, rectification and smoothing circuitry shall be furnished to provide a regulated 24 volt DC power supply. The DC power supply shall be converted to other DC voltage levels as required. Provide 24VDC power supply with diode protection and alarm (PLC input) in case of power supply failure, if shown on drawings.

2.06 ACCESSORIES

- A. General purpose relays in the control panels shall be plug in type with contacts rated 10 amperes at 120 volts AC and LED indicator. The quantity and type of contacts shall be as shown on the Drawings. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals. Relays shall be Potter and Brumfield Type KRP or KUP, Square-D Type K, or equal.
- B. Time delay relays shall be solid state on-delay or off-delay type with contacts rated 10 amperes at 120VAC. Units shall include adjustable dial with graduated scale or digital switch setting covering the time range in each case. Time delay relays shall be Agastat Series 7000, Omron series H3, SSAC type TDM or approved equal.
- C. Additional slave relays shall be installed when the number or type of contacts shown exceed the contact capacity of the specified relays and timers.
- D. All indication lights shall be LED type, round 22 mm (minimum) configuration, heavy duty and corrosion resistant type. Non-LED type indication lights are not acceptable. Switches shall be round 30.5mm configuration, heavy duty and corrosion resistant. Legend plate shall be standard size square style laminate with white field and black markings as shown. LED Indicating lights shall have integral transformer for operation from 120VAC, if necessary. Pushbuttons shall include full guard with flush button and selector switches shall include a black non-illuminated knob on switch, unless otherwise noted. Contact arrangement and configuration shall be as shown. Devices shall be Cutler Hammer Type E-30, General Electric Type CR104, Square D class 9001 type Sk, Allen Bradley Bulletin 800 or equal.

- E. Selector switches shall be of the rotary type with the number of positions as shown on the Drawings. Color, escutcheon engravings, contact configurations and the like shall be as shown. Devices shall be Cutler Hammer Type E-24, General Electric Type CR104, or equal.
- F. Circuit breakers shall be single pole, 120 volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels as shown.
- G. Nameplates shall be supplied for identification of all field mounted elements, including flow meters and their transmitters. These nameplates shall identify the instrument, or meter, descriptively, as to function and system. These nameplates shall be fabricated from black-face, white-center, laminated engraving plastic. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the control panels. These shall be descriptive, to define the function and system of such element. Adhesives shall be acceptable for attaching nameplates. Painted surfaces must be prepared to allow permanent bonding of adhesives. Nameplates shall be provided for instruments, function titles for each group of instruments and other components mounted on the front of the control panels as shown. These nameplates and/or individual letters shall be fabricated from VI-LAM, Catalog No. 200, manufactured by N/P Company, or equivalent by Formica, or equal. Colors, lettering, style and sizes shall be as shown or as selected by the Engineer.
- H. Solenoid Valves if not otherwise noted shall be globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation. Materials shall be brass globe valved bodies and Buna-N valve seats. The size shall be 1/4-inch normally closed. The coil shall be 115 VAC coil, Nema 4 solenoid enclosure. Manufacturer shall be ASCO; Red Hat, or equal.

2.07 SURGE PROTECTIVE DEVICE (SPD) FOR SURGE PROTECTION

- A. General: 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 case, properly grounded. Ground wires for all TVSS 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 4X junction box coupled to the enclosure.
- B. Power Supply: Protection of all 120 VAC instrument power supply lines shall be provided. Control panels shall be protected by line noise suppressing isolation transformers and surge. Field instruments shall be protected by SPD. For control panels, the line noise suppressing isolation transformer shall be Eaton Power Shure isolators or approved equal. The suppressor shall be Edco HSP-121, Surge Suppression Incorporated, Current Technology, or Joslyn.

- C. Signals: Protection of analog signal lines originating and terminating not in the same building shall be provided by SPD. For analog signal lines the SPD shall be MTL-SD32X. For field mounted two-wire instruments the SPD shall be encapsulated in stainless steel pipe nipples, and shall be MTL-TP32-N. For field mounted four-wire 120VAC instruments, the SPD shall be in a NEMA 4X polycarbonate enclosure, SD32X (analog) and MA15/D/I/SI for 120VAC.

2.08 INSTRUMENTATION AND CONTROL EQUIPMENT SPECIFICATIONS

A. Oak Meadow HMI Workstation

1. Dell Precision T5610 or current family product comprised of the following configuration. This configuration is to be provided as a minimum:
 - a. Processor type: Quad-Core {Intel Xeon}
 - b. Processor speed: 2.4 Ghz
 - c. Monitor type: Flat Panel, dual configuration
 - d. Monitor size: 24-inch Ultrasharp monitor 1200 x 1600 Resolution
 - e. Memory size {RAM}: 8 GB
 - f. Two 500 GB hard drives or larger with integrated RAID 1 controller
 - g. Single CPU, dual capable
 - h. 16X DVD-RW DL
 - i. 256 MB PCIe Dual Monitor DVI capable video card
 - j. 6 MB Cache
 - k. Two 10/100/1000 Gigabit RJ-4S connectivity Ethernet controller PCIe cards.
 - l. 3 button Intellimouse
 - m. Standard Windows keyboard
 - n. 2 Serial Ports standard
 - o. 2 Parallel Port standard or USB ports
 - p. Sound Card and speakers
 - q. MS Windows 7 Professional Full Service, Service Pack 1, 32-bit capable
 - r. Microsoft Office 2010 Professional 32-bit capable
 - s. GE Proficy iFIX VS.8 with development key license
 - t. Resource DVD or USB contains Diagnostics and Drivers
2. Monitor to be mounted behind plexiglass in front of PLC enclosure door. Keyboard and mouse mounted to front of PLC enclosure in a fold down tray, replace front door in its entirety.

2.09 CONTROL STRATEGY SCHEDULES

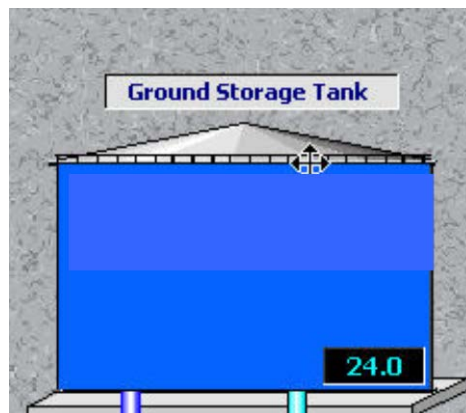
The control strategies are written descriptions of the programming required to implement regulatory and sequential control of the unit processes. Control strategies shall fully reside in the memory of the designated PLC. Coefficients pertaining to control strategies shall be modifiable through the operator interface in the monitoring / control mode. I&C supplier shall obtain the existing PLC programs of the each facility chemical feed pumps control system and mimic the new control system with additional control features stated below.

The I&C supplier shall include an additional 160 hours on-site to fine tune control systems and make minor software modifications in order to resolve any logic discrepancies encountered during start-up, and supply the Owner with a complete functional system. This shall be part of the bid package with no additional cost to the owner.

A. General Logic Description:

1. Auto-Manual Start-Stop scheme for all equipment (pump or valves) shall operate on the following way: Any equipment shall have Auto and Manual mode selectable from the HMI screen. In Auto mode the particular pump or valve shall follow the auto control strategy described above. In Manual mode, operator shall be able to Start, Stop, Open or Close pump/ Valve from the HMI screen. VFD pump or modulating valve shall have in addition the manual set point for speed/ position.
2. The control system shall be designed to allow online calibration and repair of instruments used in the plant control scheme without disruption of the plant process or production rate. This shall be accomplished using operator selectable process hold values in conjunction with operator selectable hold timers and alarms to remind operators to reset the system to active inputs.
3. All alarms that are generated by the PLC and have active role in PLC logic, shall be latched, and shall be resetable from the HMI screens, except the alarms that need to be reset on the field.
4. All alarms that are generated by the PLC and have only monitoring purposes, shall be present only while the conditions that caused the alarm are present, and be automatically reset when the conditions are no longer present.
5. All alarms generated by the PLC shall have selectable value in HMI for alarm set point, and selectable time delay.
6. All flow pacing controls (or pacing controls of any kind) shall include a ratio factor that can be entered from the screens. Also, PLC programmer shall leave the option of adding calculation blocks for all pacing controls as required during the startup.
7. All Set points for PID loops shall be enterable from the screen together with percentage that PLC shall use to calculate stage up and stage down set points. That calculation shall be one scan operation. After that one scan operation initiated by either entering the PID set point or percentage, operator shall be able to overwrite calculated values from the screen

B. Ground Storage Tank (Bent Oaks)



1. While there is no equipment to control on the GST, the level in the tank is used for many other control strategies. The level will be used to determine the status of the fill valves; the HSP use the low-low level signal as an interlock.
2. Since the fill valves automatically open or close based off the GST level reading, if the GST transmitter fails, the fill valve automatically default to AUTO/OFF if they were in the AUTO/AUTO mode. The operator may operate the fill valve by placing them to AUTO/MANUAL mode. The operator will have the option of manually controlling the fill valves.
3. Since the HSP use the level transmitter to derive a low low level lockout, if the GST transmitter fails, the HSP shall automatically default to AUTO/OFF mode. The operator may run the pumps by placing them to AUTO/MANUAL mode. HSPs shall not shut down.
4. Alarm level set points will be in feet and will be adjustable through the Eastern and Western Regional HMI as well as the local MMI.
5. Alarms
 - a. High high level.
 - b. High level.
 - c. Low level.
 - d. Low low level (Float) (HSP Lockout).
6. Tank Level Control (Fill Valves #1)
 - a. AUTO MODE
 - 1) When selecting “AUTO MODE” the operator is provided with a drop-down setpoint which allows the entry of a number to determine the percent open. Once this setpoint number is entered the valve will open to within 2% of this value (via the feedback from the position transmitter). To achieve this opening mode the Open Solenoid Valve will pulse on for two seconds (operator adjustable), off for five seconds (operator adjustable), on for two seconds, off for five seconds, etc. until the setpoint (plus or minus two percent) is reached. Once the setpoint is reached the Open Solenoid Valve will cease to pulse. While in Auto changing the setpoint to any number outside the 2% dead band will prompt the correct response (opening or closing) to achieve the new setpoint.
 - 2) If in Auto and at the desired setpoint position the Close Solenoid Valve will energize (while the mode stays in AUTO) based on the following criteria:
 - (a) If any HSP is running or if the line pressure goes low (40 psig or less) for 10 or more seconds the CLOSE solenoid valve will energize. If the pressure goes high (50 psig or more) for 10 or more seconds the CLOSE solenoid valve will de-energize or if there is a power loss to the plant.

- 3) If in Auto and at the desired setpoint position the mode will change from AUTO to CLOSE based on the following criteria:
 - (a) If the level in the selected GST goes high (20 ft. or more; 22.5 ft. = 100%) for 3 or more seconds or the watchdog timer (which tracks communication from SCADA to the local PLC) times out.
 - 4) To get back to AUTO the operator has to make the selection.
- b. CLOSE MODE
- 1) When the “CLOSE MODE” is selected the Close Solenoid Valve will pulse on for two seconds, off for five seconds, on for two seconds, off for five seconds, etc. until the position transmitter decreases to 2% or less. Once this value of 2% is reached the Close Solenoid Valve will remain energized for 30 seconds. While in the “CLOSE MODE” to prevent leaking past the Fill Valve the Close Solenoid Valve will be pulsed on for 30 seconds (operator adjustable) of every 600 seconds (i.e., 30 seconds on, 570 seconds, off, continuously).
- c. INTERLOCKS
- 1) In event of Position Transmitter failure (4-20 ma loop is faulty) the following rules apply:
 - (a) In the “CLOSE MODE” the Close Solenoid Valve will energize for 120 consecutive seconds. As noted above the valve will continue to close for 30 seconds of every 600 seconds.
 - (b) When the “OPEN MODE” is selected the Open Solenoid Valve will energize for 8 consecutive seconds. Based on the 5% opening per 2 seconds this will provide an opening of around 20%.

2.10 INSTRUMENT LIST

TAG NO.	COMPONENT CODE	COMPONENT TITLE	COMPONENT OPTIONS	REMARKS
PE/PIT-001	PE/PIT-001	Pressure Transmitter		

A. This specification covers the following services:

1. Gauge Pressure

B. Meet the following unless otherwise noted on the instrument schedule:

- | | |
|------------------------|---|
| 1. Mounting: | Provide corrosive resistant hardware required for mounting the instrument. |
| 2. Enclosure: | Unless otherwise shown on the instrument schedule, provide NEMA 4X pipe mounted |
| 3. Power Supply: | 12-48 Vdc (signal loop powered). |
| 4. Output: | 4-20 mAdc, direct acting into 600 ohms minimum. |
| 5. Zero Suppression or | 150 percent of calibrated span. |

Range Elevation:	
6. Range:	0 to 150 psig.
7. Certifications:	NSF
8. Humidity:	10 to 100 percent non-condensing.
9. Sensing Element:	Diaphragm type.
10. Vent/Drain Valve:	One each sensing cavity.
11. Material:	Sensing element components to be 316L stainless steel, or as shown on the instrument schedule.
12. Process Connection:	0.5 inch-14 NPT unless noted otherwise in the instrument schedule.
13. Electrical:	0.5 inch rigid conduit with screw terminals. Provide electrical protection against lightning.
14. Freeze Protection:	If the transmitter and process piping are located outdoors, provide freezing protection for both.
15. Design:	Provide microprocessor-based electronic design with digital communication capability and industry standard protocol.
16. Hardware:	All 316 stainless steel.

C. Provide local output indicators. Meet the following requirements:

1. Mounting: Integrally mounted on the pressure transmitter enclosure or on an enclosure near to the transmitter.
2. Enclosure: Aluminum.
3. Accuracy: +/-2.0 percent of span.
4. Scale: linear with process variable except differential pressure flow that shall be linearly proportional to flow. All scales shall be provided to read in engineering units to match process.
5. Manufacturer: Same as transmitter.

D. Provide block and shutoff valves. Meet the following requirements:

1. Size: 0.5 inch (1.0 inch for diaphragm seal installations).
2. Type: Ball.
3. Pressure: Up to 100 psi.
4. Body: Brass or bronze, for non-corrosive atmosphere, PVC or epoxy coated for corrosive atmosphere.
5. Seats and Seals: Teflon.
6. Ball and Stem: Same material as sensing element.
7. Provide: Gemini valve series 76, Apollo model 70-103, or equal.
8. Valves: 316 stainless steel
9. Hardware: 316 stainless steel

E. Manufacturer: Rosemount 3051TG

2.11 PROGRAMMING SOFTWARE

- A. The Contractor is responsible for using the PLC programming software (ProWORKX NxT) with the same version that the County is currently using for the PLC type specified under specification 13300. No PLC software license is required for this project for the Owner.
- B. Replace existing CPUs with #140CPU43412A. Typical three (3) places.

PART 3 – EXECUTION

3.01 INSTALLATION, CALIBRATION, TESTING, START-UP AND INSTRUCTION

- A. General: Under the supervision of the Single I&C supplier, all systems specified in this Section shall be installed, connected, calibrated and tested, and in coordination with the Engineer and the Owner, shall be started to place the processes in operation. This shall include final calibration in concert with equipment specified elsewhere in these Specifications, including pumps, valves, as well as certain existing equipment.
- B. Testing: All control systems both new and existing shall be exercised through operational tests in the presence of the Engineer in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Specifications. The scheduling of tests shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.
 - 1. Un-witnessed Factory Test (UFT): An un-witnessed factory test shall be conducted to prepare the I&C Supplier to demonstrate compliance with this specification during the Factory Acceptance Test (FAT). The I&C Supplier shall prepare a written procedure detailing every aspect of the UFT. This procedure must be submitted to the ENGINEER for approval prior to the commencement of the UFT. This procedure along with any forms generated during the UFT shall comprise the basis of the FAT. The I&C Supplier shall inspect and test the Integrated Control System (ICS) to ensure it is ready for the FAT. This test shall take place at the I&C Supplier's factory. It shall consist of interconnecting computers, PLC control panels, communications links, and other new Control Panels (unless specifically excluded below). All primary element inputs shall be simulated (inputs shall be adjustable by switch, if discrete; by potentiometer or similar device, if analog). Primary outputs shall be monitored via output devices (LED indication lights, for discrete; a meter, digital display (12-bit min. resolution) or other such analog device, if analog output).

During the UFT, the Contractor shall test the communications links and demonstrate error-free communications to and from each node on the fiber optic network. Verify that each I/O point is consistently mapped at the computer node, at the PLC I/O card, in the PLC memory, and at the I/O simulated device according to the database provided by the software engineer. Verify the proper operation of each of the pilot devices on each of the control panels, if any.
 - 2. Excluded New Panels: None
 - 3. Factory Acceptance Test (FAT): The I&C Supplier shall test the entire control system. The test shall take place at the I&C Supplier's factory. The I&C Supplier

shall simulate all inputs and outputs as performed in the UFT. The software engineer shall load application programs into each PLC. The software engineer shall load the HMI application into the computer. Owner and Owner's Consultant will participate and witness in FAT. Provide a minimum of 2 weeks' notice to the Owner/Engineer before conducting testing. I&C Supplier shall provide all expenses for Owner and Engineer at the FAT. Prior to commencement of the FAT, the I&C Supplier shall furnish the following documentation to the Engineer:

- a. All Drawings, Specifications, Addenda, and Change Orders
- b. Master copy of the written FAT procedures
- c. List of equipment to be tested
- d. Shop drawings of equipment to be tested
- e. Preliminary Software documentation submittal

Daily Schedule for FAT:

- a. Begin each day with a meeting to review the day's test schedule
- b. End each day with a meeting to review the day's test results and to review and to revise the next day's test schedule, if required.

The I&C Supplier shall repeat the I/O point mapping consistency check as before, with the addition of verification of mapping on HMI screens. Those variables, which are not I/O but are variables which exist in the PLC and HMI software only (see preliminary software documentation), shall all be checked. Check the function of each loop, including set points, alarms, displays, and operator interface. Check all loops. Check data logging, alarm logging, and event logging. Test all non-loop-specific functions including, but not limited to the following:

- a. Demonstrate capacity of system for expansion. Include tests for both storage capacity and processing capacity.
- b. Include tests for timing requirements.
- c. Demonstrate online and offline diagnostic tests, procedures and displays.
- d. Demonstrate Failure Mode and Backup Procedures: Power failure, auto restart, disk backup and reload, retentive outputs.

Correct deficiencies found and complete correction of deficiencies prior to shipment to site. Failed Tests shall be repeated and witnessed by the Owner and Engineer. With approval of the Engineer or Owner certain tests may be conducted by the I&C Supplier and Witnessed by the Engineer and Engineer during START-UP. I&C supplier shall include in his or her bid allowance for travel expenses for 3 persons (2 from Owner, and 1 Engineer) for entire system FAT – duration maximum 5 days. Travel expenses shall include car rental, accommodation and food for each person during FAT period. See section 3.02 supplements for sample "Loop Status Report" and "Functional Acceptance Test Sheet".

C. Installation And Connection:

1. The Contractor shall install and connect all field-mounted components and assemblies under the criteria imposed in Part 1, 1.03, herein. The installation personnel shall be provided with a final reviewed copy of the Shop Drawings and data.
2. The instrument process sensing lines and air signal tubing shall, in general, be installed in a similar manner to the installation of conduit specified under Section

16100. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 feet of rigid tubing.

3. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels.
4. The Contractor shall have a technical field representative of the I&C supplier to instruct these installation personnel on any and all installation requirements; thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel.
5. Where primary elements (supplied by I&C supplier) shall be part of a mechanical system, the I&C supplier shall coordinate the installation of the primary elements with the mechanical system manufacturer.
6. Finally, after all installation and connection work has been completed, the technical field representative shall check it all for correctness, verifying polarity of electric power and signal connections, making sure all process connections are free of leaks, and all such similar details. If the initial inspection finds no deficiencies, the technical field representative shall proceed to the certification to the Contractor. Any completed work that is found to have deficiencies shall have those deficiencies corrected by installation personnel at no additional cost to the Owner. The technical field representative shall then recheck the work after the identified deficiencies are corrected. If the technical field representative finds deficiencies in the follow-up inspection, then remedial action shall be taken by the Contractor at no cost to the Owner. This pattern shall be repeated until the installation is free from defect. The technical field representative shall then certify in writing to the Contractor that for each loop or system that he has inspected is complete and without discrepancies.
7. The field representative of the Single I&C supplier shall coordinate all work required to interface the new equipment and control devices with the existing equipment, including all required modifications to existing equipment and related devices.

D. Calibration:

1. All instruments and systems shall be calibrated after installation, in conformance with the component manufacturer's written instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation, and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the technical field representatives of the I&C system supplier who shall certify in writing to the Contractor that for each loop or system all calibrations have been made and that all instruments are ready to operate. See section 3.02 supplements for sample "Instrumentation Calibration Sheet".
2. Proof of Conformance -The burden of proof of conformance to specified accuracy and performance is on the Contractor using its designated Single I&C supplier. The Contractor's designer shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to

the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear within the guarantee period.

- E. Pre-Commissioning: The I&C Supplier shall test each loop (discrete and analog) to determine if it is functioning correctly. The I&C Supplier shall furnish a loop sheet for each loop to be tested. The loop sheet shall represent the actual "as-built" condition of the loop. The I&C Supplier shall perform a field functional loop test which shall be witnessed by the Engineer and Owner. If the loop fails the functional test, the I&C Supplier shall coordinate repairs for the Contractor to correct whatever is wrong with the loop. The I&C Supplier shall retest the loop until it is approved. Each loop shall be tested and approved by Engineer and Owner until all loops have been approved.
- F. Start-Up And Instruction: When all systems are assessed by the Contractor to have been successfully carried through complete operational tests with a minimum of simulation, and the Engineer concurs in this assessment, plant start-up by the Owner's operating personnel can follow. For a minimum of three times for (4) hours prior to start-up, operating and maintenance personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting or checking, re-calibration or maintenance by them from time to time. This instruction shall be scheduled at a time arranged with the Owner at least two (2) weeks in advance. Instruction shall be given by qualified persons who have been made familiar in advance with the systems. All equipment shall be checked during the first year of operation at intervals of three months for a period of not less than one day or as may be required to correct any defects to the satisfaction of the Owner.
- G. Modifications To Existing Facilities: The Contractor shall make all modifications to existing equipment and control devices which are required to successfully install and integrate all new instrumentation equipment. All costs for any required modification and rehabilitation effort shall be included in the Contractor's original bid amount and no additional payment shall be allowed.
- H. Plant Shutdowns: The Single I&C supplier shall carefully examine all work to be performed relative to existing I&C equipment and the installation of new equipment and control devices. Work shall be scheduled to minimize required plant shutdown times.
- I. Coordination With Other Concurrent Projects: The single I&C supplier shall coordinate extensively with other I&C suppliers of concurrent projects. Some of the equipment shown in this contract as existing might be installed while this contract is underway.

3.02 TRAINING

- A. General:
 - 1. Provide an integrated training program to meet specific needs of Owner's personnel.
 - 2. Provide instruction on one working shift as needed to accommodate the Owner's personnel schedule.
 - 3. Owner reserves the right to make and reuse video tapes of training sessions if applicable.

B. Operations and Maintenance Training:

1. Include a review of O&M manuals, expendables, and test equipment.
2. Training session duration shall be minimum 4 hours. Provide training schedule with outlines at least one week before the training to the Owner.
3. Training shall include a minimum understanding of loop functions, loop operation, component calibration, adjustments such as controller tuning, switch trip point, etc., and periodic maintenance.

3.03 SUPPLEMENTS

A. Supplements listed below shall be provided by the Integrator.

1. Instrumentation Calibration Sheet
2. Loop Status Report
3. Functional Acceptance Test Sheet

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SECTION 15000
MECHANICAL-GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. All equipment furnished and installed under this contract shall conform to the general stipulations set forth in this Section except as otherwise specified in other sections.
2. Contractor shall coordinate all details of equipment with other related parts of the Work, including verification that all structures, slabs, supports, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alternations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

B. General Design:

1. Contract Drawings and Specifications: The Contract Drawings and Specifications shall be considered as complementary 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 Contract Drawings are to be considered diagrammatic, not necessarily showing in detail or to scale all of the equipment or minor items. In the event of discrepancies between the Contract Drawings and Specifications, or between either of these and any regulations or ordinances governing work of these Specifications, the bidder shall notify the Engineer in ample time to permit revisions.

1.02 QUALITY ASSURANCE

A. Materials and Equipment: Unless otherwise specified, all materials and equipment furnished for permanent installation in the work shall conform to applicable standards and specifications and shall be new, unused, and undamaged when installed or otherwise incorporated in the work. No such material or equipment shall be used by the Contractor for any purpose other than that intended or specified, unless such use is specifically authorized in writing by the Owner. No material shall be delivered to the work site without prior acceptance of drawings and data by the Engineer.

B. Where applicable, manufacturers shall be selected from the Orange County Utilities "List of Materials and Approved Manufacturers" (see Appendix).

C. Equivalent Materials and Equipment:

1. When a material or article is specified or described by name of a proprietary product or of a particular manufacturer or vendor, the mentioned item shall be understood as establishing the type, function, and quality desired. Other manufacturers' products

- may be accepted provided sufficient information is submitted to allow the Engineer to determine that the products proposed are equivalent to those named. Such items shall be submitted for review in accordance with Section 01300: Submittals.
2. Requests for review of equivalency will not be accepted only from the Contractor and such requests will not be considered until after the contract has been awarded.
- D. Governing Standards: Equipment and appurtenances shall be designed in conformity with ANSI, ASME, ASTM, IEEE, NEMA, OSHA, AGMA, and other generally accepted applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses that 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 acceptable means. Provisions shall be made for adequate lubrication with readily accessible means.
- E. Tolerances: Machinery parts shall conform to the dimensions indicated on the Drawings within allowable tolerances. 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.
- F. Clearances: Ample clearances 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 or her expense.
- G. Testing:
1. When the equipment is specified 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.
 2. 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 Contractor. All testing shall be done in the presence of the Contractor. "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 and painted.
- H. Pressure Test:
1. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Section 15044.
 2. All tests shall be made in the presence of and to the satisfaction of the Construction Manager and also to the satisfaction of any local or state inspector having jurisdiction.
 - a. Provide not less than three days notice to the Construction Manager 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 Construction Manager shall be retested in part or in whole as directed by the Construction Manager.

- c. The piping systems may be tested in sections as the work progresses by no joint or portion of the system shall be left untested.
 3. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
 4. 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.
 5. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.
 6. Provide test pumps, gauges, or other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, additional restraint, and thrust blocking which may be required for test pressures above normal working pressures.
 7. 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.
- I. Failure of Test:
 1. Defects: 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 or her having made partial payment for work and materials which have entered into the manufacturer for such equipment, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.
 2. Rejection of Equipment: In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him to deliver to the Contractor a bill of sale of all his or her 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 or her without rental or other charge until the other equipment is obtained.
- J. Responsibility during Tests: 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.
- K. 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 delivered 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 specification. 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.

L. Safety Requirements:

1. In addition to the components shown and specified, all machinery and equipment shall be safeguarded in accordance with the safety features required by the current codes and regulations of 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 double inlet 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.

1.03 SUBMITTALS (SEE SECTION 01300: SUBMITTALS)

1.04 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 and 09905. 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 subassemblies, 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: Contractor shall arrange deliveries of products in accordance with construction schedules and coordinate to avoid conflict with work and condition at the site.
1. Contractor shall deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 2. Immediately on delivery, 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 Contractor deliver equipment to the site more than one month prior to installation without written authorization from the Construction Manager. 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. Equipment storage 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. Contractor shall store products subject to damage by the elements in weather-tight enclosures.

- b. Contractor shall maintain temperature and humidity within the ranges required by manufacturer's instructions.
 - c. Contractor shall store fabricated products aboveground, on blocking or skids, to prevent soiling or staining. Contractor shall cover products that are subject to deterioration with impervious sheet coverings and provide adequate ventilation to avoid condensation.
 - d. 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 peeling to a minimum.
 4. All materials that, in the Construction Manager's opinion, have become damaged and are unfit for the intended or specified use shall be promptly removed from the site and Contractor shall receive no compensation for the damaged material or its removal.
 5. Contractor shall arrange storage in a manner to provide easy access for inspection. 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: Contractor shall provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. 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 Construction Manager 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 Construction Manager. No equipment shall be stored onsite for more than one month without prior written authorization from the Construction Manager.
 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 Construction Manager until such time as the equipment installation.
 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 Contractor and reviewed by Contractor with the Construction Manager. 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 equipment installation, the Contractor shall start the equipment, and operate loaded when possible, 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 installation completion and as often as required thereafter during the period between installation and acceptance. If stored for longer than ninety days, mechanical equipment to be used in the work 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 Contractor's expense.
8. A maintenance log shall be maintained by the Contractor outlining the schedule of maintenance required for each piece of equipment, 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.
9. All motors for storage shall have motor space heater active and wired from nearest power source to prevent moisture entering the motor.

1.05 WARRANTY AND GUARANTEES

- A. The manufacturer's written warranty shall be submitted for all major pieces of equipment, as specified in Section 01740: Warranties and Bonds. The manufacturer's warranty period shall be concurrent with the Contractor's correction period for one year after the time of completion and acceptance.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials that come into contact with the water being treated or the finished water shall be on either the EPA or NSF lists of products 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 62555.320(3) Florida Administrative Code.

2.02 MATERIALS AND EQUIPMENT

- A. Fabrication and Manufacture:
 1. Workmanship and Materials:

- a. 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.
 - b. 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.
 - c. 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 ¼-inch thick.
2. Lubrication:
- a. Equipment shall be adequately lubricated by systems that require attention no more than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
 - b. 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.
 - c. 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.
3. 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 from 16 USS gage or heavier galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard and shall be galvanized, including bolts. All outdoor safety guards shall be designed to prevent the entrance of rain and dripping water.
4. Equipment Foundation Supports:
- a. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by Contractor.
 - b. 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-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 non-shrinking grout sloped to drain to the perimeter of the base.
- 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. 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 Section 05500: Miscellaneous Metals and, 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 1½ inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.
 - 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, thrust blocks, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.
 - g. 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.
5. Shop Painting:
- a. 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 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.
 - b. Surfaces to be painted after installation shall be prepared 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.
 - c. 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.
6. 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 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 manufacturer's name, year of manufacture, serial number, and principal rating data.
7. Pipe Identification:
 - a. All pipe (except underground) shall have code letters and flow arrows painted as per specification Section 09905. The contractor shall ensure that the pipes are properly marked.
 - b. Underground pipe and tube: Pipe and tube shall be located by laying 2-inch wide plastic tape continuously along the run of pipe or tube. Where possible, color of tape shall be consistent with the color of bands on interior pipe and as approved by the Engineer, or shall bear an imprinted identification of the line.
 - 1) Location: Tape shall be laid approximately 12 inches below ground surface and directly over pipe location.
 - 2) Manufacturer: Tape shall be as specified in Section 09905.
 8. Valve Identification: On all valves except shut-off valves located at a fixture or piece of equipment, the Contractor shall provide a coded and numbered tag attached with brass chain and/or brass "S" hooks.
 - a. Tag Types:
 - 1) Tags for valves on pipe and tube lines conducting hot medium (steam, condensate, hot water, etc.) shall be brass or anodized aluminum.
 - 2) Tags for all other valves shall be Type 304 stainless steel.
 - 3) Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.
 - b. Coding: In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the line service. All color and letter coding shall be approved by the Engineer.
 - c. Valve Schedule: The Contractor shall provide a typewritten list of all tagged valves giving tag shape, letter code and number, the valve size, type, use, and general location within building.
 9. 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. Flame-proofing treatments will not be acceptable.
 10. Heating, Ventilation, and Domestic Plumbing Equipment:
 - a. Interchangeability: In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays, and other items is essential. All similar items shall be of the same manufacturer, type, model, and dimensions.

2.03 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.

2.04 SPARE PARTS

- A. Spare parts for certain equipment provided under Divisions 11, 13, 14, 15, and 16 have been specified in the pertinent sections of the specifications. The Contractor shall collect and store all spare parts in an area to be designated by the Engineer. In addition, the Contractor shall furnish to the Engineer an inventory listing of all spare part, the equipment with which they are associated, and the name and address of the supplier.
- B. Maintenance Materials:
 - 1. All grease, oil, and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.
 - 2. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than three weeks of operation.

2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for project.

PART 3 – EXECUTION

3.01 PREPARATION (NOT APPLICABLE)

3.02 INSTALLATION

- 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 Contractor's 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 sufficient proper construction equipment and machinery of ample capacity onsite 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 skilled 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 that require 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 ½-inch to 30-foot 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 (¼-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.

3.03 INSPECTION AND TESTING

- A. Where the specifications require observation of performance tests by the Construction Manager, such tests shall comply with the quality assurance paragraph in this section.

3.04 START-UP AND INSTRUCTION

- A. Services Furnished Under This Contract:
1. 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 Construction Manager.
2. Owner and Construction Manager shall be furnished a letter of certification by each manufacturer's representative that states 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, and has been operated under full load conditions and that it operated satisfactorily.
 3. All costs for field services shall be included in the contract amount.

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SECTION 15044
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. Related Work Described Elsewhere:
 - 1. Section 11241: Chemical Feed System.
 - 2. Section 15070: Schedule 80 Polyvinyl Chloride (PVC) Pipe, Fittings and Valves.
 - 3. Section 15100: Ancillary Equipment.
- C. General Design (not applicable)

1.02 QUALITY ASSURANCE

- A. Test Pressures: Test pressures for the various services and types of piping shall be as shown in Table 15044-A, and, at a minimum, shall be 1.5 times the working pressure.

1.03 SUBMITTALS

- A. Materials and Shop Drawings (Not Applicable)
- B. Additional Information:
 - 1. Testing Plan: Submit prior to testing and include at least the information that follows:
 - a. Testing dates.
 - b. Piping systems and section(s) to be tested.
 - c. Test type.
 - d. Method of isolation.
 - e. Calculation of maximum allowable leakage for piping section(s) to be tested.
 - 2. Certifications of Calibration: Testing equipment.
 - 3. Certified Test Report.
 - 4. Testing Records:
 - a. Provide a record of each piping installation during the testing. These records shall include:
 - 1) Date of test.
 - 2) Identification of pipeline tested or retested.
 - 3) Identification of pipeline material.
 - 4) Identification of pipe specification.
 - 5) Test fluid.
 - 6) Test pressure.
 - 7) Remarks: Leaks identified (type and location), types of repairs, or corrections made.

- 8) Certification by Contractor that the leakage rate measured conformed to the specifications.
 - 9) Signature of Owner's representative witnessing pipe test.
- b. 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 clean water for all piping except air service and shall be of such quality to prevent corrosion of materials in piping system for all hydrostatic tests. Air piping shall be tested using compressed air.

2.02 MATERIALS AND EQUIPMENT

- A. Provide pressure gauges, necessary bracing and restraint, test plugs, pipes, bulkheads, pumps, and meters to perform the hydrostatic and pneumatic testing.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Pipes shall be in place and anchored before commencing 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. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes.
- 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, special flanges, or blind flanges. After the new line has been successfully tested, remove caps or flanges and connect to the existing piping.
- E. Conduct hydrostatic 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. Chlorine Piping: Test, dry, and clean in accordance with requirements of Chlorine Institute Pamphlet 6.
- G. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.

- H. Items that do not require testing include: Piping between wet wells and wet well isolation valves, equipment seal drains, tank overflows to atmospheric vented drains, and tank atmospheric vents.
- I. Gravity Piping:
 - 1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
 - 2. Determine groundwater level at time of testing by exploratory holes or other method acceptable to Engineer.
- J. 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.

3.02 INSTALLATION (NOT APPLICABLE)

3.03 INSPECTION AND TESTING

- A. Hydrostatic Testing of Aboveground or Exposed Piping: The maximum filling velocity shall be 0.25 feet per second, applied over full area of pipe. 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 no leakage or weeping. Correct leaks and retest until no leakage is obtained.
- B. Hydrostatic Testing of Buried Piping:
 - 1. Test after backfilling has been completed. Expel air from piping system during filling.
 - 2. Where any section of the piping contains concrete thrust blocks or encasement, do not make the pressure test until at least 10 days after the concrete has been poured. 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.
 - 3. Apply and maintain the test pressure by means of a hydraulic force pump. Maintain the test pressure for a minimum duration of four (4) hours. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure

during the four hours. This amount of water is the loss due to leakage in the piping system. The allowable leakage rate is defined by the formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

in which:

L = allowable leakage (gallons/hour) during the test period.

S = length of pipe, in feet

D = nominal diameter of the pipe (inches)

P = average test pressure during leakage test (psig)

4. Repair and retest any pipes showing leakage rates greater than that allowed.

C. Pneumatic Test For Pressure Piping:

1. Do not perform on PVC or CPVC pipe.
2. Fluid: Oil-free, dry air.
3. Procedure:
 - a. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections, examine for leakage.
 - b. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
 - c. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
 - d. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
 - e. Correct visible leakage and retest as specified.
4. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.
5. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

D. Hydrostatic Test For Gravity Piping:

1. Testing Equipment Accuracy: Plus or minus ½-gallon of water leakage under specified conditions.
2. Maximum Allowable Leakage: 0.16 gallon per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.
3. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.
4. Exfiltration Test:
 - a. Hydrostatic Head:
 - 1) At least 6 feet above maximum estimated groundwater level in section being tested.

- 2) No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
 5. Infiltration Test:
 - a. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.
 6. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.
 7. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.
- E. Test Pressure:
1. All pipe shall be tested at pressures shown in Table 15044-A and at a minimum shall be 1.5 times the normal working pressure of the pipe.

3.04 START-UP AND INSTRUCTION (NOT APPLICABLE)

TABLE 15044-A

Service	Legend	Maximum Operation Pressure (psig)	Test Pressure (psig)
Drain	DR	Gravity	15 ft. WCH
Hydrofluorosilicic Acid	F	50	100
Sample Line	SA	70	150
Sodium Hypochlorite	C	50	100
Water Main	WM	70	150

Legend: WCH = Water Column Height

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SECTION 15100
ANCILLARY EQUIPMENT

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 150-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 12-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.

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 from 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 pad 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
 - 2. Coating: Enamel
 - 3. Bolting: Carbon steel
 - 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: Cast iron
 - 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: Dresser Manufacturing Co. - Style 127 locking type for cast iron, ductile, iron, asbestos cement and steel pipes with diameters of 3-inches through 12-inches, or equal.
- E. Split Type
 - 1. Material: Malleable or ductile iron.
 - 2. Design: For use with grooved or shouldered end pipe.
 - 3. Coating: Enamel
 - 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. Prior to the tap, the Contractor shall assemble all materials, tools, equipment, labor, and supervision necessary to make the connection.
2. The Contractor shall excavate a dry and safe working area pit of sufficient size to enable the necessary Work.
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. 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. 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 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

SECTION 15102
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 in the locations as shown on the Drawings, all restrained ductile iron piping, restrained ductile iron fittings, and appurtenances as specified herein.

- B. Design:
 - 1. General: The equipment and materials specified herein is intended to be standard types of ductile iron pipe and ductile iron fittings for use in transporting sewage, sludges, water, and reclaimed water.
 - 2. Criteria:
 - a. Pipe shall be designed for a design working pressure of 200 psi with an additional surge pressure of 100 psi for a total working plus surge pressure of 300 psi.
 - b. Live loads shall be calculated using HS 20 Highway Loads.
 - c. Dead loads shall be calculated using 120 lb. per cubic ft. soil.
 - d. A 60° bedding angle shall be used for deflection and bending moment calculations. Soil E¹ shall be no more than 1000.

1.02 QUALITY ASSURANCE

- A. Qualifications: All of the ductile iron 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 Technical Special Provisions as applicable.

- B. Standards:
 - 1. ANSI A 21.50/AWWA C150
 - 2. ANSI A-21.51/AWWA C151
 - 3. ANSI A-21.4/AWWA C104
 - 4. ANSI A-21.10/AWWA C110
 - 5. ANSI A-21.53/AWWA C153
 - 6. ANSI A-21.5/AWWA C105
 - 7. AWWA C600
 - 8. AWWA C651

C. Factory Tests: The manufacturer shall perform the factory tests described in ANSI A-21.51/AWWA C151.

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 Owner may select an independent testing laboratory to inspect the material at the foundry for compliance with these Technical Special Provisions. The cost of foundry inspection requested by the Owner will be paid for by the Owner.

1.03 SUBMITTALS

A. Materials and Shop Drawings: Submit shop drawings, including pipeline layouts, within and under buildings and structures. Shop drawings shall include dimensioning, methods and locations of supports and all other pertinent technical specifications. 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. Operating Instructions: Submit Operation and Maintenance Manuals in accordance with Division 1.

C. Manufacturer's Certification: Submit certification of compliance with the following, sworn by a corporate officer of the manufacturer and witnessed by a notary:

1. Specified factory tests and results
2. Dimensions and weights of fittings per respective AWWA Standard.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with the manufacturer's recommendations and with DIPRA's "Guide for the Installation of Ductile Iron Pipe".

B. 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. Unloading shall be done by lifting with a forklift or crane. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.

PART 2 – PRODUCTS

2.01 MATERIALS

All materials furnished for this project shall be in accordance with the “List of Approved Products” as appended to these specifications.

A. Ductile Iron Pipe:

1. Standards: ANSI A-21.50, AWWA C150 and ANSI A-21.51, AWWA C151.
2. Thickness:
 - a. Below Ground Piping: Pipes shall be the following minimum thickness class unless otherwise noted or specified.
 - 1) 12-inch or smaller (unless otherwise noted or specified) Class 350
 - 2) 16-24 inch diameter Class 250
 - 3) 30-64 inch diameter Class 200
 - 4) 30 to 64-inch diameter Class 200
 - b. Above Ground Piping
 - 1) Flanged, Class 53 (Minimum)
 - c. Lengths: Supply pipe in lengths not in excess of 20 feet.
3. Joints:
 - a. Push-on or Mechanical Joints (below ground piping):
 - 1) Standards: ANSI A21.11/AWWA C111
 - 2) Class: The working pressure of the joint shall be equal to or exceed the rated working pressure of the pipe.
 - 3) Gaskets: SBR (Styrene Butadiene Rubber)
 - b. Flanged (above ground or inside below ground vaults):
 - 1) Standards: ANSI A21.15, ANSI B16.1
 - 2) Class: 125 lb factory applied screwed long hub flanges, plain faced without projection.
 - 3) Gaskets:
 - a) Spans less than 10 feet: full face 1/8-inch thick neoprene rubber.
 - b) Spans greater than 10 feet: Toroseal gaskets as manufactured by American Cast Iron Pipe or equal.
 - c. Restrained Joints:
 - 1) Restrained Gaskets: "Fast-Grip" as manufactured by American Ductile Iron Pipe, "Field Lok" as manufactured by U.S. Pipe or equal; May be used for: Straight runs of pipe for sizes 2-inch through 24-inch.
 - 2) Mechanically Restrained Joints:
 - a) "Manufactured" Restrained Joints: "Flex-Ring" or "Lok-Ring" restrained joint system as manufactured by American Ductile Iron Pipe, "TR-Flex" restrained joint system as manufactured by U.S. Pipe or equal; May be used for: (1) Straight runs of pipe, (2) Within bore and jackcasings (3) Aerial bridge crossings.
 - b) "Mechanical" Joint Pipe with Restraining Devices: Meg-a-Lug system as manufactured by EBBA Iron or equal; May be used for: (1) Straight runs of pipe, (2) Within bore and jack casings, (3) Aerial bridge crossings, (4) Fittings.
 - 3) Class: 250 psi (minimum) design pressure rating
 - 4) Standard mechanical joint retainer glands will not be acceptable.
 - d. Joint Accessories:
 - 1) Mechanical joint bolts, washers, and nuts: Carbon steel.

- 2) Flanged joint bolts, washers and nuts: Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts and ASTM A 194, Grade 8M for nuts.
- e. Pipe Length (below ground installation): 20 feet maximum nominal length.

B. Fittings:

- 1. Materials: Ductile iron, AWWA C 110 and/or AWWA C 153.
- 2. Pressure Class:
 - a. Mechanical Joint: 2-inch through 24-inch fittings shall be pressure rated at 350 psi minimum. All 30-inch and larger fittings shall be pressure rated at 250 psi minimum.
 - b. Flanged Joint: Minimum 250 psi pressure rating, Class 125, plain.
- 3. Grooved-End Couplings:
 - a. Grooved-end pipe couplings shall be malleable iron, ASTM A47 (Grade 32510), or ductile iron, ASTM A536 (Grade 65-45-12).
 - b. Bolts: ASTM A 183, 110,000-psi tensile strength
 - c. Gaskets: Halogenated butyl rubber or EPDM for water service and Buna-N for sewage service, conforming to ASTM D2000.
 - d. Couplings: AWWA C606 for rigid radius ductile-iron pipe. Couplings shall be Victaulic Style 31, Gustin-Bacon No. 500, or equal.
 - e. Grooved-end adapter flanges for piping having an operating pressure of 150 psi and less shall be Victaulic Style 341, or equal. Flange dimensions shall conform to ANSI B16.1 Class 125.

C. Wall Penetrations:

- 1. Wall Pipes:
 - a. Material: Ductile iron or cast iron
 - b. Type: Integrally cast wall collar/water stop located in the center of the wall.
 - c. Design: Full thrust at 250 psi transmitted to the structure wall. Tapped mechanical joint wall pipes may be used to facilitate concrete form work.
- 2. Wall Sleeves:
 - a. Material: Galvanized Schedule 40 Steel Pipe, ASTM A120
 - b. Design: as manufactured by Thunderline Corporation, "Link Seal" or equal.

2.02 COATINGS, MARKINGS, AND LININGS

A. Exterior Coatings:

- 1. Below Ground or in a Casing Pipe:
 - a. Type: Asphaltic coating, 1.0 mil DFT in accordance with ANSI/AWWA A21.51/C151.
 - b. Markings: All buried ductile iron pipe shall be marked with a continuous stripe located within the top 90 degrees of the pipe. Said stripe shall be a minimum 3-inch in width and shall be oil based paint, blue in color. Backfill shall not be placed for 30 minutes following paint application. At the Contractor's option, the pipe may be stripe marked prior to pipe installation as follows:

Up to 8-inch diameter:	(2) 3-inch wide @ 180°
10 to 16-inch diameter:	(3) 3-inch wide @ 120°

- 18 to 24-inch diameter: (4) 3-inch wide @ 90°
 - 30 to 54-inch diameter: (6) 3-inch wide @ 60°
 - c. Color: Potable Water: Blue
Wastewater: Green
Reclaimed Water: Purple
 - 2. Aboveground:
 - a. Not subject to non-potable water submergence or splashing: See Division 9.
 - b. Subject to non-potable water submergence or splashing: See Division 9.
 - c. Color: See Division 9
- B. Interior Lining:
- 1. Wastewater: Factory applied protective coating of Protecto 401. Lining material shall be 40 mils nominal thickness. The number of coats of lining material applied shall be as recommended by the lining manufacturer.
 - 2. Water and Reclaimed Water: Cement mortar lining with a seal coat of asphaltic material in accordance with ANSI/AWWA A21.4/C104.
- C. Polyethylene Encasement: HDPE cross laminated polyethylene prefabricated sleeves with UV inhibitors taped to DIP with polyethylene tape, and installed per Method A (AWWA C105).
- 1. Required for all below ground piping, fittings, and appurtenances.
 - a. Located less than 10 feet from a gas main.
 - b. As indicated on the Drawings.
 - 2. Standard: ANSI A 21.5/AWWA C105, 8 mil minimum thickness.
 - 3. Color: Color coded per paragraph A.1 above.
- D. Location Detection Wire:
- 1. Materials: Continuous, color coded insulated single strand solid 10 gauge copper wire.
 - 2. Installation: Attached directly to the pipe along the centerline with nylon wire ties as shown in the Drawings.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Standards: AWWA C600-87.
- 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 percent of that recommended by the manufacturer.

- b. Polyethylene Encasement: Provide polyethylene wrap around piping, fittings and appurtenances located less than 10 feet from a gas main and as indicated on the Drawings.
- 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.
- 4. Joints:
 - a. Joint Placement:
 - 1) 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.
 - 2) 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.
 - 3) Grooved-End Joints:
 - a) Install grooved end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following.
 - b) Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove before installing coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior, including lips, pipe ends, and housing interiors.
 - c) Fasten coupling alternately and evenly until coupling halves are seated. Use torques as recommended by the coupling manufacturer.

C. Above Ground and Interior Ductile Iron Pipe and Fittings

- 1. Pipe Supports:
 - a. General: All piping shall be properly supported with hangers, supports, base elbows and tees, concrete piers and pads as shown on the Drawings. All pipe and appurtenances connected to equipment shall be supported to prevent any strain from being imposed on the equipment.
 - b. Support Spacing: 8 feet on centers and at each fitting and where shown on the Drawings.
 - c. Hangers for Horizontal Piping:
 - 1) Material: Heavy malleable iron.
 - 2) Type: Adjustable, swivel, split ring or adjustable swivel, pipe-roll.
 - d. Hangers for Vertical Piping:
 - 1) Material: Wrought Iron.
 - 2) Type: Clamp.
- 2. Placement:
 - a. Alignment: In accordance with lines and grades shown on the Drawings. Each section of pipe shall be cleaned thoroughly prior to installation.
- 3. Flanged Joints: Joints shall be fitted so that the contact faces bear uniformly on the gasket.

D. Thrust Restraint:

1. General: Thrust restraint shall be accomplished by restrained joints.
2. All underground pipe joints (mechanical or push-on) shall be restrained.

E. Thrust Blocks: Thrust blocks shall not be allowed.

3.02 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. Correction of Non-Conforming Work: All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the Owner. 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 and failure to pass any specified test or inspection.

3.03 FIELD TESTING

- A. General: At least ten (10) days prior to beginning testing, the Contractor shall submit a testing plan to the Engineer for review.
- B. Gravity Piping: The Contractor shall perform low pressure air test on all gravity piping.
- C. Pressure Piping: The Contractor shall perform hydrostatic pressure and leakage tests on all pressure piping. Test in accordance with Section 02535 for testing wastewater and reclaimed water mains, and Section 02510 for testing potable water mains.

3.04 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 Engineer
- B. Test in accordance with Section 02510 – 3.05.
- C. Dispose of chlorinated water in accordance with Section 02510 – 3.08.

END OF SECTION

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SECTION 15111

ELECTRONIC CONTROL VALVE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Scope of Work: Furnish and install an electronic control valve in the location as shown on the Drawings and/or specified herein.
- B. General Design:
 - 1. Comply with the requirements of Section 15000.
 - 2. The electronic control valve shall control flow, pressure, and GST water level. The electronic controller shall enable remote computer control over valve operations.

1.02 QUALITY ASSURANCE

- A. Qualifications: See Section 15000.
- B. Standards: See Section 15000.
- C. Warranty: See Section 15000.
- D. Equipment Manufacturers: Manufacturer shall be Cla-Val or approved equal.

1.03 SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. General: Product delivery, storage and handling shall be in accordance with Section 15000.

1.05 SPECIAL TOOLS AND SPARE PARTS

- A. General: Provide special tools in accordance with Section 15000.

PART 2 - PRODUCTS

2.01 GENERAL

- A. General: 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.

2.02 MATERIALS

A. Main Valve

- 1. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearing installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

B. Main Valve Body

- 1. No separate embers shall be allowed between the main valve cover and body. Valve body and cover shall be ductile iron. No fabrication or welding shall be used in the manufacturing process.
- 2. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hour-glass shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.
- 3. The diaphragm assembly containing a non-magnetic Type 303 stainless steel stem; of sufficient diameter to withstand high hydraulic pressures, shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.
- 4. The flexible, non-wicking, NSF 61 approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a

- Mullins Burst Test of a minimum of 600 x per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.
5. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted and components including cast material shall be of North American manufacture.
 6. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.
 7. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.
 8. The main valve stem shall include outdoor rated limit switches for indication of open or closed position for remote monitoring by the SCADA system.

C. Pilot Control System

1. The hydraulic control valve pilot system shall consist of dual solenoids which alternately apply or relieve pressure to the diaphragm chamber to position the main valve. They shall be normally closed (energized to open), 120 volt AC with Nema type 4 enclosure. A manual system to by-pass the solenoids shall also be provided.

D. Electronic Valve Controller

2. The operator keypad shall consist of two rows of alphanumeric characters to display numeric values and units. Color-coded alarm, status and mode indicators will display operating conditions. Security key codes shall protect against unauthorized changes to the controller. All programming shall include key words and prompts to aid in set-up and timing the controller. Valve controller shall be a 131VC series controller or approved equal.
3. The controller shall be solid-state construction with an internal chassis capable of being removed for inspection and repair. All program memory including set-point and timing parameters shall be protected by an internal lithium battery rated for 10 year life.
4. Controller Specifications
Control Input: 4-20 mA full scale

Control Parameters:

Proportional Bands: 1-200% adjustable in 1% increments independently for opening and closing.

Deadband: Adjustable 0.00 to 25.5% of span.

Cycle Time: 1 to 60 seconds in 1 sec. increments.

5. Environmental Parameters:

Temperature: 5 C to 55 C (40 F to 130 F)

Humidity: 90% RH, non-condensing.

Power Input: 13.5 watts max. at 110 VAC, 50/60 Hz.

Memory Protection: 10 yr. type. life lithium battery

Housing: Flame retardant UL rated ABS plastic. Fits 1/4 DIN cutout.

A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Valves shall be installed in the locations shown, true to alignment and rigidly supported. Install valves with stem position vertical, unless shown otherwise.
- B. Allow sufficient clearance around valve operator for proper operation and maintenance.
- C. Install in accordance with Section 15000.
- D. 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.

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

SECTION 15126
PIPE HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish all labor, materials, equipment, and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

B. Related Work Described Elsewhere:

1. Concrete is included in Division 3.
2. Metal fabrications are included in Section 05500.
3. Painting is included in Section 09900.
4. Pipe and fittings are included in respective sections of Division 15.
5. Mechanical – General Requirements: Section 15000.

C. General Design (Not Applicable)

1.02 QUALITY ASSURANCE

- A. Hangers and supports 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 pipe supports shall be five times the ultimate tensile strength of the material, assuming 10 feet of water filled pipe being supported.

- B. 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, the Contractor shall submit a certification stating compliance with such requirements.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. Submit to the Engineer for approval, as provided in the General Conditions and Section 01300, shop drawings of all items to be furnished under this Section.
2. Submit to the Engineer, for approval, samples of all materials specified herein.

1.04 PRODUCT 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 01610: Delivery, Storage, and Handling.

1.05 WARRANTY AND GUARANTEES

- A. Provide equipment warranty in accordance with Section 01740: Warranties and Bonds.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and cure 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. All pipe supports shall be approved prior to installation.
- B. The Contractor shall select and design all piping support systems within the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.
- C. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant.
- D. All support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support onto a concrete base, roof, wall, or structural steel works, shall be of the proper size, strength, and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
- E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.
- F. Hangers and supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.
- G. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Anvil International, Inc., Carpenter and Patterson, Inc., or approved equal. Any reference to a specific figure number of a specific manufacturer is to establish a type and quality of product and shall not be considered as proprietary. Any item comparable in type, style, quality, design, and performance will be considered for approval.

2.02 MATERIALS AND EQUIPMENT

A. Pipe Hangers and Supports for Metal Pipe:

1. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts as follows:

a. Hangers:

<u>Pipe Size, Inches</u>	<u>Anvil Fig. No.</u>
Less than ½	138R
½ through 1	97C
1¼ through 4	104
6 through 12	590
14 through 30	171

b. Hanger rods shall be rolled steel machine threaded with load ratings conforming to ASTM Specifications and the strength of the rod shall be based on root diameter. Hanger rods shall have the following minimum diameters:

<u>Pipe Size, Inches Min.</u>	<u>Rod Diameter, In.</u>
Less than 2½	3/8
2½ to 3	½
4	5/8
6	¾
8 to 12	7/8
14 to 18	1

c. Where applicable, structural attachments shall be beam clamps. Beam clamps, for rod sizes ½-inch through ¾-inch shall be equal to Anvil Fig. No. 229, and for rod sizes 7/8-inch through 1¼-inch shall be equal to Anvil Fig. No. 228, or equal.

d. Concrete inserts for pipe hangers shall be; continuous metal inserts designed to be used in ceilings, walls or floors, spot inserts for individual pipe hangers, or ceiling mounting bolts for individual pipe hangers and shall be as manufactured by Unistrut Corp., Wayne, Michigan; Carpenter and Patterson, Inc., Laconia, New Hampshire; Richmond or equal and shall be as follows:

- 1) Continuous concrete inserts shall be used where applicable and/or as shown on the Drawings and shall be used for hanger rod sizes up to and including ¾-inch diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be Series P3200 by Unistrut Corp., Fig 1480 Type 2 by Carpenter and Patterson, Inc., or equal. Inserts to be used where supports are perpendicular to the main slab reinforcement shall be Series P3300 by Unistrut Corp., Fig. 1480 Type I by Carpenter and Patterson, Inc. or equal.
- 2) Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8-inch diameter. Inserts shall be Fig. 650 by Carpenter and Patterson, Inc. for hanger rod sizes ½-inch through and including ¾-inch, and Fig. 266 by Carpenter and Patterson Inc., for 7/8-inch hanger rods.
- 3) Ceiling mounting bolts shall be used where applicable and be for hanger rod sizes 1-inch through and including 1¼-inch and shall be Fig. 104M as manufactured by Carpenter and Patterson, Inc., or equal.

- e. All pipe hangers shall be capable of vertical adjustment under load and after erection. Turnbuckles, as required and where applied, shall be equal to Anvil Fig. No. 230.
- 2. Wall or column supported pipes shall be supported by welded steel brackets equal to Anvil Fig. 194, 195 and 199 as required, for pipe sizes up to and including 20-inch diameter. Additional wall bearing plates shall be provided where required.
 - a. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes 4 inches and larger and by a U-bolt for pipes smaller than 4 inches. Anchor chairs shall be equal to Carpenter Patterson Fig. No. 127. U-bolts shall be equal to Anvil Fig. No. 120 and 137.
 - b. Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by steel rods from the bracket. Hangers and steel rods shall be as specified above.
- 3. Floor-supported pipes 3-inches and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of pipes is not probable.
 - a. Each concrete support shall conform to the details shown on the Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Concrete piers shall conform accurately to the bottom $\frac{1}{3}$ to $\frac{1}{2}$ of the pipe. Top edges and vertical corners of each concrete support shall have 1-inch bevels. Each pipe shall be secured on each concrete support by a wrought iron or steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the Engineer, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the Engineer, maximum support height shall be five (5) feet.
 - b. Concrete piers used to support base elbows and tees shall be similar to that specified above. Piers may be square or rectangular.
 - c. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 pound companion flanges or slip-on welding flanges respectively. Supporting pipe shall be of Schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Anvil Fig. No. 264. Where used under base fittings, a suitable flange shall be substituted for the saddle.
- 4. Vertical piping shall be supported as follows:
 - a. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within 2 feet of the change in direction by pipe supports as previously specified herein.
 - b. For vertical runs exceeding 15 feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.

- c. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Anvil Fig. 262.
 5. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCulloch Industries, Minneapolis, Minnesota, or Wej-it manufactured by Wej-it Expansion Products, Inc., Bloomfield, Colorado.
 6. All rods, hangers, inserts, brackets, and components shall be furnished with galvanized finish.
- B. Pipe Hangers and Supports for Plastic Pipe:
1. Single plastic pipes shall be supported by pipe supports as previously specified herein.
 2. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or equal. Ladder shall be of mild steel construction. Rung spacing shall be approximately 18 inches for plastic pipe and 12 inches for rubber hose. Tray width shall be approximately 6-inch for single runs of rubber hose and 12 inches for double runs of rubber hose. Ladder-type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc. required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC, Husky-Burndy Model SCR or approved equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe.
 3. Individual clamps, hangers, and supports in contact with plastic pipe shall provide firm support, but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.
- C. Pipe Supports for Small Diameter PVC and Steel Pipe:
1. Small diameter Schedule 80 PVC piping 3-inch in diameter and smaller and steel piping 2-inch in diameter and smaller shall be supported with "SUSPORT" system arrangements as manufactured by Universal Suspension Systems Inc. of Gillette, NJ or an Engineer-approved equal. Clamping halves for the pipe support shall be manufactured of molded polypropylene and shall support and fit closely for 360° around the pipe. To support piping carrying non-corrosive fluids or gases and located in noncorrosive, indoor environments, all hardware for the "SUSPORT" system shall be nickel chrome plated carbon steel. To support piping carrying corrosive fluids or gases, piping located in corrosive environments, or piping located outdoors, all hardware for the system shall be manufactured of Type 304 stainless steel.
 2. To adequately support small diameter PVC or steel piping, a metal frame support structure may be required to support the above-specified "SUSPORT" system. Where required, metal frame support structures shall be constructed using channels, fittings, brackets, hardware, and other accessories as manufactured by B-Line Systems, Inc. of Highland, IL, or an Engineer- approved equal. Materials for the frame structure in indoor, non-corrosive environments shall be carbon steel with an epoxy coating applied by a cathodic electro-deposition process equal to "Dura-a-Green" by B-Line Systems, Inc. Materials for the frame structure in corrosive or outdoor environments

shall be Type 316 stainless steel unless otherwise noted on the Drawings. Hardware used to construct the frame support structure shall be cadmium-plated for carbon steel supports or Type 316 stainless steel for stainless steel supports.

3. Pipe supports for small diameter PVC and steel piling shall be located wherever necessary to adequately support the pipe in the Engineer's opinion. They shall have a maximum spacing as specified below for straight pipe runs. Adequate supports shall especially be used adjacent to valves and fittings in pipelines. The following table is based on spacing requirements for Schedule 80 PVC or Standard Weight (Schedule 40) steel pipe carrying a fluid with a Specific Gravity of 1.0 at a temperature not exceeding 120°F. Support spacing for PVC or steel piping carrying fluids exceeding the above-stated Specific Gravities or temperatures shall be Engineer-approved.

Nominal Pipe Diameter, Inches	Support Spacing, Feet	
	PVC Pipe	Steel Pipe
1/2"	3.5	4.5
3/4"	4.0	5.0
1"	4.5	5.5
1 1/4"	5.0	6.5
1 1/2"	5.0	7.5
2"	5.5	8.0
2 1/2"	5.5	-
3"	6.0	-

2.03 ACCESSORIES (NOT APPLICABLE)

2.04 SPARE PARTS (NOT APPLICABLE)

2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for this project.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Prior to prime coating, all pipe hangers and supports shall be thoroughly clean, dry and free from all mill-scale, rust, grease, dirt, paint and other foreign substances to the satisfaction of the Engineer.
- B. All submerged pipe supports shall be prime coated with Koppers 654 Epoxy Primer or approved equal. All other pipe supports shall be prime coated with Rustinhibitive Primer No. 621 as manufactured by Koppers Company, Inc., Pittsburgh, Pa., or equal.
- C. Finish coating shall be compatible with the prime coating used and shall be applied as specified in Section 09900: Painting.

3.02 INSTALLATION

- A. All pipes, horizontal and vertical, shall be rigidly supported from the building structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless it is so indicated on the Drawings, or specifically directed or authorized by the Engineer.
- B. 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.
- C. 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.
- D. Pipe supports shall be provided as follows:
 - 1. Cast iron and ductile iron shall be supported at a maximum support spacing of 10 feet, 0-inch with minimum of one support per pipe section at the joints.
 - 2. All vertical pipes shall be supported at each floor or at intervals of at least 15 feet by approved pipe collars, clamps brackets or wall rests, and at all points necessary to insure rigid construction.
- E. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.
- F. Inserts for pipe hangers and supports shall be installed on forms before concrete is poured. Before setting these items, all Drawings and figures shall be checked that have a

direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

G. Continuous metal inserts shall be embedded flush with the concrete surface.

H. Standard Pipe Supports:

1. Horizontal Suspended Piping:
 - a. Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.
 - b. Grouped Pipes: Trapeze hanger systems.
 - c. Furnish galvanized steel protection shield and oversized hangers for all insulated pipe.
 - d. Furnish precut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.
2. Horizontal Piping Supported From Walls:
 - a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
 - b. Stacked Piping:
 - 1) Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
 - 2) Piping clamps which resist axial movement of pipe through support not acceptable.
 - c. Wall mounted piping clips not acceptable for insulated piping.
3. Horizontal Piping Supported From Floors:
 - a. Stanchion Type:
 - 1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
 - 2) Use yoke saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.
 - 3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
 - b. Floor Mounted Channel Supports:
 - 1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
 - 2) Attach channel framing to floors with anchor bolts.
 - 3) Attach pipe to channel with clips or pipe clamps.
 - c. Concrete Cradles: Use for piping larger than 3-inch along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
 - a. To Concrete Ceilings: Concrete inserts.
 - b. To Steel Beams: I-beam clamp or welded attachments.
 - c. To Wooden Beams: Lag screws and angle clips to members not less than 2½-inch thick.
 - d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

3.03 INSPECTION AND TESTING (NOT APPLICABLE)

3.04 START-UP AND INSTRUCTION (NOT APPLICABLE)

END OF SECTION

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SECTION 15607

FUEL OIL SYSTEM FOR STANDBY EMERGENCY POWER

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation and testing of above ground steel fuel piping for standby engine-generator.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and the following.
- B. Submit manufacturer's catalogue data, fabrication installation drawings and performance data for above fuel oil piping material, valves, fill caps and other fuel oil system appurtenances, pipe support systems, sleeves, anchor bolt design.

1.03 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications", and ASME B31.3.

1.04 WARRANTY

- A. Special Product Warranty: Submit a written warranty for all proposed equipment, executed by the manufacturer, agreeing to repair the failure, replace the failed equipment, or refund the original purchase price.

1.05 REFERENCES

- A. Materials and installation shall comply with the requirements of the following Codes, Regulations and Standards.
 1. NFPA-30: Flammable and Combustible Liquids Code.
 2. STI F921: Standard for Above Ground Tanks with Integral Secondary Containment.
 3. API Standard 620: Welded Steel Tanks for Oil Storage.
 4. Florida Administrative Code Department of Environmental Protection (DEP) 62-761.
 5. PEI/RP200-96: Recommended Practices for Installation of Above Ground Storage Systems for Motor Vehicle Fueling.
 6. NFPA 30: Fuel Pipe Testing

PART 2 - PRODUCTS

2.01 PIPE AND PIPE FITTINGS

- A. Fuel oil piping above grade shall be ASTM A53, grade B, seamless, black steel. Piping 2" and smaller shall be schedule 80. Piping 2-1/2" and larger shall be schedule 40. Piping shall be painted red

- B. Pipe fittings on steel pipe 2 shall be butt welded carbon steel conforming to ASTM A234, grade B and ANSI B16.9 of the same wall thickness as the pipe.
- C. Pipe fittings and unions on steel pipe 2" and smaller shall be forged steel, socket welded or screwed, 2000 W.O.G., conforming to ASTM A105, grade II.

2.02 FUEL OIL STORAGE TANK ACCESSORIES

- A. The controller shall be microprocessor-based, and shall be designed and constructed with modular architecture easily permitting either factory or field upgrades and servicing. Configuration and set-up data shall be maintained in non-volatile memory having minimum fifty (50) year data retention without requiring power of any kind. Replacement or substitution of any controller plug-in card shall not require system re-configuration. Real-Time clock and non-critical log data, such as inventory, delivery, alarm, theft, error, and leak reports shall be maintained in battery backed non-volatile memory with a minimum data retention of from (5)-(10) years in the event of a power outage. System shall include digital display for viewing tank information and LED indicators for the alarm conditions System shall have the capability to continuously monitor up to two (2) dual-float magneto stricture in-tank level probes and up to eight (8) secondary containment leak or point-level sensors. Leak and point-level sensor inputs shall support a means to detect sensor open-circuit and short-circuit wiring faults as a standard feature when used in conjunction with fault-reporting sensors. The system shall provide hardcopy 24 column environmental compliance reports, which exit the front panel or are stored internally with optional auto-winder take-up spool. The RS-232 serial port shall be standard for communications with a local PC computer. 12-channel Analog Output card shall be available to provide 0-20ma/4-20ma/0-24ma/0-1ma signals for tank-related real-time data. System shall operate on switch selectable 115/230 VAC (+/- 10%), 50/60 Hz. Maximum power consumption shall be 20 watts.
- B. Console: The console shall be housed in a lockable wall mounted in NEMA 4X outdoor configurations. A printer with auto-winder shall be available for the outdoor versions. The console shall include microprocessor board, probe/sensor card, power supply, control I/O and communications interfaces. Front panel display shall include audible and visual alarms, user-friendly membrane pushbutton controls, and optional impact printer. The display shall be nine digit, seven segment, quasi-alphanumeric sunlight readable LED type, with LED alarm annunciators for five (5) alarm conditions; leak, three (3) tank product setpoints, and one (1) bottom water setpoint per tank. LED alarm lights shall be visible from at least 60 feet and the seven-segment display data shall be readable from no less than twenty (20) feet. Displays shall include product gross or net, percent of capacity, 90/95/100% ullage, product and water level, product temperature, and product type. As a standard, two (2) programmable relay outputs and two (2) contact closure inputs shall be provided. All relays and contact closure inputs shall be user-programmable for activation by the following event types; Theft, Power Fail Recovery, System Error, Tank Leak, Product Setpoints, Water Setpoints, Leak/Point Level Sensors, Contact Closure inputs and Line Leak. The system shall be supplied with three industrial quality front panel sealed membrane pushbuttons labeled MODE, TANK SELECT, and

TEST. Membrane pushbuttons shall be utilized in conjunction with the display screen to select tank quantities, view, set, acknowledge alarm conditions; set/review configuration data, initiate system tests, view inventory and other logged data. The system shall provide hardcopy environmental compliance and status reports via front panel 24-column printer or with optional auto-winder take-up spool. The RS-232 serial port shall be provided as standard for two-way communications with a PC computer. Microsoft Windows 95 thru XP compatible software shall be provided to retrieve and display current tank statuses, remotely read, write and initialize system setup, clock, and configuration data. An RS-485 port shall be provided as standard for connection to "smart" peripherals, such as remote "slave" display and annunciator panels. The system shall be independently third party certified for UST petroleum storage tanks and have the capability to automatically or manually conduct a static volumetric tank tightness test to an accuracy of 0.2 GPH for monthly monitoring and 0.1 GPH for annual precision testing, with minimum test times of two hours and eight hours respectively. System shall be capable of performing both tests with as little as 20% of tank capacity.

- C. **Tank Gauging Probe:** Probe shall be designed for both AST and UST applications and shall have performance characteristics permitting 0.1 GPH or better in-tank leak test with continuous gauging accuracy of +/- 0.0005 inches for product, +/- 0.001 for water and +/- 0.001 degrees F for (relative) temperature. Probe shall contain an array of at least five (5) temperature sensors along its length for accurate volumetric temperature compensation. Probe to console communication shall employ digital transmission techniques carried over standard, readily available two-conductor, shielded cable, with a maximum cable length restriction of no less than 4000 feet. Probe operating temperature and pressure shall be -40 to +175 degrees F and 150 PSIG respectively. Probes shall be supplied with product float, water float, six (6) foot leader cable with watertight connector, and centering rings for riser mounted applications. Probe shall be UL/CSA approved for use in Class I, Division I, Group C & D hazardous locations.
- D. **Secondary Containment Leak Sensors:** Both non-discriminating and product/water discriminating leak sensors shall be available for liquid detection in interstitial spaces, containment areas, sumps, brine reservoirs, dispenser pans and piping locations. All sensors shall be optionally available with a wiring fault detection feature.
- E. Provide packaged leak detection system to monitor the interstitial space of the aboveground storage tank. Provide NEMA 4X leak detection local alarm panel and fuel piping monitoring wells, which monitors the sensor in the tank. Panel shall send leak detection alarm to the SCADA system. The panel shall operate on 120 VAC. Leak detection system shall be a complete system including the alarm panel, intrinsically safe sensor, jumper cables, integral disconnect switches, 2 dry contacts for communication with the SCADA system, relays, control power transformers, conduit, wiring, and built-in test diagnostics. Leak detection system shall be equal to Pneumercator systems.
- F. Provide an electronic tank gauging system. The system shall include a direct lift magnetic float, a liquid level tank mounted transmitter and a remote mounted electric

indicator panel with high and low level warning lights, audible alarm with silence button and two dry relay contacts for external controls. The indicating dial scale shall be capable of indicating in gallons and shall have the capacity to indicate 8,000 gallons. The electric indicator shall be motor driven with a built-in simulator for testing and calibrating the system. The system shall operate on 120 VAC and be equal to Pneumercator systems.

G. Tank monitoring system shall be Pneumercator TMS 2000

2.03 FUEL OIL SYSTEM APPURTENANCES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are as follows:

1. Special Duty Valves:
 - a. Automatic Switch Company (ASCO)
2. Vertical Ball Check Valve:
 - a. Lunkenheimer
3. Strainers:
 - a. Armstrong Machine Works
 - b. Hoffman Specialty ITT
 - c. Metraflex Company
 - d. Spriax Sarco
 - e. Watts Regulator Company
4. Oil Piping Specialties:
 - a. Morrison Bros. Co.

2.04 MONITORING WELL

A. Provide monitoring manhole, 12-inch diameter with 18-inch long skirt designed for sandy soil conditions constructed from cast iron top and steel skirt. Provide locking cover marked observation well. Monitoring well shall be equal to: OPW 104-GWO-1012.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Remove all scale and dirt from pipe, both outside and inside, before installation.
- B. Ream the ends of all pipe to remove the burrs.
- C. Anchor and guide all piping in order to keep it from moving.
- D. Provide swing joints in supply and return piping at connections to tanks.
- E. Where pipes of different metals connect, ferrous to nonferrous, a dielectric or cast brass union shall be installed.
- F. Install flexible connectors at inlet and discharge connections to vibration producing equipment.

3.02 WELDED CONNECTIONS

- A. All joints in piping systems specified or noted to be welded shall be fusion welded, using standard catalogue product welding fittings. All welders must be certified.
- B. All pipe ends shall be beveled at 45 degrees to within 1/16 inch of inside wall. Abutting edges shall be sufficiently separated to provide for expansion. All welds shall be continuous around pipe and shall be made of sound metal, thoroughly fused into the ends of the pipe to the bottom of the "V", and built up in excess of the pipe wall. Fillet welds shall be built up to a depth of 1-1/4 times the wall thickness.

3.03 VALVE APPLICATIONS

- A. General Duty Valve Applications:
Where specific valve types are not indicated, the following requirements apply:
 - 1. Shut-off duty: Use ball valves.

3.04 VALVE INSTALLATIONS

- A. Install valves in accessible locations that are protected from physical damage.
- B. Install shut-off duty valves at each branch connection to supply mains and elsewhere as indicated.
- C. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

3.05 FIELD QUALITY CONTROL

- A. Test oil piping in accordance with the requirements of NFPA 30 and fuel piping shall meet FDEP regulations 62-762. The piping shall be on the FDEP approved equipment list, as applicable.
- B. Remake leaking joints and connections using new materials.

3.06 COMMISSIONING

- A. Test and adjust controls and safety systems. Replace damaged or malfunctioning controls and equipment.
- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
- C. Review data in Operating and Maintenance Manuals. Refer to Division 1 section "Project Closeout".
- D. Before activating system perform these steps:
 - 1. Open valves to full open position. Close bypass valves.
 - 2. Remove and clean strainer screens.
 - 3. Fill storage tank with proper fuel type.
 - 4. Check operating controls of fuel burner units.

END OF SECTION

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SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. General Division of Work

1. In general, the Division 16 contractor shall provide and install all control and power conductors and conduit in accordance with the plans and specifications. The Division 16 contractor shall terminate and identify both ends of all control and power cable and wiring. Specialty cable required by equipment supplied under Division 13 (any communication wiring other than twisted shielded pair) shall be provided and installed as required by the Division 13 contractor and in accordance with the equipment vendor.

1.02 RELATED DOCUMENTS

- ###### **A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.**

1.03 SUMMARY

- ###### **A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:**

1. Submittals.
2. Coordination drawings.
3. Record documents.
4. Maintenance manuals.
5. Rough-ins.
6. Electrical installations.
7. Cutting and patching.

- ###### **B. Related Sections: The following sections contain requirements that relate to this section:**

1. Division 15 Section "ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT," for factory-installed motors, controllers, accessories, and connections.

1.04 SUBMITTALS

- ###### **A. General: Follow the procedures specified in Division 1 Section "SHOP DRAWINGS AND SUBMITTALS."**

- ###### **B. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.**

1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
3. Product Data: 1 additional copy of each item.
4. Samples: 1 addition as set.

C. Additional copies may be required by individual sections of these Specifications.

1.05 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 1 Section "PROJECT COORDINATION," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
 - a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Exterior wall and foundation penetrations.
 - c. Fire-rated wall and floor penetrations.
 - d. Equipment connections and support details.
 - e. Sizes and location of required concrete pads and bases.
 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.

1.06 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "CONTRACT CLOSEOUT." In addition to the requirements specified in Division 1, indicate installed conditions for:
1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.07 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "CONTRACT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance

curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.02 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system

requirements, refer conflict to the Engineer.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install access panel or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.03 CUTTING AND PATCHING

- A. General: In addition to the requirements specified in Division 1, the following requirements apply:
 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover Work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.
 2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 6. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

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 electrical materials and methods:
 - 1. Supporting devices for electrical components.
 - 2. Concrete equipment bases.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Shop Drawings detailing fabrication and installation of supports and anchorage for electrical items.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate electrical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.
- 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 installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.
- E. Coordinate connecting electrical service to components furnished under other Sections.
- F. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where electrical items requiring access are concealed by finished surfaces.
- H. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
- I. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.01 SUPPORTING DEVICES

- A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.
 - 1. Material: 316 stainless steel all outdoor locations and unconditioned spaces, except in chemical areas, use non-metallic.
 - 2. Fitting and Accessory Material: Same as channels and angles, except metal items may be stainless steel.
- B. 316 stainless steel channel supports have 9/16-inch (14-mm) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least 1 surface.
 - 1. Fittings and accessories mate and match with channels and are from the same manufacturer.
- C. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, fiberglass-resin channels and angles with 9/16-inch (14-mm) diameter holes at a maximum of 8-inches (203-mm) o.c., in at least 1 surface.
 - 1. Fittings and accessories mate and match with channels or angles and are from the same manufacturer.
 - 2. Fitting and Accessory Material: Same as channels and angles, except metal items may be stainless steel.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and "click"- type hangers.
 - 1. Materials: 316 stainless steel.

- E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers.
- F. Expansion Anchors: 316 stainless steel wedge or sleeve type.
- G. Toggle Bolts: 316 stainless steel springhead type.
- H. Powder-Driven Threaded Studs: 316 stainless steel.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION REQUIREMENTS

- A. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.
- B. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.02 ELECTRICAL SUPPORTING METHODS

- A. Damp Locations and Outdoors: 316 stainless steel materials, U-channel system components.
- B. Dry Locations: 316 stainless steel materials.
- C. Support Clamps for Raceways: 316 stainless steel clamp system.
- D. Conform to manufacturer's recommendations for selecting supports.
- E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200-lb- (90-kg-) minimum design load.

3.03 INSTALLATION

- A. Install devices to securely and permanently fasten and support electrical components.
- B. Raceway Supports: Comply with NFPA 70 and the following requirements:
 - 1. Conform to manufacturer's recommendations for selecting and installing supports.
 - 2. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 3. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
 - 4. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.

5. Support individual horizontal raceways with separate, pipe hangers or clamps.
 6. Hanger Rods: 1/4-inch (6-mm) diameter or larger threaded, except as otherwise indicated.
 7. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminals.
- C. Vertical Conductor Supports: Install simultaneously with conductors.
- D. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.
- E. In open overhead spaces, cast boxes threaded to raceways need not be separately supported, except where used for fixture support; support sheet-metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24-inches (610-mm) from the box.
- F. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- G. Firestopping: Apply to cable and raceway penetrations of fire-rated floor and wall assemblies. Perform firestopping as specified in Division 7 Section "Firestopping" to reestablish the original fire-resistance rating of the assembly at the penetration.
- H. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:
1. 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 by machine screws, welded threaded studs, or spring-tension clamps on steel.
 2. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.
 3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.
 4. In partitions of light steel construction use sheet-metal screws.
 5. Drill holes in concrete beams so holes more than 1-1/2-inches (38-mm) deep do not cut main reinforcing bars.
 6. Drill holes in concrete so holes more than 3/4 -inch (19-mm) deep do not cut main reinforcing bars.
 7. Fill and seal holes drilled in concrete and not used.
 8. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.
- I. Install concrete pads and bases according to requirements of Division 3 Section "Cast-in-Place Concrete."

- J. Install utility-metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by company.
- K. All conduits in contact with concrete shall be painted with two coats of bitumastic paint. Paint 12 inches above grade.

END OF SECTION

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SECTION 16060

POWER DISTRIBUTION SYSTEM COORDINATION STUDY

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, services and incidentals required to perform Power System Studies and distribution system field testing.
- B. The Power System Studies shall include a Short Circuit Study, a Protective Device Evaluation Study, Arc Flash Study and a Protective Device Coordination Study for a completely coordinated Power Distribution System.
- C. The Power System Studies shall be performed on three (3) complete power systems including all existing facilities.

Oak Meadows WTP

1. Furnish as study as specified.

Western Regional Plant.

1. Existing power system studies are available for use under this by Eaton Powering #GOSOR00516809, software is SKM.

1.02 REFERENCES

- A. Standards referenced in this Section are listed below:
1. American National Standards Institute, (ANSI).
 - a. ANSI C37.04, Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - b. ANSI C37.010, Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Basis.
 2. Institute of Electrical and Electronics Engineers, (IEEE).
 - a. IEEE 141, Electric Power Distribution in Industrial Plants.
 - b. IEEE 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 3. National Electrical Code, (NEC).

1.03 QUALITY ASSURANCE

A. Source Quality Control:

1. Retain the services of a Registered Professional Engineer, to perform the Power System Studies and field services. The Registered Professional Engineer shall be from an independent consulting firm. Services by manufacturer of the power distribution equipment are not acceptable.
2. Coordinate with the Engineer performing the studies and assist him in the collection of all information necessary to complete the studies specified.
3. All information pertaining to the existing system necessary to perform the studies shall be obtained in advance prior to performing the studies.
4. All motor starting and transformer information shall be based upon the equipment actually installed distribution system. The Field Engineer shall be from the manufacturer of the power distribution equipment.

- #### B. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.

1.04 SUBMITTALS

A. Shop Drawings: Submit the following:

1. Copies of calculations and results of the Short Circuit Study, Protective Device Evaluation and Coordination Studies in a report format. The report shall be stamped and signed by the Registered Professional Engineer.
2. Work sequence for the field testing shall be submitted in advance prior to performing tests. The sequence shall indicate the schedule of work, time frame and downtime for the equipment.
3. Time current curves for all protective devices included within the power system studies.

B. Reports:

1. Field test report shall be submitted.

PART 2 – PRODUCTS

2.01 POWER SYSTEM STUDIES

A. General:

1. Provide a current and complete Short Circuit Study, Protective Device Evaluation Study, and a Protective Device Coordination Study for the Electrical Distribution System.
2. The studies shall include all portions of the high and low voltage electrical distribution system from the normal and alternate sources of power through the low- voltage

distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

3. Problem areas or equipment inadequacies shall be promptly brought to the ENGINEER'S attention.
4. Studies shall include all scenarios related to tie breakers, multiple generators, and manual transfer switches.

B. Short Circuit Study:

1. The Short Circuit Study shall be performed with the aid of a computer program, SKM or Easy Power, working files shall be provided to the Owner.
2. The study input data shall include the utility company's short circuit, single and three phase contributions, with the X/R ratio, the resistance and reactance components of and all other applicable circuit parameters.
3. Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
4. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, including motor back EMF current contributions shall be listed with its respective X/R ratio.

C. Protective Device Evaluation Study:

1. A Protective Device Evaluation Study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents.
2. Appropriate multiplying factors based upon system X/R ratios and protective device rating standards shall be applied.

D. Protective Device Coordination Study:

1. A Protective Device Coordination Study shall be performed to select or to check the selections of the power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and setting.
2. The overcurrent device settings computed in the Protective Device Coordination Study shall provide complete 100 percent selectivity. The system shall be selectively coordinated such that only the device nearest a fault will operate to remove the faulted circuit. System selectivity shall be based on both the magnitude and the duration of a fault current.
3. The Protective Device Coordination Study shall include all voltage classes of equipment starting at the utility's incoming line protective device down to and including each of the medium and low voltage equipment. The phase and ground

overcurrent and the phase and ground fault protection shall be included, as well as settings for all other adjustable protective devices.

4. The time-current characteristics of the installed protective devices shall be plotted on the appropriate log-log paper. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate selective coordination achieved through the utility main breaker, power distribution feeder breakers, and the overcurrent devices at each major load center.
5. There shall be a maximum of eight protective devices per plot. Each plot shall be appropriately titled. Plots shall include the following information as required for the circuits shown:
 - a. Representative one-line diagram, legends and types of protective devices selected.
 - b. Power company's relays or fuse characteristics.
 - c. Significant motor starting characteristics.
 - d. Parameters of transformers, ANSI magnetizing inrush and withstand curves.
 - e. Operating bands of low voltage circuit breaker trip curves, and fuse curves.
 - f. Relay taps, time dial and instantaneous trip settings.
 - g. Cable damage curves.
 - h. Symmetrical and asymmetrical fault currents.
6. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system.

D. Arc Flash Hazard Study:

1. An Arc Flash Hazard Study shall be performed for the electrical distribution system shown on the one line drawings. The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment shown on the one line drawing. This includes switchgear, switchboards, panelboards, motor control centers and transformers. The study shall include creation of Arc Flash Hazard Warning Labels listing all items. The Contractor will furnish and install the labels. The arc flash hazard study shall consider all operating scenarios during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard

2.02 STUDY REPORT

- A. The results of the Power Distribution System Coordination Study shall be summarized in a final typewritten report. The report shall include the following Sections:
 1. Description, purpose, basis, written scope, and a single-line diagram of the PowerDistribution System which is included within the scope of the study.

2. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current tabulation including a definition of terms and a guide for interpretation.
5. Tabulation of appropriate tap settings for relay seal-in units.
6. Tabulation of equipment survey information.

PART 3 – EXECUTION

3.01 FIELD SERVICES

- A. The Registered Professional Engineer shall conduct an equipment survey of devices and information necessary to perform the Power System Studies.
- B. The survey shall include the following information to the extent applicable:
 1. Manufacturer, type and size of each power fuse.
 2. Manufacturer, type, model and settings for each protective relay, trip unit and circuit breaker.
 3. Current transformer ratios for each protective relay.
 4. Appropriate data of motors and transformers included with the study.
- C. The Registered Professional Engineer, as part of the field service Work, shall collect all data and coordinate with the equipment vendors to establish the proper settings for the actual devices provided.

3.02 FIELD TESTING

- A. Provide field testing of the distribution system in accordance with the manufacturer's recommendations. All field testing shall be performed by the Field Engineer, after the completion and approval of the Power System Studies. The field testing results shall be documented within a report, with the final settings of all protective devices.
- B. The Field Engineer with necessary tools and equipment shall adjust, set, calibrate and test all protective devices. All protective relays and meters in the medium and low voltage equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturer's recommendations, the coordination study and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment, shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and lubrication necessary to achieve proper operation shall be considered part of this Contract.

- D. All solid state trip devices shall be set including all required programming necessary for the protection required. The devices shall be checked and tested for setting and operation. Circuit breakers and/or contactors associated with the trip devices shall be tested for trip and close function with their protective device.

3.02 MAINTENANCE OF OPERATIONS

- A. Since the field testing work specified may require that certain pieces of equipment be taken out of service, CONTRACTOR shall perform the Work with due regard to maintenance of operations and construction staging. All testing procedures and schedules must be scheduled in advance prior to any work beginning.

END OF SECTION

SECTION 16100

RACEWAYS, BOXES, AND CABINETS

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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Raceways include the following:
 - 1. Rigid metal conduit
 - 2. Electrical metallic tubing (EMT)
 - 3. Flexible metal conduit
 - 4. Liquid-tight flexible conduit
 - 5. Rigid nonmetallic conduit
 - 6. Wireway
 - 7. Surface raceways
 - 8. Concrete-encased duct banks.
- C. Boxes, enclosures, and cabinets include the following:
 - 1. Device boxes
 - 2. Floor boxes
 - 3. Outlet boxes
 - 4. Pull and junction boxes
 - 5. Cabinets and hinged cover enclosures.
- D. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 16 Section 16050 for raceway and box supports.
 - 2. Division 16 Section "Wiring Devices" for devices installed in boxes and floor box service fittings.

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for surface raceway, wireway and fittings, floor boxes, hinged cover enclosures, and cabinets.
- C. Shop drawings for nonstandard boxes, enclosures, and cabinets. Include layout drawings showing components and wiring.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Comply with NECA "Standard of Installation."
- D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide Products by of one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Monogram Co., AFC.
 - b. Alflex Corp.
 - c. Allied Tube and Conduit, Grinnell Co.
 - d. Anamet, Inc., Anaconda Metal Hose.
 - e. Anixter Brothers, Inc.
 - f. Carol Cable Co., Inc.
 - g. Cole-Flex Corp.
 - h. Flexcon, Inc., Coleman Cable Systems, Inc.
 - i. Spiraduct, Inc.
 - j. Triangle PWC, Inc.
 - k. Wheatland Tube Co.
 - 2. Nonmetallic Tubing and Conduit:
 - a. Anamet, Inc., Anaconda Metal Hose.
 - b. Aruco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Can-Tex Industries, Harsco Corp.
 - e. Carlon.
 - f. Certainteed Corp, Pipe & Plastics Group.
 - g. Cole-Flex Corp.
 - h. Condux International, Electrical Products.
 - i. Electri-Flex Co.
 - j. George-Ingraham Corp.
 - k. Hubbell, Inc., Raco, Inc.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
 - 3. Conduit Bodies and Fittings:
 - a. Scott Fetzer Company, Adalet-PLM.

- b. American Electric, Construction Materials Group.
- c. Emerson Electric Co., Appleton Electric Co.
- d. Carlon.
- e. Hubbell, Inc., Killark Electric Manufacturing Co.
- f. General Signal, O-Z/Gedney Unit.
- g. Spring City Electrical Manufacturing Co.
- 4. Wireway:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
- 5. Surface Metal Raceway:
 - a. Airey-Thompson Co., Inc., A-T Power Systems.
 - b. American Electric, Construction Materials Group.
 - c. Butler Manufacturing Co., Walker Division.
 - d. The Wiremold Co., Electrical Sales Division.
- 6. Surface Nonmetallic Raceway:
 - a. Anixter Brothers, Inc.
 - b. Butler Manufacturing Co., Walker Division.
 - c. Hubbell, Inc., Wiring Device Division.
 - d. JBC Enterprises, Inc., Enduro Fiberglass Systems.
 - e. Panduit Corp.
 - f. United Telecom, Premier Telecom Products, Inc.
 - g. Thermotools Co.
 - h. The Wiremold Co., Electrical Sales Division.
- 7. Boxes, Enclosures, and Cabinets:
 - a. Scott Fetzer Company, Adalet-PLM.
 - b. Butler Manufacturing Co., Walker Division.
 - c. Cooper Industries, Midwest Electric.
 - d. Electric Panelboard Co., Inc.
 - e. Erickson Electrical Equipment Co.
 - f. American Electric, FL Industries.
 - g. Hoffman Engineering Co., Federal-Hoffman, Inc.
 - h. Hubbell Inc., Killark Electric Manufacturing Co.
 - i. General Signal, O-Z/Gedney.
 - j. Parker Electrical Manufacturing Co.
 - k. Racco, Inc., Hubbell Inc.
 - l. Robroy Industries, Inc., Electrical Division.
 - m. Spring City Electrical Manufacturing Co.
 - n. Square D Co.
 - o. Thomas & Betts Corp.
 - p. Woodhead Industries, Inc., Daniel Woodhead Co.

2.02 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. Electrical Metallic Tubing and Fittings: ANSI C80.3 with compression-type fittings.

- D. Flexible Metal Conduit: Aluminum.
- E. Flexible Metal Conduit: Zinc-coated steel.
- F. Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.
- G. Fittings: NEMA FB 1, compatible with conduit/tubing materials.

2.03 NONMETALLIC CONDUIT AND TUBING

- A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2, Schedule 40 or 80 PVC.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

2.04 WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.
- C. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.05 SURFACE RACEWAY

- A. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceway.
- B. Surface Metal Raceway: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating suitable for painting.
- C. Surface Nonmetallic Raceway: 2-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.

2.06 OUTLET AND DEVICE BOXES

- A. Cast Metal Boxes: NEMA FB 1, type FD, cast ferrous alloy box with gasketed cover.
- B. Nonmetallic Boxes: NEMA OS 2.

2.07 FLOOR BOXES

- A. Floor Box: Cast metal, fully adjustable, rectangular with escutcheon plate/appropriate for floor finish.

2.08 PULL AND JUNCTION BOXES

- A. Cast Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.09 CABINETS AND ENCLOSURES

- A. Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.
- B. Cabinets: NEMA 250, type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch-to-match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.10 CONCRETE-ENCASED DUCT BANKS

- A. Concrete: Use 3000-psi-(20.7-MPa-) minimum, 28-day compressive strength and 3/8-inch (10-mm) maximum aggregate size. Concrete and reinforcement are specified in Division 3 Section "Cast-in-Place Concrete".
 - 1. Color: Red dye added to concrete during batching.
- B. Accessories:
 - 1. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling, produced by the same manufacturer as the ducts.
 - 2. Grounding Materials: Comply with Division 16 Section "Grounding and Bonding"
 - 3. Warning Tape: Underground-line warning tape specified in Division 16 Section "Electrical Identification".

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid aluminum metal conduit.
 - 2. Concealed: Rigid aluminum metal conduit.
 - 3. Underground, Single Run: Rigid aluminum, painted.

4. Underground, Grouped: Rigid aluminum, painted
 5. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal aluminum conduit.
 6. Boxes and Enclosures: NEMA Type 4X 316 stainless steel.
- B. Indoors: Use the following wiring methods:
1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit, except in wet or damp locations use liquidtight flexible metal aluminum conduit.
 2. Damp or Wet Locations: Aluminum conduit.
 3. Exposed: Rigid aluminum
 4. Corrosive Areas: Not Applicable
 5. Concealed: Rigid aluminum
 6. Boxes and Enclosures: NEMA Type 4X, 316 stainless steel.

3.03 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Conceal conduit, unless otherwise indicated, within finished walls, ceilings, and floors.
- C. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
- D. Install raceways level and square and at proper elevations. Provide adequate headroom.
- E. Complete raceway installation before starting conductor installation.
- F. Support raceway as specified in Division 16 Section 16050.
- G. Use temporary closures to prevent foreign matter from entering raceway.
- H. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- I. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- J. 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.
- K. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
- L. Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 1-inch (25 mm) concrete cover.

1. Secure raceways to reinforcing rods 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.
- M. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
1. Run parallel or banked raceways together, on common supports where practical.
 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
- N. Join raceways with fittings designed and approved for the purpose and make joints tight.
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.
- O. Tighten setscrews of threadless fittings with suitable tool.
- P. 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. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
- Q. 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.
- R. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb (90 kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.
- S. Telephone and Signal System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install in maximum lengths of 150-feet and with a maximum of two 90-deg bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- T. Install raceway-sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway-sealing fittings at the following points and elsewhere as indicated:
1. Where conduits enter or leave hazardous locations.
 2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 3. Where otherwise required by the NEC.
- U. 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

finished floor. Extend conductors to equipment with rigid steel conduit; flexible conduit may be used 6-inches (150-mm) above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

- V. Flexible Connections: Use maximum of 6-feet (1830-mm) of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- W. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceway is installed for such circuits and it passes through concrete, install in a nonmetallic sleeve.
- X. Do not install aluminum conduit embedded in or in contact with concrete.
- Y. Set floor boxes level and adjust to floor surface.
- Z. Install hinged cover enclosures and cabinets plumb. Support at each corner.
- AA. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.04 CONCRETE-ENCASED DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet , both horizontally and vertically, at other locations.
- C. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.
- E. Building Entrances: Make a transition from underground duct to conduit at least 10 feet (3 m) outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:
 - 1. Concrete-Encased Ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.

2. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.
- F. Concrete-Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
 3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
 4. Forms: Use walls of trench to form sidewalls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 5. Minimum Clearances between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
 6. Depth: Install top of duct bank at least 24 inches below finished grade in non-traffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.
- G. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.
- H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- I. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

3.05 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
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.

3.06 CLEANING

- 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.

END OF SECTION

SECTION 16120

WIRES AND CABLES

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 building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.05 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corporation, Leviton Manufacturing Co.
 - b. Brand-Rex Cable Systems, Brintec Corp.
 - c. Carol Cable Company, Inc.
 - d. Senator Wire & Cable Co.
 - e. Southwire Co.
 - 2. Connectors for Wires and Cables:
 - a. AFC, Monogram Co.
 - b. AMP, Inc.
 - c. Anderson, Square D Co.
 - d. Electrical Products Division, 3M Co.
 - e. O-Z/Gedney Unit, General Signal.

2.02 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.
- B. Rubber Insulation: Conform to NEMA WC 3.
- C. Thermoplastic Insulation: Conform to NEMA WC 5.
- D. Cross-Linked Polyethylene Insulation: Conform to NEMA WC 7.
- E. Ethylene Propylene Rubber Insulation: Conform to NEMA WC 8.
- F. Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG.

2.03 CONNECTORS AND SPLICES

- A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Service Entrance: Type RHW or THWN, copper conductor, in raceway.
- B. Feeders: Type THHN/THWN, copper conductor, in raceway.
- C. Branch Circuits: Type THHN/THWN, copper conductor, in raceway.
- D. Control Circuits:
 - 1. Single Conductor Shielded Pair or Triad. Conductors shall be 16 AWG minimum. Wires shall have uniform twists with a minimum of 6 twists per foot. Each pair or triad shall be provided with a continuous foil or metalized plastic shield providing 100 percent coverage. Each pair or triad shall contain a tinned copper drain wire in continuous contact with the shield. Each pair shall have a black and white wire; each triad shall have a black, white, and red wire. Insulated conductors shall meet the requirements of UL 62 for type TFN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the vertical flame test requirements of UL 1277 and shall be rated type TC and shall be UL listed.
 - 2. Multiconductor Shielded Pair or Triad. Conductors shall be 18 AWG minimum. Wires shall have uniform twists with a minimum of 6 twists per foot. Each pair or triad and cable assembly shall be provided with a continuous foil or metalized plastic shield providing 100 percent coverage and total shield isolation from all other pair or triad shields. Each pair shall have a black and white wire; each triad shall have a black, white, and red wire. Each pair or triad shall contain a tinned copper drain wire in continuous contact with the shield. Insulated conductors shall meet the requirements of UL 62 for type TFN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the vertical flame test requirements of UL 1277 and shall be rated type TC and shall be UL listed.

3.03 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."
- B. Remove existing wire from raceway before pulling in new wire and cable.
- C. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.
 - 1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

- E. Conductor Splices: Not allowed
- F. Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.
- G. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.04 FIELD QUALITY CONTROL

- A. Testing: Perform specified field quality-control testing.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

END OF SECTION

SECTION 16122
5 KV CABLE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install 5 KV cable and shall retain the services of an independent testing firm to perform acceptance testing of the cable installation.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
1. Codes: Install cable in accordance with the current standards and recommendations of the National Electrical Code and with any applicable local codes. Where discrepancies arise between codes, the most restrictive regulation shall apply.
 2. Tests by Independent Regulatory Agencies: Cable shall bear the label of the Underwriters' Laboratories, Incorporated.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
1. National Electrical Code.
 2. ASTM B 3, Uncoated Annealed Copper Conductors.
 3. ASTM B 8, Specification for Concentric Lay Stranded Copper Conductors.
 4. ASTM B 33, Tin Coated Conductors.
 5. ASTM B 189, Lead or Alloy Coated Conductors.
 6. ICEA S-68-516, Ethylene-Propylene-Rubber-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
 7. AEIC CS6-87, Ethylene-Propylene-Rubber-Insulated Shielded Power Cables.
 8. UL 1072, Revised Outline of Requirements for Medium Voltage Cables.
 9. ANSI C2, National Electrical Safety Code.
 10. NETA, InterNational Electrical Testing Association.
 11. IEEE 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5kv through 765kv.
 12. IEEE 404, Standard for Cable Joints for use with Extruded Dielectric Cable Rated 5000-138,000 V and Cable Joints for use with Laminated Dielectric Cable Rated 2500-500,000 V.
- C. Factory Production Tests:
1. Conductors shall meet the electrical resistance requirements of ICEA-69-516 Section 2.5.
 2. Insulation Resistance test shall be performed in accordance with the requirements of ICEA S-68-516, Part 6.28. Each cable shall have an insulation resistance not less than

that corresponding to the insulation resistance constant of 20,000 megohms-1000 ft. at 15.6C.

3. A high voltage AC and DC test shall be performed in accordance with Part 6.27 of ICEA S-68-516. The AC and DC test voltages shall be in accordance with Section B of AEIC CS6.
4. Shield resistance shall be measured and recorded from end to end on the completed cable.
5. Corona Test: Each reel of completed shield power cable shall be partial discharge tested in accordance with Sections E and F of AEIC CS6.

D. Testing Firm Qualifications: The testing firm shall have experience in the inspection and testing of cables of the type specified and shall be NETA certified.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's catalog cuts and technical information indicating compliance with this Specification. Any exceptions shall be stated and completely explained.
2. Literature identifying the methods and materials which CONTRACTOR proposes to use to make splices and terminations. Submittal shall consist of manufacturers' literature evidencing compatibility of the conductor insulation, shield and jacket of the cable with the splicing or terminating materials and methods which CONTRACTOR proposes to use.
3. Listing of cable sizes to be furnished.
4. Listing of locations where splices are proposed.
5. Qualifications of splicing and termination personnel and testing firm.

B. Test Reports: Submit for approval copies of factory tests and field acceptance testing. Acceptance testing procedures shall be submitted in advance prior to actual testing. Test reports shall indicate results of all testing.

C. Record Drawings: Include the actual location and routing of all installations of 5 KV cables on record drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Cable furnished under this Specification shall be rated for an insulation level of 133 percent at 5. Cable insulation shall be thermosetting rubber based suitable for normal installation, indoors or outdoors, in conduit, in air, and intermittent or continuous submersion in water. Cable shall be single conductor bearing UL label "MV 90" and comply with or exceed ICEA S-68-516 and AEIC CS6-87.

B. Materials:

1. Conductor: All conductors shall be soft or annealed copper with concentric-lay Class B round stranding in accordance with the current ASTM Standards B 8, and either B 33 or B 189.
2. Insulation System: The cable insulation system shall include two separate shield layers and the primary insulation.
 - a. Conductor shield shall consist of an extruded inner layer of non-conducting energy suppression or semiconducting material.
 - b. Primary Insulation shall be a high quality ozone resistant ethylene-propylene rubber based compound. The insulation system shall be suitable for use at conductor temperatures not exceeding 90 C for normal operation, 130 C for emergency overload conditions, and 250 C for short circuit conditions. Minimum average thickness of the insulation system at any point of the cable shall not be less than 115 mils. The minimum thickness at any part of the cable shall not be less than 90 percent of the specified average.
 - c. Insulation shield shall be an outer layer of semi-conducting material consisting of a 5 mil copper tape applied helically with a minimum 12-1/2 percent overlap.
3. Jacket: A continuous jacket of moisture, heat, oil resistant black polyvinyl chloride shall be applied over the insulation and shielding system. The average minimum thickness of the jacket at any point of the cable shall be in accordance with ICEA S-68-516 table 4-3.

C. Manufacturer: Provide one of the following:

1. Kerite Company.
2. The Okonite Company.
3. Pirelli Cable Corporation.
4. Rome Cable Corporation.
5. Or equal.

D. Cable Connectors:

1. All connectors shall be copper, tin-plated, long barrel compression type. Suitable for voltage applications up to 35 KV.
2. For sizes 250 MCM and larger, connectors shall be two hole mount type with provisions for two bolts for joining to apparatus terminal.
3. Product and Manufacturer: Provide one of the following:
 - a. Burndy Hylug.
 - b. T&B Connectors.
 - c. Or equal.

E. Cable Terminations:

1. All cable terminations shall meet Class 1 requirements of IEEE 48.
2. Terminations shall be of the molded elastomer, wet-process porcelain or heat-shrinkable types with grounding, provisions for the cable shielding.
3. Product and Manufacturer: Provide one of the following:
 - a. Elastimold.
 - b. G&W Electric Co.

- c. Raychem Corporation.
- d. 3M Co.
- e. Or equal.

F. Cable Splices:

1. All cable splices shall be made using standard splice kits which reinstate the cable's insulation and jacket, and continue the metallic shielding through the entire cable joint.
2. Splices shall be premolded, conventional tape or heat-shrinkable type.
3. Product and Manufacturer: Provide one of the following:
 - a. Elastimold.
 - b. G&W Electric Co.
 - c. Raychem Corporation.
 - d. 3M Co.
 - e. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install all cables complete with proper terminations at both ends. Check for proper phase sequence and proper motor rotation.
- B. Splice and terminate all 5 KV cables in strict accordance with the cable manufacturer's recommendations.
 1. Use experienced personnel familiar with the materials and procedures to be employed.
 2. Make splices watertight in all cases below grade and submersible in all manholes and handholes.
- C. Pulling:
 1. Use insulating types of pulling compounds containing no mineral oil.
 2. Limit pulling tension within values recommended by the cable manufacturer.
 3. Use a dynamometer where mechanical means are used.
 4. Cut off section subject to mechanical means.
- D. Bending Radius: Limit to 12 times cable overall diameter.
- E. Slack: Provide maximum slack at terminal points and in manholes.
- F. Wrap cables located within manholes, handholes and boxes with fireproofing tape for their entire length on an individual cable basis. Tape shall be 30 mils thick of self-extinguishing material which will not support combustion. Tape shall not deteriorate when subjected to water, salt, sewage or fungus and shall be secured with glass cloth tape. Fireproof cables in accordance with the cable manufacturer's recommendations and then cover with tape extending at least one inch into any duct.

- G. Identification: Identify all conductors by circuit number and phase at each terminal and splice location.
- H. Color code cables by applying general purpose, flame retardant tape, wrapped in overlapping turns covering an area of at least 2 inches. Colors shall be as follows:
 - 1. Grounded Neutral: White.
 - 2. Phase A: Brown.
 - 3. Phase B: Orange.
 - 4. Phase C: Yellow.
- I. Install in conformance with National Electrical Code and National Electrical Safety Code.

3.02 TESTING

- A. Perform acceptance testing of the 5KV cable system. Each 5KV cable circuit shall be inspected and tested on an individual per phase basis. All testing and inspection shall be performed by the testing firm.
- B. Visual and Mechanical Inspection: Perform inspection of each power cable installation in accordance with the latest NETA acceptable testing specifications. All splices and terminations shall be inspected.
- C. Electrical Tests: Perform electrical testing of each power cable in accordance with the latest NETA testing procedures. Testing shall include the following:
 - 1. Shield continuity test.
 - 2. DC high potential test.
 - 3. Adhere to following procedures before performing dc over potential tests:
 - a. Disconnect all equipment including but not limited to transformers, switches, motors, circuit breakers and surge arrestors, from cable circuit to prevent test interruptions due to flashovers or trip outs resulting from excessive leakage current.
 - b. Establish adequate clearance between the circuit test ends and any grounded object and to other equipment not under test.
 - c. Ground all circuit conductors not under test, all cables shields and nearby equipment.
 - d. Clean insulation surfaces.
 - e. Keep cable ends dry.
 - 4. Apply high-potential slowly in 8 to 10 equal steps to 80 percent of the manufacturer's test value. Record the leakage current at each test voltage and plot the curve on graph paper.
 - 5. Stop test if the leakage current increases excessively or a "knee" appears in the curve before reaching maximum test voltage.
 - 6. Upon reaching the specified maximum test voltage, maintain the voltage for 15 minutes, record the leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Plot leakage current versus time on the same graph as the step voltage curve.
 - 7. Reduce conductor test potential to zero and measure residual voltage at discrete intervals.
 - 8. Apply ground for a time period adequate to drain charges stored in the insulation.
 - 9. Repair or replace and retest new cable failing tests.

10. The test curves shall be signed by the individual who performed the tests, and sent to ENGINEER for review.

- D. Where existing cables are spliced to cables provided under this Contract, the new cables shall be DC high-potential tested prior to splicing. After approval of the new cable test, the splicing shall be made and the entire cable shall be insulation-resistance tested. A shield continuity test shall also be performed. When these tests prove positive, a DC high-potential test shall be performed. Test voltage and procedures shall be in accordance with the latest NETA recommendations. Any cable failure shall be brought to the ENGINEER'S attention.

END OF SECTION

SECTION 16140
WIRING DEVICES

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 various types of receptacles, connectors, switches, and finish plates.

1.03 SUBMITTALS

- A. Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each product specified.
- C. Samples of devices and device plates for color selection and evaluation of technical features.
- D. Operation and maintenance data for materials and products specified in this Section to include in the "Operating and Maintenance Manual" specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for devices and installation.
- B. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.05 COORDINATION

- A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.
- B. Cord and Plug Sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Wiring Devices:
 - a. Arrow Hart Div., Cooper Industries.
 - b. Bryant Electric, Inc.
 - c. Challenger Electrical Equipment Co.
 - d. Eagle Electric Mfg. Co., Inc.
 - e. General Electric Co.
 - f. Hubbell Inc.
 - g. Killark Electrical Mfg. Co.
 - h. Leviton Mfg. Co., Inc.
 - i. Pass & Seymour/Legrand.
 - j. Pyle-National Co.
 - k. Slater Electric, Inc.
 - 2. Wiring Devices for Hazardous (Classified) Locations:
 - a. Crouse-Hinds Electrical Construction.
 - b. Killark Electrical Mfg. Co.
 - c. Pyle-National Co.
 - 3. Multi-Outlet Assemblies:
 - a. Airey-Thompson Co., Inc.
 - b. Dual-Lite.
 - c. Isoduct Energy Systems.
 - d. Kellems Div., Hubbell, Inc.
 - e. Wiremold Co.

2.02 WIRING DEVICES

- A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices."
- B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.
- C. Color: White except as otherwise indicated or required by Code.
- D. Receptacles, Straight-Blade and Locking Type: Comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles," heavy-duty grade except as otherwise indicated.
- E. Receptacles, Straight-Blade and Locking Type: Except as otherwise indicated, comply with Federal Specification W-C-596 and heavy-duty grade of UL Standard 498, "Electrical Attachment Plugs and Receptacles." Provide NRTL labeling of devices to verify these compliances.

- F. Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:
 - 1. Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch (70-mm) deep outlet box without an adapter.
 - 2. Isolated Ground Receptacles: Equipment grounding contacts are connected only to the green grounding screw terminal of the device and have inherent electrical isolation from the mounting strap.
 - a. Devices: Listed and labeled as isolated ground receptacles.
 - b. Isolation Method: Integral to the receptacle construction and not dependent on removable parts.

- G. Receptacles, Industrial Heavy-Duty: Conform to NEMA Standard PK 4 "Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type for Industrial Use."

- H. Receptacles in Hazardous (Classified) Locations: Comply with NEMA Standard FB 11 "Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations" and UL Standard 1010 "Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations."

- I. Pendant Cord/Connector Devices: Matching, locking type, plug and plug receptacle body connector, NEMA L5-20P and L5-20R, heavy-duty grade.
 - 1. Bodies: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire mesh type made of high-strength galvanized-steel wire strand and matched to cable diameter and with attachment provision designed for the corresponding connector.

- J. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.
 - 1. Cord: Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Grounding conductor has green insulation. Ampacity is equipment rating plus 30 percent minimum.
 - 2. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.

- K. Snap Switches: Quiet-type a.c. switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.

- L. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permits separate or common feed connection.

1. Switch: 20 ampere, 120-277 V a.c.
2. Receptacle: NEMA configuration 5-15R.

M. Wall Plates: Single and combination types that mate and match with corresponding wiring devices. Features include the following:

1. Color: Matches wiring device except as otherwise indicated.
2. Plate-Securing Screws: Metal with heads colored to match plate finish.
3. Material for Finished Spaces: Steel with wrinkled finish, white baked enamel, suitable for field painting, except as otherwise indicated.
4. Material for Unfinished Spaces: Stainless steel C type 304.

2.03 FLOOR SERVICE OUTLET ASSEMBLIES

- A. Types: Modular, flush with floor, dual-service units suitable for the wiring method used.
- B. Compartmentation: Barrier separates power and signal compartments.
- C. Housing Material: Die-cast aluminum, satin finished.
- D. Power Receptacles: NEMA configuration 5-20R, gray finish, except as otherwise indicated.
- E. Signal Outlet: Blank cover with bushed cable opening, except as otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- D. Protect devices and assemblies during painting.
- E. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit the indicated arrangement of partitions and furnishings.

3.02 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."
 1. Switches: Where 3 or more switches are ganged, and elsewhere where indicated, identify each switch with approved legend engraved on wall plate.

2. Receptacles: Identify the panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.03 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
- B. Check TVSS receptacle indicating lights for normal indication.
- C. Test ground-fault circuit interrupter operation with both local and remote fault simulations according to manufacturer recommendations.
- D. Replace damaged or defective components.

3.04 CLEANING

- A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

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SECTION 16195

ELECTRICAL 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 identification of electrical materials, equipment, and installations.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Schedule of identification nomenclature to be used for identification signs and labels.
- D. Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with ANSI C2.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
- B. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. American Labelmark Co.; Labelmaster Subsidiary.
 2. Brady USA, Inc.; Industrial Products Div.
 3. Calpico, Inc.
 4. Carlton Industries, Inc.
 5. Champion American, Inc.
 6. Cole-Flex Corp.
 7. D&G Sign and Label.
 8. EMED Co., Inc.
 9. George-Ingraham Corp. (The).
 10. Grimco, Inc.
 11. Ideal Industries, Inc.
 12. Kraftbilt.
 13. LEM Products, Inc.
 14. Markal Corp.
 15. National Band & Tag Co.
 16. Panduit Corp.
 17. Radar Engineers.
 18. Ready Made Sign Co.; Cornerstone Direct Corp. Div.
 19. Seton Name Plate Co.
 20. Standard Signs, Inc.

2.02 RACEWAY AND CABLE LABELS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Conform to ANSI 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.
 3. Legend: Indicates voltage and service.
- C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).

- E. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 1. Size: Not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
 2. Compounded for permanent direct-burial service.
 3. Printed Legend: Indicates type of underground line.
- F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- G. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- (0.4-mm-) 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.
- H. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- I. Aluminum-Faced Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 mm) thick, laminated with moisture-resistant acrylic adhesive, and punched for the fastener. Preprinted legends suit each application.
- J. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 inches (51 by 51 mm) by 0.05 inch (1.3 mm).

2.03 ENGRAVED NAMEPLATES AND SIGNS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Engraving stock, melamine plastic laminate, 1/16-inch (1.6-mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) 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 the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396-inch (1-mm), galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6.4-mm) 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 and flat and lock washers.

2.04 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength: 50 lb (22.3 kg) minimum.
 - 3. Temperature Range: Minus 40 to 185 deg F (Minus 4 to 85 deg C).
 - 4. Color: As indicated where used for color-coding.

- B. Paint: Alkyd-urethane enamel over 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 other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the 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 one intermediate and one 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, waterproof 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 plastic line marker located directly above line 12-inches (150- to 200-mm) below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16-inches (400-mm), use a single line marker.
1. Install line marker for underground wiring, both direct buried and in raceway.
- I. Color-Code Conductors: Secondary service, feeder, and branch circuit conductors throughout the secondary electrical system.
1. 208/120-V System: As follows:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 2. 480/277-V System: As follows:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - e. Ground: Green.
 3. Factory-apply color the entire length of the conductors, except the following field-applied, color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6-inches (150-mm) from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
- J. 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 switchboard rooms.
1. Legend: 1/4-inch- (6.4-mm-) 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.
- K. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding for voltage and phase indication of secondary circuit.

3. Control and Communication Circuits: Identify each conductor by its system, circuit, and wire designation. Coordinate and use system, circuit, and wire designation to match approved wiring submittals from SCADA system integrator. Standardize on one type/manufacturer of labeling system and materials. All labels shall be printed by machine, handwritten labels are not acceptable.
- L. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch (9-mm) high lettering for emergency instructions on power transfer, load shedding, and other 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 a single line of text with 1/2-inch (13-mm) high lettering on 1-1/2-inch (38-mm) high label; where 2 lines of text are required, use lettering 2-inches (51-mm) high. Use white lettering on black field. Apply labels for each unit of the 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. Motor starters.
 - f. Push-button stations.
 - g. Power transfer equipment.
 - h. Contactors.
 - i. Control devices.
 - j. 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.

END OF SECTION

SECTION 16452

GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this Section:
 - 1. "Basic Electrical Requirements."

1.02 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Wire and Cable."

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for ground rods, connectors and connection materials, and grounding fittings.
- C. Report of field tests and observations.

1.04 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
 - 1. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
 - 2. Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).
- C. UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 1. Anixter Bros., Inc.
 2. Bashlin Industries, Inc.
 3. Buckingham Mfg. Co.
 4. A.B. Chance Co.
 5. Dossert Corp.
 6. Engineered Products Co.
 7. Erico Products, Inc.
 8. Galvan Industries, Inc
 9. GB Electrical, Inc.
 10. General Machine Products Co., Inc.
 11. Hastings Fiber Glass Products, Inc.
 12. Ideal Industries, Inc.
 13. Kearney-National.
 14. McGill Mfg.
 15. O-Z/Gedney Co.
 16. Raco, Inc
 17. Thomas & Betts Corp.
 18. W. H. Salisbury & Co
 19. Utilco Co.

2.02 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.
 1. Where aluminum conductors are used for power wiring, use aluminum for grounding system conductors (except provide copper for those insulated and un-insulated conductors in direct contact with earth, concrete, or crushed stone).

2.03 WIRE AND CABLE CONDUCTORS

- A. General: Comply with Division 16 Section "Wire and Cable." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B
 - 2. Assembly of Stranded Conductors: ASTM B
 - 3. Tinned Conductors: ASTM B

2.04 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30-gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connector: Soft copper, 0.05-inch thick and 2 inches wide, except as indicated.

2.05 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity-plated units
- C. Bolted Clamps: Heavy-duty units listed for the application.
- D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected
- E. Aluminum-To-Copper Connections: Bimetallic type, conforming to UL 96, Lighting Protection Components, or UL 467.

2.06 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
 - 1. Size: 3/4 inch by 20-feet except as otherwise indicated on plans.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
 - a. Feeders and branch circuits
 - b. Lighting circuits.
 - c. Receptacle Circuits
 - d. Single-phase motor or appliance circuits
2. Computer Panel Circuits: Install separate insulated equipment ground wire in branch circuits from computer area power panels.
3. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways unless they are designated for telephone or data cables.

B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.

C. Signal and Communications: For telephone, alarm, and communication systems, provide a #4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.

D. Separately derived systems required by NEC to be grounded shall be grounded in accordance with NEC paragraph 250-26.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground poles to a grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit.

F. Common Ground Bonding With Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system ground conductor and installed in conduit.

3.02 INSTALLATION

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

B. Electrical Room Ground Bus: Size, location, and arrangement as indicated. Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.

C. Ground Rods: Locate a minimum of one-rod length from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 24-inches below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Use 3/4-inch by 20-foot ground rods except as otherwise indicated. Drive rods until tops are 6-inches below finished floor or final grade except as otherwise indicated.

- D. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- E. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

3.03 CONNECTIONS

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
 2. Make connections with clean bare metal at points of contact.
 3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
 4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps
 5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
- B. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B
- E. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

- F. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
- G. Proposed grounding system will connect to existing grounding system with exothermic welds.

3.04 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and handholes: install a 3/4-inch by 20-foot driven ground rod close to the wall and set the rod depth such that 4 inches will extend above the finished floor. Where necessary, install ground rod before the manhole is placed and provide a No. 1/0 bare tinned-copper conductor from the ground rod into the manhole through a waterproof sleeve in the manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below the concrete. Seal floor opening with waterproof non-shrink grout.
- B. Connections at Manholes: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handle to the ground rod or ground conductor. Make connections with minimum No. 4 AWG stranded hard-drawn copper wire. Train conductors plumb or level around corners and fasten to manhole walls. Connect to cable armor and cable shields by means of tinned terminals soldered to the armor or shield, or as recommended by manufacturer of splicing and termination kits.
- C. Grounding System: Ground non-current-carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

3.05 FIELD QUALITY CONTROL

- A. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."
- B. Ground/resistance maximum values shall be as follows:
 - 1. Equipment rated 500 kVA and less: 10 Ohms
 - 2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms
 - 3. Equipment rated over 1000 kVA: 3 Ohms
 - 4. Unfenced substations and pad-mounted equipment: 5 Ohms
 - 5. Manhole grounds: 10 Ohms

- C. Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated the provisions of the Contract, covering changes will apply.
- D. Report: Prepare test reports of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.06 CLEANING AND ADJUSTING

- A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, capable of laying, and other Work to their original condition. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Perform such Work in accordance with Division 2 Section Landscape Work. Maintain disturbed surfaces. Restore vegetation in accordance with Section Landscape Work. Restore disturbed paving as indicated.

END OF SECTION

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SECTION 16460

TRANSFORMERS

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 general-purpose and specialty dry-type transformers and voltage regulators with windings rated 600 V or less.

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each product specified, including dimensioned plans, sections, and elevations. Show minimum clearances and installed features and devices.
- C. Wiring diagrams of products differentiating between manufacturer-installed and field-installed wiring.
- D. Product certificates signed by manufacturers certifying that their products comply with the specified requirements.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of relevant completed projects with project names and addresses, and names and addresses of the respective Architects and Owners.
- F. Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.
- G. Sound Level Test Reports: Certified copies of manufacturer's sound level tests applicable to equipment for this Project.
- H. Operation and maintenance data for materials and products to include in the "Operating and Maintenance Manual" specified in Division 1.

- I. Field test reports of tests and inspections conducted according to Part 3 of this Section.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing components that comply with the requirements of these Specifications and that have a record of successful in-service performance.
- B. Comply with NFPA 70 "National Electrical Code."
- C. Comply with IEEE C2 "National Electrical Safety Code."
- D. Listing and Labeling: Products are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Transformers:
 - a. Acme Electric Corp.
 - b. Square D Co.
 - c. Cutler-Hammer

2.02 TRANSFORMERS, GENERAL

- A. Transformers: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
- D. Internal Coil Connections: Brazed or pressure type.

2.03 GENERAL-PURPOSE, DRY-TYPE TRANSFORMERS

- A. Comply with NEMA Standard ST-20 "Dry-Type Transformers for General Applications."

- B. Transformers: Two-winding type, 3-phase units using 1 coil per phase in primary and secondary.
- C. Windings: All copper.
- D. Features and Ratings: As follows:
 - 1. Enclosure: Suitable for the location where installed.
- E. Insulation Class: 185 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
 - 1. Insulation Temperature Rise: 150 deg C maximum rise above 40 deg C, for 220 deg C class insulation; 115 deg C maximum rise for 185 deg C class insulation.
- F. Taps: For transformers 3 kVA and larger, full capacity taps in high-voltage winding are as follows:
 - 1. 15 kVA through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
- G. Accessories: The following accessory items are required where indicated:
 - 1. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.

2.04 CONTROL AND SIGNAL TRANSFORMERS

- A. Comply with NEMA Standard ST 1, "Specialty Transformers," and UL Standard 506, "Specialty Transformers."
- B. Ratings: Continuous duty. Where ratings is not indicated, provide capacity exceeding peak load by 50 percent minimum.
- C. Type: Self-cooled, 2-winding, dry type.
- D. Enclosure: Suitable for the location where installed.

2.05 FINISHES

- A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

2.06 SOURCE QUALITY CONTROL

- A. Factory Tests: Design and routine tests conform to referenced standards.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Arrange equipment to provide adequate spacing for access and for cooling air circulation.
- B. Identify transformers and install warning signs according to Division 16 Section "Electrical Identification."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A and UL 486B.

3.02 GROUNDING

- A. Ground transformers and systems served by transformers according to Division 16 Section "Grounding."

3.03 FIELD QUALITY CONTROL

- A. Test Objectives: To ensure transformer installation is operational within industry and manufacturer's tolerances, install according to Contract Documents, and suitable for energizing.
- B. Tests: Include the following minimum inspections and tests according to the manufacturer's instructions. Conform to IEEE Standard Test Code C57.12.91 for dry-type units, test method, and data correction factors.
 - 1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.
 - a. Include internal inspection through access panels and covers.
 - b. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL standards 486A and 486B.
 - 2. Insulation Resistance: Perform megohm meter test of primary and secondary winding-to-winding and winding-to-ground. Use a minimum test voltage of 1,000 V d.c. Minimum insulation resistance is 500 megohms.
 - 3. Duration of Each Test: 10 minutes.
 - 4. Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.
- C. Test Failures: Correct deficiencies identified by tests and retest. Verify that equipment meets the specified requirements.

3.04 ADJUSTING

- A. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout the normal operating cycle of the facility. Record voltages and tap settings to submit with test results.

END OF SECTION

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SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this Section:
 - 1. "Basic Electrical Requirements."

1.02 SUMMARY

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.
- B. Related Sections: The following Division 16 Sections contain requirements that relate to this Section:
 - 1. "Disconnect and Circuit Breakers" for circuit breakers, fusible switches, fuses, and other devices used in panelboards.
 - 2. "Motor Controllers" for combination starters installed in panelboards.

1.03 DEFINITIONS

- A. Load Center: A panelboard with thermal magnetic circuit-breaker branches, primarily of the plug-in type, designed for residential and light commercial projects, operating at 240 V and below, available in both single and 3-phase versions, and equipped with combination flush/surface mounting trim.
- B. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type panelboard, accessory item, and component specified.
- C. Shop drawings from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating.

Include the following:

1. Enclosure type with details for types other than NEMA Type 1.
 2. Bus configuration and current ratings.
 3. Short-circuit current rating of panelboard.
 4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
- D. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.
- E. Report of field tests and observations.
- F. Panel schedules for installation in panelboards. Submit final versions after load balancing.
- G. Maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements." Include instructions for testing circuit breakers.

1.05 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA Standard: Comply with NEMA PB1, "Panelboards."
- D. UL Standards: Comply with UL 61, "Panelboards," and UL 50, "Cabinets and Boxes."

1.06 EXTRA MATERIALS

- A. Keys: Furnish six spares of each type for panelboard cabinet locks.
- B. Touch-up Paint for surface-mounted panelboards: One half-pint container.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton Corp.
2. General Electric Co.
3. Square D Co.

2.02 PANELBOARDS, GENERAL REQUIREMENTS

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 16 Section "Disconnects and Circuit Breakers," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.
- B. Enclosures: Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated.
 1. NEMA 3R: Raintight.
 2. NEMA 3S: Raintight and dust tight.
 3. NEMA 4X: Corrosion-resistant fiberglass enclosure, watertight, dust tight, and resistant to oil and coolant seepage.
 4. NEMA 12: Dust tight, drip-proof, and resistant to oil and coolant seepage.
- C. Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified.
- D. Directory Frame: Metal, mounted inside each panel door.
- E. Bus: Hard drawn copper of 98 percent conductivity.
- F. Main and Neutral Lugs: Compression type.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
- H. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.
- I. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

2.03 LOAD CENTERS

- A. Provide load-center-type panelboards only where specifically indicated.
 1. General: Conform to above article "Panelboards, General Requirements" except as follows:
- B. OCPDs: Plug-in full module (nominal 1-inch width) circuit breaker.

- C. Circuit Breakers for Equipment Marked HCAR Type: Indicated HCAR type.
- D. Interiors: Provide physical means to prevent installation of more OCPDs than the quantity for which the enclosure was listed.
- E. Main, Neutral, and Ground Lugs and Buses: Have mechanical connectors for conductors.

2.04 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Double-Width Panels: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards under single front.
- C. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.05 DISTRIBUTION PANELBOARDS

- A. Doors: In panel front, omit single panelboard door in cabinet front for fusible switch panelboards except as indicated. Secure with vault-type with tumbler lock, all keyed alike.
- B. Branch-Circuit Breakers: Where OCPDs are indicated to be circuit breakers, use bolt-on breakers except circuit breakers 225-ampere frame size and greater may be plug-in type where individual positive locking device requires mechanical release for removal.

2.06 IDENTIFICATION

- A. General: Refer to Division 16 Section "Electrical Identification" for labeling materials.
- B. Panelboard Nameplates: Engraved laminated plastic or metal nameplate for each panelboard mounted with epoxy or industrial cement or industrial adhesive.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- B. Mounting Heights: Top of trim 6'-2" above finished floor, except as indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.

- D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.
- E. Install filler plates in unused spaces.
- F. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.02 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs in accordance with Division 16 Section "Electrical Identification."

3.03 GROUNDING

- A. Connections: Make equipment grounding connections for panelboards as indicated.
- B. Provide ground continuity to main electrical ground bus indicated.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

- A. Pretesting: Upon completing installation of the system, perform the following preparations for tests:
 1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
 2. Make continuity tests of circuits.
 3. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
- B. Visual and Mechanical Inspection: Include the following inspections and related work:
 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 3. Check panelboard mounting, area clearances, and alignment and fit of components.
 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 16 Section "Disconnects and Circuit Breakers."
- C. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:
1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.
 2. Ground resistance test on system and equipment ground connections.
 3. Test main and subfeed overcurrent protective devices in accordance with Section "Disconnects and Circuit Breakers."
- D. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

3.06 CLEANING

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.07 COMMISSIONING

- A. Balancing Loads: After Substantial Completion, but not more than two months after Final Acceptance, conduct load-balancing measurements and circuit changes as follows:
1. Perform measurements during period of normal working load as advised by the Owner.
 2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as FAX machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

END OF SECTION

SECTION 16476

DISCONNECTS AND CIRCUIT BREAKERS

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. Service disconnects.
 - 2. Feeder and equipment disconnects.
 - 3. Enclosed circuit breakers.

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for switches, circuit breakers, and accessories specified in this Section.
- C. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.
- D. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- F. Field test reports indicating and interpreting test results.
- G. Maintenance data for tripping devices to include in the "Operation and Maintenance Data" specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Testing comply with NFPA 70 "National Electrical Code" for components and installation.

- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Single-Source Responsibility: All enclosed switches and circuit breakers shall be the product of a single manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering enclosed switches and circuit breakers that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Fusible Switches:
 - a. Allen-Bradley Co.
 - b. Cutler-Hammer Products; Eaton Corp.
 - c. Electrical Distribution and Control; General Electric Co.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D Co.
 - 2. Fused Power Circuit Devices:
 - a. Electrical Distribution and Control; General Electric Co.
 - b. Square D Co.
 - 3. Molded-Case Circuit Breakers:
 - a. Cutler-Hammer Products; Eaton Corp.
 - b. Electrical Distribution and Control; General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.
 - 4. Combination Circuit Breaker and Ground Fault Trip:
 - a. Electrical Distribution and Control; General Electric Co.
 - b. Square D Co.
 - 5. Molded-Case Current-Limiting Circuit Breakers:
 - a. Distribution and Control (formerly Westinghouse Electric Co.).
 - b. Electrical Distribution and Control; General Electric Co.
 - c. Square D Co.
 - 6. Integrally Fused Molded-Case Circuit Breakers:
 - a. Distribution and Control (formerly Westinghouse Electric Co.).
 - b. Electrical Distribution and Control; General Electric Co.

2.02 ENCLOSED SWITCHES

- A. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

- B. Enclosure: NEMA KS 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 4X.
 - 2. Other Wet or Damp Indoor Locations: Type 4X.
 - 3. Indoor Locations: Type 4X.

2.03 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.
- B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated; interrupting capacity rating to meet available fault current, 10,000 symmetrical RMS amperes minimum; with appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.
- C. Interchangeable Trips: Circuit breakers, 200 amperes and larger, with trip units interchangeable within frame size.
- D. Field-Adjustable Trips: Circuit breakers, 400 amperes and larger, with adjustable short time and continuous current settings.
- E. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
- F. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
- G. Molded-Case Switch: Where indicated, molded-case circuit breaker without trip units.
- H. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- I. Shunt Trip: Where indicated, 120-volts, 60-Hz.
- J. Accessories: As indicated.
- K. Enclosure: NEMA AB 1, Type 1, unless specified or required otherwise to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 4X.
 - 2. Other Wet or Damp Indoor Locations: Type 4X.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

- B. Install enclosed switches and circuit breakers level and plumb.
- C. Install wiring between enclosed switches and circuit breakers and control/indication devices.
- D. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.02 FIELD QUALITY CONTROL

- A. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
- B. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3.03 ADJUSTING

- A. Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.04 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules for startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the "Operation and Maintenance Data." Refer to Division 1 Section "Contract Closeout."
- C. Schedule training with Owner through the Architect with at least 7 days' advance notice.

END OF SECTION

SECTION 16480

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install motor control centers.
- B. Coordination: Obtain motor nameplate data on equipment being furnished for properly sizing circuit breakers, starters and overloads.
- C. Related Sections:
 - 1. Section 16495, Automatic Transfer Switches.

1.02 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:
 - 1. UL Standard #845, Electric Motor Control Centers.
 - 2. NEMA ICS2-322, AC General Purpose Motor Control Centers.
 - 3. National Electrical Code.

1.03 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's technical information for motor control centers proposed for use.
 - 2. Outline and summary sheets with schedules of equipment in each unit.
 - 3. Unit control schematic and elementary wiring diagrams showing numbered terminal points and interconnections to other units.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Motor control center lineups shall be provided as shown on the Drawings.
 - 1. Service: Voltage rating and number of wires shall be as shown on the Drawings. MCC shall operate from a 3 phase, 60 Hertz system.
 - 2. Wiring: NEMA Class II, Type B.
 - 3. Enclosure: NEMA 12.

B. Construction:

1. Totally enclosed structure, dead front, consisting of nominal 20-inch deep, 20-inch wide, 90-inch high vertical sections bolted together to form a unit assembly.
2. Removable lifting angles for each shipping section.
3. Two removable floor sills for mounting.
4. Horizontal wireways top and bottom, isolated from horizontal bus and readily accessible.
5. Isolated vertical wireways with cable supports, accessible through hinged doors, for each controller section.
6. All metal non-conducting parts electrically continuous.

C. Bus System:

1. Rating: Bus bracing and bus current capacities as indicated on the Drawings.
2. All bus bars tin plated copper rated UL heat rise standards.
3. Bus bar connections easily accessible with simple tools.
4. Main Horizontal Bus: Continuous edge mounted, and isolated from wireways and working areas.
5. Vertical Bus: Continuous, and isolated by a glass polyester barrier.
6. Grounding Bus: Full length mounted across the bottom, drilled with lugs of appropriate capacity as required.
7. Neutral Bus: Insulated, continuous through control center for 4 wire services, drilled with lugs of appropriate capacity as required.

D. Unit Compartments:

1. Individual front door for each unit compartment with engraved nameplate identifying equipment. Nameplates to be 1 inch by 3 inches minimum, secured to unit door with two screws.
2. Starter and feeder-unit doors interlocked mechanically with the unit disconnect device to prevent unintentional opening of the door while energized and unintentional application of power while door is open, with provisions for releasing the interlock for intentional access and application of power.
3. Padlocking arrangement permitting locking the disconnect device in the OFF position with at least three padlocks with the door closed or open.
4. NEMA 1 minimum motor starter size. Starter units completely drawout type in Sizes 1 and 2 and drawout type after disconnecting power leads only in Sizes 3 and 4.
5. Motor starters shall include a magnetic contactor, NEMA rated with encapsulated magnet coils. Wound coils not acceptable.
6. Reversing Starters: Single speed full voltage with two contactors and extra interlocking contacts.
7. Solid-State Type Reduced Voltage Starters: Suitable for use with standard NEMA Design B, 3-phase induction motors, providing adjustable acceleration rate control using voltage or current ramp. Provide adjustable starting torque control with up to 500 percent current limitation for 20 seconds. Provide surge suppressor in solid-state power circuits to provide 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage. Provide snubbers to prevent malfunction due to system voltage transients. Provide overload protection for NEMA

Class 10 or better. Provide LEDs to indicate motor and control status including control power available, controller on, overload trip, loss of phase, and shorted SCR.

- a. Provide automatic voltage reduction controls to reduce voltage when motor is running at light load.
 - b. Provide a motor running contactor to operate automatically when full voltage is applied to motor. Controller shall operate as a magnetic motor controller except during starting of motor.
8. Overload Relays: Three melting alloy type, manually reset from outside the enclosure by means of an insulated button with normally open auxiliary contact for remote alarm purposes and separate heater elements sized for the full load amperes and service factor of the actual motors furnished.
 9. Individual control power transformers for all starters, capacity as required for all control circuit devices, 100VA minimum, Class A insulation, two primary fuses, 120 volt secondary, one secondary fuse and the other secondary leg grounded.
 10. Separate Control: Where control power to starter is provided by a separate power source, a control power fuse shall be provided in the unit and the main disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.
 11. Motor horsepowers shown are preliminary. Circuit breaker trips and starter overload heaters to be coordinated with the actual equipment installed.
 12. Auxiliary contacts, relays, timers as required for specified control functions and those shown on the Drawings.
 13. All starter devices, including spare contacts wired to numbered terminal blocks.
 14. Control devices shall be 600 volt heavy duty, NEMA A600. Relays shall have convertible contacts. Pilot devices shall be oiltight. Pilot lights shall be transformer type with 6 volt secondary.
 15. Feeder Circuit Breakers: Thermal magnetic type.
 16. Motor Starter Circuit Breakers: Magnetic trip only motor circuit protectors.
 17. Provide the following diagrams and tables on the inside of the door for each compartment:
 - a. Elementary wiring diagram.
 - b. Table of overload heater sizes with the correct heater highlighted.
 - c. Table of the motor circuit protector settings with the correct setting highlighted.
 18. Main breaker shall be solid state, 100% rated, stored energy, ground fault, short and long, overcurrent trip time settings.
 19. Metering:
 - a. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
 - b. Provide potential transformers including primary and secondary fuses with disconnecting means fused potential taps as the potential source for metering.
 - c. Metering shall be Ethernet Modbus/TCP compatible.
 - d. Metering shall provide the following data:
 - 1) Voltage each phase
 - 2) Amperage each phase
 - 3) Total voltage harmonics

- 4) Total current harmonic
- 5) Voltage balance
- 6) Current balance

E. Spare Parts:

1. Provide the following spare parts for each motor control center lineup:
 - a. Two fuses of each size and type used.
 - b. One auxiliary control relay with at least two normally open and two normally closed contacts.
 - c. One control transformer of each size used.
 - d. Twelve indicating lamps.
2. Package spare parts in suitable containers bearing labels clearly indicating the contents and equipment with which they are to be used. Deliver spare parts at the same time as the motor control centers.

F. Product and Manufacturer: Provide motor control centers of one of the following:

1. Model 6 by Square D Company.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install on raised concrete base at locations shown on the Drawings. Install support channels in concrete per manufacturer's recommendations.
- B. For installations against masonry walls, provide an insulation board, 1/4-inch minimum thickness, between motor control center and wall for corrosion protection. Trim board neatly within outline of unit.
- C. Provide no openings in top or side of units not required for conduit.
- D. Cable circuits together within enclosures and identify with durable tag secured to cabling twine.
- E. Set motor circuit protectors at lowest setting which permits motor starting without nuisance tripping.
- F. Field test all motor control center components.
- G. Verify that wiring diagrams on inside of door of each compartment reflects the "as-built" circuitry and that the correct overload heater size and motor circuit protector setting are noted.
- H. Install in conformance with the National Electrical Code.

3.02 MANUFACTURER TRAINING SERVICES

- A. CONTRACTOR shall furnish the services of qualified factory trained specialists from the manufacturer to instruct OWNER'S operations and maintenance personnel in the recommended operation and maintenance of this equipment.

END OF SECTION

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SECTION 16483

PULSE WIDTH MODULATED VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section describes the requirements for furnishing, installing, and placing in operation two (2) variable frequency drives (AFD), to provide variable speed control for following motors, driving centrifugal pumps with variable torque requirements.
- B. The motors are as follows:
 - 1. High Service Pumps 203: 350 HP, 4160V, 3 phase, 60 hz., 1,750 RPM.
 - 2. High Service Pumps 205: 600 HP, 4160V, 3 phase, 60 hz., 1,750 RPM.
- C. Scope of Work:
 - 1. The work shall include providing two (2) variable frequency drives (AFD) in accordance with the standard specifications, the plans, these special provisions, the manufacturer's installation manuals and approved shop drawings. It shall also include conducting tests prior to shipment and after installation to assure proper operation.
 - 2. The Bidder shall prepare the bid to be in complete compliance with this specification. Any exception shall be included in the bid with an explanation, clearly indicating the paragraph of this specification to which the exception applies, and concisely stating the reasons.
 - 3. The Contractor shall furnish all tools, equipment, material, supplies and perform all labor required to install the medium voltage adjustable frequency drive system[s] as indicated on the drawings and specified herein in order install, test and place the AFDs into satisfactory operation
- D. Handling and Shipping:
 - 1. Structural provisions shall be made to prevent damage during handling and lifting. All assemblies shall be adequately packed so that no damage occurs during shipping and storage.

1.02 RELATED WORK

- A. Shop Drawings:
 - 1. Shop drawings for this item of work shall include:
 - a. One-line diagram.
 - b. Detailed physical drawings.
 - c. Schematic and wiring diagrams.
 - d. Bill of materials.

- e. Calculations for harmonic voltage and current distortion for the conditions specified.
- f. Test data demonstrating energy efficiency.

B. Submittals:

1. The Contractor's operation and maintenance manual shall specifically include the following items:
 - a. AFD characteristics.
 - b. Safety precautions.
 - c. Schematic and wiring diagrams.
 - d. Troubleshooting procedures with symptom/cause-effect and corrective actions.
 - e. Harmonic analysis report.
 - f. Parts lists and recommended spare parts.
 - g. AFD checkout procedure.
 - h. AFD protective and control adjustment procedure.
 - i. A hard copy of the AFD software and configuration.
 - j. Dimensional outline and plan arrangement drawings including clearance requirements, foundation details and weights.
 - k. Conduit entry/exit locations.
 - l. Assembly ratings
 - m. Major component ratings
 - n. Cable terminal sizes
 - o. Descriptive bulletins
 - p. The Manufacturer shall provide overall efficiency data at 25%, 50%, 75% and 100% speed for all components.
 - q. The AFD manufacturer shall provide system total power factor data at 25%, 50%, 75% and 100% load.
 - r. Provide harmonic calculations to the 49th harmonic The calculations shall show total harmonic voltage and current distortion at the Point of Common Coupling (PCC) which will be at the utility.

1.03 DRIVE MANUFACTURES'S RESPONSIBILITIES

- A. The AFD manufacturer shall be responsible for the installation, testing and start-up of each drive.
- B. The AFD manufacturer shall be responsible for the coordination of the drive with their respective motor(s) specified in other Section(s) of this specification.
- C. The AFD manufacturer shall be, at no additional cost to the Owner, responsible for mitigating any harmonic, and/or all RF and/or EMI and/or any other electrical type noise created by the drive which adversely affects the proper operation of any and all electronic and/or electrical power and/or mechanical devices on this project. The AFD manufacturer shall repair all damages due the drive misapplication.

- D. The AFD manufacturer shall provide input and/or output filters and/or other accessories on each drive to mitigate the transient to a limit which is not detrimental to the motor winding regardless of the motor lead length and/or type of conduit and wire.
- E. The AFD manufacturer shall be responsible for all additional materials and labor related to the installation of the drive that is above and beyond the scope of work as shown on the electrical drawings and specification.

1.04 REFERENCES

- A. IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters
- B. IEEE 1100 – Powering and Grounding Sensitive Electronic Equipment
- C. National Electrical Manufacturers Association (NEMA)
- D. NEMA ICS 6 – Industrial Control and Systems Enclosures
- E. NEMA ICS 7 – Industrial Control Systems Adjustable Speed Drives
- F. NPFA 70 – National Electrical Code (NEC)
- G. UL 347A – Medium Voltage Power Conversion Equipment

1.05 CERTIFICATIONS

- A. ANSI / NEMA Standards
- B. UL (certified)
- C. CSA

1.06 STORAGE

- A. Equipment shall be stored indoors with condensation control in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The variable frequency drives described in this specification shall be as manufactured by one of the following:

1. Cutler Hammer
2. Square-D

2.02 SYSTEM DESCRIPTION

- A. The system shall consist of the following main components: one medium voltage adjustable frequency drive (AFD), fused isolation switch, isolation contactor, drive isolation/phase shifting transformers with minimum 24 pulse rectification, DC bus pre-charge circuit, output harmonic filter as necessary.
- B. The integrated dedicated fused contactor with isolation switch shall be rated to protect the AFD from specified short-circuit levels. The minimum interrupting rating of the input contactor shall be 8500A @ 400A and 12,500A @ 800A. The AFD enclosure doors shall be interlocked to prevent opening when main power is available.
- C. The DC bus capacitors shall be charged before application of main power to limit inrush current to the main rectifier/converter bridge devices by use of a DC bus pre charge circuit. When the proper DC bus voltage is attained, the main contactor is closed and the pre-charge circuit shall be turned off.
- D. Use of electrolytic capacitors in the drive assembly is not acceptable.
- E. The AFD shall meet the requirements of IEEE 519 with the point of analysis (POA) at the input terminals of the VFD, and the requirements shall be met without an input filter. The point of common coupling shall be located at the utility. The harmonic current distortion shall not exceed the limits listed in table 10.3 of IEEE 519 at the POA. The harmonic voltage distortion shall not exceed the limits listed in table 11.1 of IEEE 519 at the POA.
- F. Drive shall operate with a +/-10 % input voltage variation.
- G. The AFD shall be rated for 60kV BIL and 50kA short circuit.
- H. Auxiliary power 480V, 3-phase, 60 Hz shall be provided internal to the integrated Drive. External auxiliary supply voltage sources will not be acceptable.
- I. The drive will be suitable for the motor(s) rated 4160V, 3-phase, 60 Hz,
- J. For variable torque applications the overload capacity shall be 110% of rated current for 1 minute repeated every 10 minutes. For constant torque applications the overload capacity shall be 150% of rated current for 1 minute repeated every 10 minutes.
- K. The AFD shall be suitable for use with an existing standard non-inverter rated squirrel cage motor with 1.15 service factor and standard medium-voltage insulation.

2.03 INVERTER DESIGN

- A. The AFD inverter shall be of the pulse width modulated (PWM) neutral point clamp (NPC) type. The output devices shall be insulated gate bipolar transistors (IGBT's) with a voltage rating of 3300V for 2400V outputs and 6500V for 4160V outputs. Use of lower voltage rated devices is unacceptable. The inverter shall be one three- phase inverter up to 3500hp and two in parallel for up to 6000hp capable. Inverters shall be of the roll- in / roll- out design to minimize downtime in the event of inverter failure. Multiple single-phase inverters will not be acceptable.
- B. The AFD inverter shall be constructed using six individual power poles installed on a roll-in/roll-out inverter. All power components associated with the power pole shall be encapsulated. All inverter mounted printed circuit boards shall be conformal coated.
- C. Drive shall be capable of running with an inverter with larger devices to minimize the number of spare inverters that will be stocked at the County site.
- D. Oil filled power capacitors must be used, electrolytic devices are not acceptable.

2.04 INTEGRATED INPUT ISOLATION TRANSFORMER AND RECTIFIER

- A. The AFD shall contain an incoming isolation transformer with primary voltage as specified on the data sheet.
- B. The transformer shall contain 12 three phase secondary windings that provide the proper phase shifting to develop a 24-pulse rectification to reduce harmonic currents and voltages reflected to the primary power system. Anything less than 24-pulse is not acceptable. Transformer shall have a 220 degree C insulation rating.
- C. The transformer and rectifier shall be an integral part of the AFD assembly along with primary isolation switch, power fuses, and input vacuum contactor eliminating the need for separate components, field installation, or wiring.
- D. The rectifier shall be a diode bridge design with fast acting current limiting semi-conductor fuses to protect the bridge.
- E. A drive isolation transformer shall be integrated in the AFD enclosure to provide power conversion from the line voltage to the required AFD voltage and to isolate the line from harmonics and common mode voltages. The transformer shall conform to ANSI/IEEE C57 or to corresponding IEC standards
- F. The transformer shall be designed to withstand a short circuit. It shall maintain electromagnetic symmetry when only one secondary winding is in short circuit in order to minimize the resulting short circuit forces. The transformer shall be capable of thermally withstanding a short circuit for 2 seconds.

- G. Transformers shall be of a high efficiency type with full load losses of no greater than 2%.
- H. Suitable vibration dampers shall be provided with the transformer and its enclosure in order to attenuate mechanical resonance and to reduce the operational sound level.
- I. The transformer shall include electrostatic shielding between the windings to carry high frequency capacitive currents to ground.
- J. Transformer designs shall be open type mounted.
- K. The transformer shall be of the air-cooled type and be forced ventilated.
- L. Only rectifier grade K-factor transformers shall be utilized, with K-Factor of 6 for diode rectifiers. AFD manufacturers providing SCR type rectifiers shall include K 12 transformers for variable torque applications and K 20 for constant torque applications.

2.05 RELIABILITY

- A. The manufacturer shall list any control or power components that require recommended maintenance or replacement before 50,000 hours of operation. Information must be available in the manufacturer's maintenance manual and available for submittal.
- B. All components of the AFD shall be considered for MTBF calculations using Failure in Time (FIT) analysis.
- C. The Mean Time Between Failure (MTBF) of the current carrying devices of the AFD shall be 98,000 hours or greater
- D. The AFD shall be capable of continuous operation (“ride-through”) in the event of a power loss of up to 5 cycles.
- E. The AFD shall be able to safely operate, without tripping, with up to 30% voltage sag on the rated input voltage.
- F. All power semiconductors and passive power components in both the rectifier and inverter sections shall be medium voltage rated components. Low voltage components are not acceptable in the power sections.

2.06 INPUT POWER QUALITY

- A. The AFD total harmonic voltage distortion (THD) contribution at each point of common coupling between the drives and other loads within the facility (Load PCC) shall not exceed the 5% THD limit recommended for General Systems as listed in Table 11.1 of IEEE 519, throughout the speed range.
- B. The AFD fundamental power factor shall be > 0.97 . The total power factor at the VFD input shall be > 0.95 , for the load range of 20 to 100%. The AFD manufacturer shall provide a power factor correction filter if the AFD does not meet this requirement. The AFD including power factor correction and/or harmonic filter shall never have a leading power factor.
- C. For any AFD employing capacitors on the input side, such capacitors shall be rated 12.47kV or higher to avoid harmonic transient resonance.

2.07 OUTPUT POWER QUALITY

- A. Output waveform switching transients and harmonic content shall have a negligible contribution to motor heating, acoustical noise in the motor, torsional stress in the power train, and motor insulation.
- B. Common mode voltages on the AFD output shall be isolated from the motor.
- C. Motor cable voltage reflections and the resulting restrictions on motor cable length shall be taken into consideration and the drive shall be properly applied to the motor.
- D. All AFD manufacturers shall incorporate output filtering.

2.08 CONTROL FUNCTIONS

- A. Frequently accessed AFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the AFD. The AFD's shall have a three line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, particularly those that use alphanumeric codes and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
- B. The keypad shall include a local/remote pushbutton selection. Both start/ stop source and speed reference shall be independently programmable for keypad, remote I/O, or field-bus.
- C. The keypad shall have copy/paste capability.
- D. Upon initial power up of the AFD, the keypad shall display a startup guide that will sequence all the necessary parameter adjustments for general start up.

- E. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows™ based software. In addition the software shall permit control and monitoring via the AFD's RS232 port. The manufacturer shall supply the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this specifications.
- F. The operator shall be able to scroll through the keypad menu to choose between the following:
 - 1. Monitor
 - 2. Operate
 - 3. Parameter setup
 - 4. Actual parameter values
 - 5. Active faults
 - 6. Fault history
 - 7. LCD contrast adjustment
 - 8. Information to indicate the standard software and optional features software loaded.
- G. The following setups and adjustments, at a minimum, are to be available:
 - 1. Start command from keypad, remote or communications port
 - 2. Speed command from keypad, remote or communications port
 - 3. Motor direction selection
 - 4. Maximum and minimum speed limits
 - 5. Acceleration and deceleration times, two settable ranges
 - 6. Critical (skip) frequency avoidance
 - 7. Torque limit
 - 8. Multiple attempt restart function
 - 9. Multiple preset speeds adjustment
 - 10. Catch a spinning motor start or normal start selection
 - 11. Programmable analog output
 - 12. DC brake current magnitude and time
 - 13. PID process controller

2.09 THE AFD SHALL HAVE THE FOLLOWING SYSTEM INTERFACES:

- A. Inputs — A minimum of six (6) programmable digital inputs, two (2) Analog inputs and serial communications interface shall be provided with the following available as a minimum:
 - 1. Remote manual/auto
 - 2. Remote start/stop
 - 3. Remote forward/reverse
 - 4. Remote preset speeds
 - 5. Remote external trip
 - 6. Remote fault reset

7. Process control speed reference interface, 4-20mA dc
8. Potentiometer and 1-10V dc speed reference interface
9. RS232 programming and operation interface port Serial communications port.
10. Modbus/Ethernet

B. Outputs — A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.

1. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
 - a. Fault
 - b. Run
 - c. Ready
 - d. Reversed
 - e. Jogging
 - f. At speed
 - g. Torque Limit Supervision
 - h. Motor rotation direction opposite of commanded
 - i. Over-temperature
2. Programmable open collector output with available 24 V dc power supply and selectable with the following available at minimum:
 - a. Fault
 - b. Run
 - c. Ready
 - d. Reversed
 - e. Jogging
 - f. At speed
 - g. Torque Limit Supervision
 - h. Motor rotation direction opposite of commanded
 - i. Over temperature
3. Programmable analog output signal, selectable with the following available at minimum:
 - a. Motor current
 - b. Output frequency
 - c. Frequency reference
 - d. Motor speed
 - e. Motor torque
 - f. Motor power
 - g. Motor voltage
 - h. Dc-bus voltage
 - i. Analog Output 1 to match Analog Input 1
 - j. Analog Output 2 to match Analog Input 2
 - k. PT100 temperature
 - l. Jog speed

C. Monitoring and Displays

1. The AFD display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:
 - a. Run
 - b. Forward
 - c. Reverse
 - d. Stop
 - e. Ready
 - f. Alarm
 - g. Fault
 - h. I/O terminal
 - i. Keypad
 - j. Bus/Comm
 - k. Local (LED)
 - l. Remote (LED)
 - m. Fault (LED)
2. The AFD keypad shall be capable of displaying the following monitoring functions at a minimum:
 - a. Output frequency
 - b. Frequency reference
 - c. Motor speed
 - d. Motor current
 - e. Motor torque
 - f. Motor power
 - g. Motor voltage
 - h. Dc-bus voltage
 - i. Unit temperature
 - j. Calculated motor temperature
 - k. Voltage level of analog input
 - l. Current level of analog input
 - m. Digital inputs status
 - n. Digital and relay outputs status
 - o. Analog out

D. Protective Functions

1. The AFD shall include the following protective features at minimum:
 - a. Over current
 - b. Over voltage
 - c. Inverter fault
 - d. Under voltage
 - e. Input phase loss
 - f. Output phase loss
 - g. Under temperature
 - h. Over temperature
 - i. Motor stalled

- j. Motor over temperature
 - k. Motor under load
 - l. Logic voltage failure
 - m. Microprocessor failure
2. The AFD shall provide ground fault protection during power-up, starting, and running. AFD's with no ground fault protection during running are not acceptable.

E. Diagnostic Features

- 1. Fault History
- 2. Record and log faults
- 3. Indicate the most recent first, and store up to 30 faults.
- 4. An Emergency-stop (E-Stop) shall be provided on the AFD door in addition to inputs for remote supplied E-Stop command.

2.10 CONTROL POWER TRANSFORMERS (CPT'S)

- A. A control power transformer (CPT) shall be provided within the enclosure.
- B. The kilovolt-ampere rating of the CPT shall be determined by the manufacturer and shall have a minimum of 25% spare capacity.
- C. The CPT secondary voltage shall be 120 Vac.
- D. The CPT primary shall be fused with current limiting fuses with an interrupting rating no less than 50,000 amperes.
- E. The CPT secondary shall be fused and have one terminal grounded.

2.11 INTEGRATED MAIN POWER TOP BUS

- A. When specified, a top mounted bus will be an integral part of the AFD design to be configured as a part of a motor control center or switchgear.
- B. Top-mounted bus shall allow provisions for adding motor control components such as AFD's, various starter types, circuit breakers and load-break switches. Top-mounted bus allows for future installation of various motor control components via bus splice kit. Inter-connecting cabling shall not be acceptable.
- C. Top-mounted bus ratings shall be as follows: 7.2KV at 3000 Amps, 15KV at 2000 Amps.
- D. Bus bars shall be braced to withstand short circuit currents at a minimum of 50k AIC.

2.12 INTEGRATED INPUT ISOLATION SWITCHGEAR

- A. Each AFD shall include a fused manually operated isolation switch with visible blades, current limiting power fuses, and a removable vacuum contactor to feed the isolation/phase shifting transformer. These components shall be provided to safely isolate the drive from the power source. The vacuum contactor shall carry the same ratings as full voltage vacuum contactors designed for MV motor starting duty. The fault rating of the vacuum contactor shall be a minimum of 8500A.

2.13 SYNCHRONOUS TRANSFER (OPTIONAL)

- A. The synchronous transfer system shall be capable of controlling multiple loads via an integrally designed AFD/Controller.
- B. The synchronous transfer system shall adjust the AFD output voltage, frequency, and phase to match the utility and provide “bump-less” transfer from drive output to utility bus
- C. All power components in the synchronous transfer system shall be hard copper-bus connected and provided by the same manufacturer. Cable bus is not acceptable.

2.14 HARMONIC FILTERS AND POWER FACTOR CORRECTION

- A. Power factor correction equipment shall be provided if necessary to maintain a constant input power factor of 0.95 lagging throughout the entire load range.
- B. Filters shall be contained and mounted in the AFD enclosure. Freestanding filters will not be acceptable.
- C. Capacitors shall be environmentally safe. Discharge resistors and a method of shorting the phases shall be provided.
- D. Inductors may be air or iron core. Inductors shall have Class F insulation with Class B temperature rise.
- E. There shall be annunciation of output filter failure.

2.15 EFFICIENCY

- A. Overall efficiency of the AFD shall include the drive isolation transformer, AFD and all AFD auxiliaries, output filter, power factor correction and harmonic filter.
- B. AFD system efficiency calculations shall be in accordance with IEEE 995.
- C. The overall efficiency shall be not less than 96% at full load, full speed.

2.16 MOTOR/BEARING PROTECTION RELAYS

- A. RTD Module and Display accepting up to 8 inputs (3 wire 100 ohm platinum RTD's (PT100)) and 3 relay outputs, similar to NT-538.
- B. Utilize the Eaton EMR4000 with RTD module and Modbus TCP/Ethernet interface with existing SCADA system.

2.17 AUXILIARY DEVICES

- A. For stand-alone AFD's, provide fixed mounted potential transformers, fused-type, of the quantity and ratings indicated on the contract drawings.
- B. Provide window-type current transformers of the quantity and current rating as indicated on the contract drawings. Current transformer accuracy shall be suitable for the connected burden.
- C. Provide an auxiliary control power transformer of the quantity and kVA rating as indicated on the contract drawings.
- D. Provide a 120V remote input source for the specific use of testing low voltage controls when main power is off.

2.18 ENVIRONMENTAL CONDITIONS

- A. The AFD shall operate in an ambient temperature range of 0° C to 40° C (32° F to 104° F) with a relative humidity of up to 95% (non-condensing), unless specified otherwise.
- B. The equipment shall be capable of being stored in an environment with an ambient temperature range of -40° C to 70° C.
- C. The equipment shall operate at altitudes from 0 to 1000m (3,300 ft.) above sea level, without de-rating.

2.19 ENCLOSURES

- A. Indoor enclosures shall be NEMA 1A with gasket and filters.
- B. The AFD shall require front access only. Designs requiring rear or side access are not acceptable.
- C. The AFD enclosure doors shall include an interlocking system with the isolation switch.
- D. A safety grounding device shall be provided for grounding the positive, and negative buses to ensure all stored AFD energy is discharged.

- E. Enclosures shall be configurable separately or in a continuous line-up. AFD's shall be capable of being integrated with conventional motor starters, load break switches, circuit breakers, and reduced voltage starters into a continuous control-gear assembly.
- F. The drive isolation transformer, fused input contactor, isolation switch, ac pre-charge circuit contactor, output filter if required, and input harmonic filter and power factor correction filter if required shall be factory mounted wired by the manufacturer and integrated into the AFD enclosure.
- G. All painted surfaces shall be ANSI 61 Gray.
- H. The enclosure must be designed to avoid harmonic and inductive heating and eliminate radio frequency interference.
- I. The AFD enclosure shall comply with UL 347 standards suitable for installation in an indoor, unclassified area.
- J. All enclosure openings exceeding 0.25 inch (6 mm) in width shall be provided with screens to prevent the entrance of snakes, rodents, etc. The maximum screen mesh opening width shall be 0.25 inch (6 mm).
- K. Air filters shall be of a reusable type that can be easily cleaned. All doors or front panels will be fully gasketed. Air exhaust from cooling fans will be at the top of the enclosure and direct exhaust airflow away from personnel in front of the equipment.
- L. The AFD shall be designed for harsh environments, including encapsulated power components. All exposed copper components shall be tin-plated or epoxy-coated. All printed circuit cards shall be conformal coated.

2.20 COOLING

- A. A "loss of cooling" fault shutdown shall be furnished with forced-cooled equipment. In the event of clogged filters or fan failure, the drive will shut down safely without electronic component failure.
- B. Fan motors shall be protected by an input circuit breaker. Metal squirrel cage ball bearing 460V three phase fan motors with 50,000 hour life are to be used in the drive design. Plastic muffin fans are not acceptable. As specified on the data sheet, fan power will be obtained from the primary 2400/4160V power through a 480V, 3-phase, 60 Hz internal auxiliary power supply. In the event of a fault or opening of the main contactor feeding the drive, the fans will continue to run for a time to allow for sufficient cooling of the drive. Convection cooling in the case of fault or main contactor opening is unacceptable as a method to ensure proper cooling of the drive.

- D. The AFD shall have internal fans to ensure proper operation in the above referenced ambient. When specified furnish additional redundant fan(s) to ensure operation in the event of primary fan failure.

2.21 SPACE HEATERS

A. AFD Enclosure Space Heaters

1. When specified, space heaters shall be supplied.
2. The space heater circuit shall turn on automatically when the drive is not operating.
3. A circuit breaker for space heater circuit shall be provided for overload protection and as a disconnecting means.
4. When specified, a meter and a test circuit shall be provided on the enclosure door for indication that space heater power is available.
5. Space heater elements shall be rated 240 Vac and operated at 120 Vac, single-phase.

B. AC Motor Space Heaters

1. Motor space heater control shall be provided. The space heater circuit shall turn on automatically when the motor is not operating.

2.22 NAMEPLATES

- A. Nameplates shall be 2-inch high x 2-1/2 inch wide, laminated black with white with core.
- B. Unit nameplate and device marker lettering shall be 3/16-inch high.

2.23 FINISH

- A. The finish for internal and external parts shall consist of a coat of ANSI 61 (gray) thermosetting, polyester, powder paint applied electrostatically to pre-cleaned phosphatized steel and aluminum surfaces.

2.24 ACCESSORIES

- A. Provide a portable lifting device for transporting contactor outside its compartment.
- B. Provide an auxiliary and portable Ampgard Remote Operator (ARO) shall be used to enable users to open or close the AFD input isolation switch through the use of a pushbutton station operated up to 30 feet away from the door. Users can mount the ARO on the front of the door, plug it into any available 120 Vac source, and operate the isolation switch from outside the arc flash boundary.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The AFD shall be installed by the Contractor in accordance with specifications, plans, and the manufacturer's recommendations.
- B. After all of the AFD's have been placed, wiring connections shall be examined to make sure they have not been loosened or damaged during shipment or installation. All power and control wiring to the motors, switches, control panel, instrumentation racks, etc., shall be checked.
- C. AFD's shall be functionally checked in the field with the following adjustments made:
 - 1. Starting current limit - 110 percent.
 - 2. Normal current limit - 110 percent.
 - 3. Overload trip - 110 percent at 60 seconds (inverse time).
 - 4. Maximum frequency limit - 63 Hz.
 - 5. Minimum frequency limit - 12 Hz.
 - 6. Speed reference, remote 4-20 mA.
- D. The Engineer will approve all field adjustments and functional/protective test.
- E. Following confirmation that all wiring and functional/protective checks are correct, the AFD's shall be started up, tested, and placed into operation by an authorized representative. The manufacturer's manuals shall be used as a basis for all testing and commissioning work.
- F. A harmonic analysis shall be performed by the AC drive manufacturer based on the provided system documentation consisting of but not limited to one-line diagrams and specific transformer information consisting of X/R, %Z and KVA rating.
- G. Installation, Start-Up and Testing Services: A qualified manufacturer's representative shall supervise the installation, testing and start-up of the AC drives for a minimum of three person days.
- H. Training: Upon acceptance, the AC drive manufacturer's representative shall provide a minimum of 8 hours of training for the operators. The training shall be scheduled with at least 72 hours advance notice.

3.02 SERVICE AND SUPPORT

- A. The AFD vendor shall maintain an inventory of spare/replacement parts within 100-miles of the installation site. These shall be available for immediate shipment to replace an inoperable device or module with the AFD.

- B. The AFD vendor shall employ and maintain a qualified technician within 100 miles of the installation site. The name, location, and phone number shall be provided with the submittal package. Full-time support personnel shall be employed by the manufacturer.

APPENDIX A

VARIABLE FREQUENCY DRIVE SCHEDULE

AFD I.D.	MTR I.D.	NAME	HP	ENCL	VOLT /PH	TORQUE	METER	PILOT DEVICES	MISC. OPTIONS
AFD-3	HSP-203	HIGH SERVICE PUMP 3	350	NEMA 12	4160/3	VARIABLE	M1,M2, M3	A,B,C,D,E	NOTES 1, 2
AFD-5	HSP-205	HIGH SERVICE PUMP 4	600	NEMA-12	4160/3	VARIABLE	M1, M2, M3	A,B,C,D,E	NOTES 1, 2

METER NOTES:

N=NONE
M1=DIGITAL SPEED METER
M2=DIGITAL AMMETER
M3=ELAPSED TIME METER

PILOT DEVICES:

A=START/STOP
B=AUTO-MANUAL/AUTO-COMPUTER
C=MAN. SPEED CONTROL
D=RED RUN LIGHT
E=AMBER FAULT LIGHT

MISCELLANEOUS OPTIONS:

Note 1. Reference typical AFD wiring control schematic on E Drawings.

Note 2: Provide monitor compatible with RTD Thermal Protection system for winding protection.

END OF SECTION

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SECTION 16495

AUTOMATIC TRANSFER SWITCH

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 transfer switches rated 600 V and less. It includes the following items:
 - 1. Automatic closed transition transfer switch (ATS): The closed transition switch shall transfer the load in a parallel mode, thus momentarily connecting both sources of power. A closed transition transfer shall occur only when both sources are available and within specified limits. The maximum interconnect time is 100 milliseconds. The transfer switch shall operate in an "open transition" mode (break before make" when the power source servicing the load fails. In the "open transition" mode, the transfer switch shall incorporate a "neutral" position or "delayed transition" feature so all motor loads decay. Passive devices such as phase monitors or motor disconnects are not acceptable.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Conductors for hard-wired connections between transfer switches and remote equipment are specified in Division 16 Section "Wires and Cables."
 - 2. SECTION 16480 MOTOR CONTROL CENTERS

1.03 REMOTE ANNUNCIATION AND CONTROL SYSTEM DESCRIPTION

- A. Functional Description: Provide the functions listed below at indicated transfer switches for monitoring:
 - 1. Sources-available indication (as defined by actual pick-up and drop-out settings of transfer switch controls).
 - 2. Switch position indication.
 - 3. Switch in test mode indication.
 - 4. Control of switch test initiation.
 - 5. Control of switch operation in either direction.
- B. Malfunction of the annunciator unit or communication link does not affect functions of the ATS. In the event of a failure of the communication link the ATS automatically reverts to stand-alone, self-contained operation. No ATS sensing, controlling, or operating function depends on the remote panel for proper operation.

1.04 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

- B. Shop drawings or published product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices; and materials lists.
- C. Wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.
- D. Single-line diagrams of transfer switch units showing connections between automatic transfer switch, power source, and load, plus interlocking provisions.
- E. Operation and maintenance data for each type of product, for inclusion in Operating and Maintenance Manual specified in Division 1. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay setting and calibration instructions.
- F. Manufacturer's certificate of compliance to the referenced standards and tested short-circuit closing and withstand ratings applicable to the protective devices and current ratings used in this Project, as indicated and as specified in paragraph "Tested Fault Current Ratings."

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms are experienced in manufacturing equipment of the types and capacities indicated and have a record of successful in-service performance.
- B. Emergency Service: Manufacturer maintains a service center capable of providing emergency maintenance and repairs at the Project site with an 8-hour maximum response time.
- C. Comply with NFPA 70, "National Electrical Code," for components and installation.
- D. Comply with NEMA ICS 1, "General Standards for Industrial Control," ICS 2, "Industrial Control Devices, Controllers and Assemblies," and ICS 6, "Enclosures for Industrial Controls and Systems."
- E. Nationally Recognized Testing Laboratory Listing (NRTL) and Labeling: Items furnished under this Section are listed and labeled by a NRTL for emergency service under UL Standard 1008.
 - 1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- F. UL Compliance: Comply with UL Standard 1008, "Automatic Transfer Switches," except where requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Automatic Switch Co.
 - 2. GE Zenith Controls, Inc.
 - 3. Russelectric

2.02 TRANSFER SWITCH PRODUCTS, GENERAL

- A. Number of Poles and Current and Voltage Ratings: As indicated.
 - 1. Units 1200 amperes, 4 pole and larger have current ratings that apply to all mixtures of loads.
- B. Tested Fault-Current Ratings: Closing and withstand ratings exceed the indicated available rms symmetrical fault current at the equipment terminals based on testing according to UL Standard 1008, conducted at full-rated system voltage and 20 percent power factor. Rate each product for withstand duration time as follows when tested for rated short-circuit current correlated with the actual type of circuit protective device indicated for transfer switches for this Project:
 - 1. Main Contacts: 3 closing and withstand duration cycles.
 - 2. Power Circuit Breakers: 10 closing and withstand duration cycles.
 - 3. Current-Limiting Fuses: 0.5 (nominal) closing and withstand duration cycles.
- C. Annunciation and Control Interface Components: Devices at transfer switches for communicating with remote annunciators or annunciator/control panels have communications capability matched with the remote device.
- D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20° C to 70° C.
- E. Resistance to Damage by Voltage Transients: Components meet or exceed voltage surge withstand capability requirements when tested according to ANSI C37.90.1, IEEE Guide for Surge Withstand Capability (SWC) Tests. Components meet or exceed voltage impulse withstand test of NEMA ICS 1.
- F. Enclosures: General-purpose NEMA 1, conforming to UL Standard 508, "Electric Industrial Control Equipment," except as otherwise indicated.
- G. Factory Wiring: Train and bundle factory wiring and identify consistently with shop drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations.
 - 1. Designated terminals accommodate field wiring.
 - 2. Power Terminals Arrangement and Field Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Terminals: Pressure-type, suitable for copper or aluminum conductors of sizes indicated.
 - 4. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- H. Electrical Operation: Where indicated, accomplish by a non-fused, momentarily energized solenoid or electric motor-operated mechanism, mechanically and electrically interlocked in both directions. Switches using components of molded-case circuit breakers or contactors not designed for continuous-duty, repetitive switching between active power sources is not acceptable.
- I. Switch Contacts: Use silver composition for switching load current. Units rated 225 amperes and more have separate arcing contacts.
- J. Overcurrent devices are not part of switch products.
- K. The automatic transfer switch shall be an integral component of the motor control center specified in Section 16480.

2.03 AUTOMATIC TRANSFER SWITCH SEQUENCE OF OPERATION

- A. When the voltage on any phase of the normal source is reduced to 85% of rated voltage for .5-6 seconds (adjustable), a pilot contact shall close to initiate starting of the standby plant.
- B. When the standby plant is delivering not less than 90% of rated voltage and 95% of rated frequency, the load shall be transferred to the emergency source. During test or other source-to-source transfer, 95% voltage and frequency, phase rotation and angle shall be verified.
- C. When the normal source has been restored to not less than 95% and not more than 105% of nominal voltage on all phases, proper phase rotation is verified, and after a time delay of 0 to 30 minutes (adjustable), the load shall be transferred to the normal source in a closed transition operation. The standby plant shall run unloaded for 5 minutes and then shut down. The genset shall be ready for automatic operation upon the next failure of the normal source.
- D. If the standby plant should fail while carrying the load, open transition retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) of the normal source.
- E. A synch-check relay (in-phase monitor) shall be provided for closed transition operation. The monitor shall control transfer and retransfer between live sources and operate by sensing the zero voltage point. It shall be factory set to accomplish transfer within 5 electrical degrees and +/- 5% voltage differential. An alarm shall be provided to indicate if closed transition transfer is not accomplished within a preset time period due to a failure to meet operational parameters. An automatic synchronizer (active type) shall be provided for closed transition operation. This device automatically adjusts for voltage and frequency, allowing a faster transition between both sources and eliminates inherent problem in standard passive type synchronizers. Provide an automatic synchronizer pilot light.
- F. Closed transition transfer in conjunction with over/under voltage, phase rotation and angle sensing shall be accomplished when both sources are within specified parameters without any power interruption and without altering the speed or actively controlling the standby plant.
- G. During closed transition operation, the control circuit shall monitor interconnect time. Should connection exceed 100MS, the set of power contacts just closed shall be reopened and an alarm circuit shall be energized. If the main contacts fail to open, the control system shall energize a 24VDC shunt trip circuit to the standby feeder breaker to disconnect this source and the alarm circuit shall be closed. VDC from the engine batteries shall be supplied for the shunt trip and alarm backup circuits.

2.04 AUTOMATIC TRANSFER SWITCH FEATURES

- A. The closed transition transfer switch shall be operated by two solenoids momentarily energized.
- B. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes.
- C. A dielectric test at the conclusion of the withstand and closing tests shall be performed.

- D. During open transition operation, the transfer switch manufacturer shall certify arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- E. Temperature rise tests in accordance with UL-1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- F. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
- G. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
- H. A manual handle shall be provided for maintenance purposes. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
- I. The switch shall be mounted in NEMA 1 enclosure unless otherwise indicated on the plans.
- J. Switches constructed from molded case breakers, contactors or components thereof no specifically designed, as an automatic transfer switch will not be acceptable.
- K. The closed transition transfer switches shall include the following standard equipment:
 - 1. Auxiliary contact closed in emergency position.
 - 2. Auxiliary contact closed in normal position.
 - 3. Engine start contact, 1 N.O., 1 N.C.
 - 4. Pilot light to indicate switch in emergency position.
 - 5. Pilot light to indicate emergency source availability.
 - 6. Pilot light to indicate switch in normal position.
 - 7. Pilot light to indicate normal source availability.
 - 8. Pilot light to indicate sources in sync.
 - 9. Adjustable time delay on retransfer to normal, 0-30 minutes.
 - 10. Adjustable time delay on transfer to emergency, 0-30 minutes.
 - 11. Adjustable time delay for engine cool down, 0-30 minutes.
 - 12. Load test switch.
 - 13. Transition mode selector switch to allow open or closed transition transfer.
 - 14. Auxiliary contact for alarm.
 - 15. Alarm and shunt trip circuit with diagnostic indicators.
 - 16. Extended parallel electrical operator reversal safety circuit and lockout.
 - 17. Close differential over/under voltage, phase rotation and angle sensing for closed transition operation.
- L. The automatic transfer switch shall be protected by two (2) year warranty on parts and labor or the equivalent.

2.07 FINISHES

- A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.08 SOURCE QUALITY CONTROL

- A. Factory test components, assembled switches, and associated equipment to ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for conformance with specified requirements. Perform dielectric strength test conforming to NEMA ICS 1.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Floor Mounting of Transfer Switches: Level and anchor the unit to the floor.
- B. Identify components according to Division 16 Section "Electrical Identification."

3.02 WIRING TO REMOTE COMPONENTS

- A. Match the type and number of cables and conductors to the control and communications requirements of the transfer switches used. Increase raceway sizes at no additional cost to the owner if necessary to accommodate required wiring.

3.03 CONNECTIONS

- A. Tighten factory-made connections, including connectors, terminals, bus joints, mountings, and grounding. Tighten field-connected connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. When manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.04 GROUNDING

- A. Make equipment-grounding connections for transfer switch units as indicated and as required by the NEC.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise field tests.
- B. Preliminary Tests: Perform electrical tests as recommended by the manufacturer and as follows:
 1. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester, including external annunciator and control circuits. Use test voltages and procedure recommended by the manufacturer. Meet manufacturer's specified minimum resistance.
 2. Check for electrical continuity of circuits and for short circuits.
- C. Field Tests: Give 7-day advance notice of the tests and perform tests in presence of owner's representative.

- D. Coordinate tests with tests of generator plant and run them concurrently.
- E. Tests: As recommended by the manufacturer and as follows:
 - 1. Contact Resistance Test: Measure resistance of power contacts for ATs, NATs, and BP/ISs. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.
 - 2. Ground Fault Tests: Coordinate with testing specified in Division 16 Section "Overcurrent Protective Devices" to ensure sensors are properly selected and located to optimize ground-fault protection where power is being delivered from either source.
 - a. Verify grounding points and sensor ratings and locations.
 - b. Apply simulated fault current at the sensors and observe reaction of circuit interrupting devices.
 - 3. Operational Tests: Demonstrate interlock, sequence, and operational function for each switch at least 3 times.
 - a. Simulate power failures of normal source to ATs and of emergency source with normal source available.
 - b. Simulate low phase-to-ground voltage for each phase of normal source of ATs.
 - c. Verify time-delay settings and pick-up and drop-out voltages.
- F. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets the specified requirements.
- G. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- H. Warranty: Automatic transfer switch to be warranted against defective workmanship for a period of at least two years, defective material for at least five years and defective contacts for at least ten years.

3.06 DEMONSTRATION

- A. Training: Furnish the services of a factory-authorized service representative to instruct Owner's personnel in the operation, maintenance, and adjustment of transfer switches and related equipment. Provide a minimum of 4 hours of instruction scheduled 7 days in advance.

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SECTION 16525

EXTERIOR LIGHTING

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 exterior lighting fixtures, lamps, ballasts, pole standards, and accessories.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Interior Lighting" for interior fixtures, lamps, ballasts, emergency lighting units, and accessories; also for exterior fixtures normally mounted on buildings.

1.03 DEFINITIONS

- A. Fixture: A complete lighting device. Fixtures include a lamp or lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.
- B. Lighting Unit: A fixture or an assembly of fixtures with a common support, including a pole or bracket plus mounting and support accessories.
- C. Luminaire: A fixture.

1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data describing fixtures, lamps, ballasts, poles, and accessories. Arrange Product Data for fixtures in order of fixture designation. Include data on features, poles, accessories, finishes, and the following:
 - 1. Outline drawings indicating dimensions and principal features of fixtures and poles.
 - 2. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps.
- C. Wind Resistance Calculations: Certified by a registered professional engineer.
- D. Shop Drawings detailing nonstandard fixtures and poles and indicating dimensions, weights, method of field assembly, components, and accessories.

- E. Wiring diagrams detailing wiring for control system showing both factory-installed and field-installed wiring for specific system of this Project, and differentiating between factory-installed and field-installed wiring.
- F. Anchor-Bolt Templates: Keyed to specific poles and certified by manufacturer.
- G. Product certificates signed by manufacturers of lighting units certifying that their products comply with specified requirements.
- H. Field test reports indicating and interpreting test results specified in Part 3 of this Section.
- I. Maintenance data for products to include in the operation and maintenance manual specified in Division 1.

1.05 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Comply with ANSI C2.
- C. Listing and Labeling: Provide fixtures and accessories specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.06 STORAGE AND HANDLING OF POLES

- A. General: Store poles on decay-resistant treated skids at least 12-inches (300-mm) 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 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Warranty: Submit a written warranty signed by manufacturer and Installer agreeing to replace external parts of lighting fixtures exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies the Owner may have under the Contract Documents.
 - 1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.
 - 2. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation.
 - 3. Special Warranty Period: 5 years from date of Substantial Completion.

1.08 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 one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2. PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, fixtures that may be incorporated in the Work include, but are not limited to, the products specified in the Lighting Schedule.

2.02 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- 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: Materials as indicated. 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 the ON position and factory set to turn light unit on at 1.5-to 3- foot-candles (16 to 32 lux) and off at 4.5 to 10 foot-candles (48 to 108 lux) with 15-second minimum time delay.
- J. Fluorescent Fixtures: Conform to UL 1570.
- K. Fluorescent Ballasts: Class P, low-temperature, electromagnetic type, compatible with the lamps and lamp combinations to which connected.
 - 1. Certification by Electrical Testing Laboratory (ETL).
 - 2. Labeling by Certified Ballast Manufacturers Association (CBM).
 - 3. Sound Rating: "A" rating, except as otherwise indicated.
 - 4. Voltage: Match connected circuits.
 - 5. Minimum Power Factor: 90 percent.
 - 6. Total Harmonic Distortion (THD) of Ballast Current: Less than 10 percent.
 - 7. Conform to FCC Regulations Part 15, Subpart J for electromagnetic interference.
 - 8. Conform to IEEE C62.41, Category A, for resistance to voltage surges for normal and common modes.
 - 9. Minimum Starting Temperature: Minus 20 C.
- L. High-Intensity-Discharge (HID) Fixtures: Conform to UL 1572.
- M. HID Ballasts: Conform to UL 1029, and ANSI C82.4. Constant wattage autotransformer (CWA) or regulating high-power-factor type, unless otherwise indicated.
 - 1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
 - 2. Operating Voltage: Match system voltage.
 - 3. Single-Lamp Ballasts: Minimum-starting temperature of minus 30 C.
 - 4. Open circuit operation will not reduce average life.
 - 5. High-Pressure Sodium (HPS) Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 C.
 - 6. Noise: Uniformly quiet operation, with a noise rating of B or better.

N. Lamps: Comply with ANSI C78 series that is applicable to each type of lamp. Provide fixtures with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a fixture, provide medium wattage lamp recommended by manufacturer.

O. LED Fixtures

1. Construction: low-copper aluminum, single-piece die cast housing. Provide a metallic screen to cover the top of the housing, preventing debris build-up with air-flow and natural cleaning of the light engine heat sink. The LED driver and electronics shall be thermally isolated from the heat-generating light engine. Housing shall be completely sealed against moisture and environmental contaminants.
2. Finish: Exterior parts shall be protected by a zinc-infused TGIC thermoset powder coat finish. Provide 3 mm thickness for a without cracking or peeling. dark bronze.
3. Optics: Precision-molded acrylic lenses for luminaire spacing and uniformity. Type III, optical system controls light above 90 degrees.
4. High-efficiency 4000K, 65 CRI LEDs mounted to a metal-core circuit board and aluminum heat sink, ensuring thermal management and long life (L85 60,000 hrs, 25°C ambient). Standard and dimming drivers are available in 120-277V and 347-480V; 50/60 Hz. Drivers shall have power factor >90% and THD <20%. Thermal isolation results in expected driver life of over 100,000 hours. Replaceable surge protection device is tested in accordance with IEEE/ANSI C62.41.2 meeting Category C Low.
5. Listing: CSA certified to U.S. and Canadian standards. Light engine is IP66 rated. Luminaire is IP65 rated. U.S. Patent No. D632830

2.03 FIXTURE SUPPORT COMPONENTS

- A. Pole-Mounted Fixtures: Conform to AASHTO LTS-3.
- B. 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 as required by local codes with a gust factor of 1.3.
- C. Arm, Bracket, and Tenon Mount Materials: Match poles' finish.
- D. 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.
- E. Pole Shafts: Round, tapered.
- F. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.
- G. Aluminum Poles: ASTM B 429, 6063-T6 alloy. Provide access handhole in pole wall.

- H. Aluminum Poles: ASTM B 209 (ASTM B 209M), 5052-H34 alloy. Provide access handhole in pole wall.
- I. Metal Pole Grounding Provisions: Welded 1/2-inch (12-mm) threaded lug, accessible through handhole.
- J. Aluminum Mast Arms: Tapered oval arms continuously welded to pole attachment plate with span and rise as indicated.
- K. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate fixture.
- L. Pole-Top Tenons: Fabricated to support fixture or fixtures and brackets indicated and securely fastened to pole top.
- M. Concrete for Pole Foundations: Comply with Division 3 Section "Cast-in-Place Concrete." Use 3000-psi (20.7-MPa) strength, 28-day concrete.

2.04 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 approved Shop Drawings.
- B. Concrete Foundations: Construct according to Division 3 Section "Cast-in-Place Concrete."
 - 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. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.

- F. 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 Division 16 Section "Grounding."
 - 1. Poles: Install 20-foot (3-m) driven ground rod at each pole.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged fixtures and components.
- B. Give advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source.
- E. Replace or repair damaged and malfunctioning units, make necessary adjustments, and retest. Repeat procedure until all units operate properly.

3.04 ADJUSTING AND CLEANING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

3.05 EXTERIOR LIGHTING UNIT SCHEDULE

- A. See Contract Drawings

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SECTION 16620

PACKAGED ENGINE GENERATOR SYSTEMS

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 a packaged diesel engine generator system including engine generator set, cooling system, fuel system, combustion air intake and engine exhaust systems, starting system, and the following additional features:

1.03 DEFINITIONS

- A. Emergency or Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage.
- B. Operational Bandwidth: The total variation from the lowest to the highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- C. Power Output Rating: Gross electrical power output of generator set minus total power requirements of electric motor-driven accessories normally constituting part of the engine assembly.
- D. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in volts.

1.04 SYSTEM DESCRIPTION

- A. System Includes: Standby-rated, automatically started diesel engine coupled to an a.c. generator unit. Engine and generator are factory-mounted and -aligned on a structural steel skid in a weatherproof, sound attenuated enclosure. Subsystems and auxiliary components and equipment are as indicated.
- B. Functional Description: When the mode selector switch on the control and monitoring panel is in the "automatic" position, remote control contacts in one or more separate automatic transfer switches initiate the starting and stopping of the generator set. When the mode selector switch is placed in the "on" position, the generator set starts manually. The "off" position of the same switch initiates shutdown of the generator set. When the unit is running,

specified system or equipment failures or derangements automatically shut the unit down and initiate alarms. Operation of a remote emergency stop switch also shuts down the unit. Automatic transfer switches are specified in another Section of these Specifications.

1.05 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for products specified in this Section. Include data on features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components.
- C. Maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in Division 1. Include the following:
 - 0. Lists: Tools, test equipment, spare parts, and replacement items recommended to be stored at the site for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - 1. Detailed Operating Instructions: Cover operation under both normal and abnormal conditions.
- D. Shop Drawings: Detail fabrication, piping, wiring, and installation of the field-installed portions of the system. Include general arrangement drawings showing locations of auxiliary components in relation to the engine generator set and duct, piping, and wiring connections between the generator set and the auxiliary equipment. Show connections, mounting, and support provisions and access and working space requirements.
- E. Wiring Diagrams for System: Show power and control connections and distinguish between factory-installed and field-installed wiring.
- F. Qualification Data for Manufacturer: Include capabilities and experience data required to demonstrate qualifications specified in Quality Assurance Article. Include list of completed projects with project names and addresses and names of Engineers and Owners, plus other information specified. Include separate data for each of the following items:
 - 1. Engine Generator System.
 - 2. Engine Generator Weatherproof, Sound Attenuated Enclosure.
 - 3. Remote Radiator.
 - 4. Load Banks.
- G. Certified Summary of Prototype Unit Test Report: Submit certified copies of actual prototype unit test report if subsequently requested.
- H. Certified Test Reports of Components and Accessories: Submit for devices that are equivalent, but not identical, to those tested on prototype unit.
- I. Exhaust Emissions Test Report.

- J. Certification of Torsional Vibration Compatibility: Conform to NFPA 110.
- K. Factory Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements. Certified test report shall verify that unit has been load tested at 100% load, 0.8 power factor.
- L. Field Test Report: Record of tests specified in Part 3.
- M. Submit generator sizing calculations for review.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance.
 - 1. Emergency Service: System manufacturer maintains a service center capable of providing training, parts, and emergency maintenance and repairs at the Project site with 4 hours maximum response time.
- B. Comply with NFPA 70, "National Electrical Code."
- C. Comply with NFPA 110, "Standard for Emergency and Standby Power Systems," for requirements for a Level 1 emergency power supply system.
- D. NRTL Listing: System components of types and ratings for which NRTL listing or labeling service is established and components are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Engine Exhaust Emissions: Comply with applicable Federal, State, and local government requirements.
- F. Single-Source Responsibility: Obtain engine generator system components from a single manufacturer with responsibility for entire system. Unit shall be a representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

1.08 EXTRA MATERIALS

- A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.
 - 1. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.
 - 2. Pilot Lights: 2 for every 6 of each type used, but not less than 2 of each.
 - 3. Filters: 1 set each of lubricating oil, fuel, and combustion air filters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Engine Generator Sets:
 - a. Caterpillar, Inc.
 - b. Cummins
 - 2. Storage Batteries:
 - a. Caterpillar, Inc.
 - b. Exide Corp.
 - c. NIFE, Inc., NIFE, AB
 - d. SAFT America, Inc., Advanced Battery Systems Div.
 - e. Yuasa Battery (American), Inc.
 - 3. Battery Chargers:
 - a. LaMarche Mfg. Co.
 - b. Sens

2.02 SYSTEM SERVICE CONDITIONS

- A. Environmental Conditions: Engine generator system withstands the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 deg C to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet (300 m).

2.03 ENGINE GENERATOR SYSTEM

- A. General: System is a coordinated assembly of compatible components.
- B. Ratings: Voltage, frequency, and power output ratings of the system are as indicated.
- C. Output Connections: 3-phase, 4-wire.

- D. Safety Standard: Comply with ASME B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."
- E. Nameplates: Each major system component is equipped with a conspicuous nameplate of the component manufacturer. Nameplate identifies manufacturer of origin and address, and the model and serial number of the item.
- F. Limiting dimensions indicated for system components are not exceeded.
- G. Generator subtransient reactance X''_d shall not exceed .14 per unit at 100% of standby rating.
- H. SKVA for 30% voltage dip shall not be less than 5,174 skva.

2.04 SYSTEM PERFORMANCE

- A. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
- B. Steady-State Voltage Modulation: +/- .5 Hz.
- C. Transient Voltage Performance: Not more than 10 percent variation for a rated load increase or decrease. Voltage recovers to remain within the steady-state operating band within 5 seconds, less than 2 seconds with a 300 kW step-load increase. These values shall be measured using the actual diesel generator set, not prototype tests of the alternator driven by a synchronous driver.
- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When the system is operating at any constant load within the rated load, there are no random speed variations outside the steady-state operational band and no regular or cyclical hunting or surging of speed.
- F. Transient Frequency Performance: Less than 6 Hz variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state-operating band within 5 seconds.
- G. Output Waveform: At no load, the harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor determined according to NEMA MG1, "Motors and Generators," does not exceed 50.
- H. Sustained Short-Circuit Current: For a 3-phase bolted short circuit at the system output terminals, the system will supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.

- I. Temperature Rise of Generator: 130 degree temperature rise.
- J. Nonlinear Load Performance: System performance is not degraded from that specified in this Article by continuous operation, with the load current having a minimum total harmonic content of 15 percent rms, and minimum single harmonic content of 10 percent rms.
- K. Starting Time: Maximum total time period for a cold start, with ambient temperature at the low end of the specified range, is 8-10 seconds. Time period includes output voltage and frequency settlement within specified steady-state bands.

2.05 ENGINE GENERATOR SET

- A. Power Output Rating: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
- B. Skid: Adequate strength and rigidity to maintain alignment of the mounted components without dependence on a concrete foundation. Skid is free from sharp edges and corners. Lifting attachments are arranged to facilitate lifting with slings without damaging any components.
- C. Rigging Diagram: Inscribed on a metal plate permanently attached to the skid. Diagram indicates location and lifting capacity of each lifting attachment and location of the center of gravity.

2.06 ENGINE

- A. Comply with NFPA 37, "Stationary Combustion Engines and Gas Turbines."
- B. Fuel: Diesel fuel oil grade DF-2.
- C. Maximum Speeds: Engine - 1800 rpm. Piston speed for 4-cycle engines - 2250 feet per minute. Two-cycle engines will not be permitted.
- D. Lubrication System: Pressurized by a positive displacement pump driven from the engine crankshaft. The following items are mounted on the engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 microns and smaller while passing full flow.
 - 2. Oil Cooler: Maintains lubricating oil at the manufacturer's recommended optimum temperature throughout 2 hours of operation of the generator set at 110 percent of system power output rating.
 - 3. Thermostatic Control Valve: Controls flow in the system to maintain optimum oil temperature. Unit is capable of full flow and is designed to be fail-safe.
 - 4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without the use of pumps or siphons or special tools or appliances.

- E. Engine Fuel System: Comply with NFPA 30, "Flammable and Combustible Liquids." System includes:
 - 1. Integral Injection Pumps: Driven by the engine camshaft. Pumps are adjustable for timing and cylinder pressure balancing.
 - 2. Main Fuel Pump: Mounted on the engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 3. Parallel Fuel Oil Filters: Ahead of the injection pumps. Changeover valves are located on water separator.
 - 4. Relief/Bypass Valve: Automatically regulates pressure in the fuel line and returns excess fuel to the source.

- F. Jacket Coolant Heater: Electric 6 kw heaters, factory-installed in the jacket coolant system. Unit is rated and thermostatically controlled to maintain an engine temperature of 25 deg C at the low end of the ambient temperature range specified under "Environmental Conditions" above. Heaters shall operate on 208 or 240 VAC single-phase power.

- G. Speed Governor: Adjustable isochronous type, with speed sensing.

2.07 ENGINE COOLING SYSTEM

- A. Description: Closed-loop, liquid-cooled, with radiator factory-mounted on engine generator set skid and integral engine-driven coolant pumping.

- B. Radiator: Factory-piped and -rated for specified coolant.

- C. Coolant: Solution of 30 percent ethylene glycol and 70 percent water.

- D. Expansion Tank: Constructed of welded steel plate and equipped with gage glass and petcock. Capacity is as indicated. Low coolant level alarm switch shall be installed and shut down the generator set if activated.

- E. Temperature Control: Self-contained thermostatic control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by the engine manufacturer. Features include:
 - 1. Thermostatic Elements: Interchangeable and nonadjustable.
 - 2. Actuator Design: Normally-open valves to return to open position when actuator fails.

- F. Coolant Hose: Flexible assembly with nonporous rubber inside surface and aging, ultraviolet, and abrasion-resistant fabric outer covering.
 - 1. Rating: 50 psi (345 kPa) maximum working pressure with 180°F (82°C) coolant, and non-collapsible under vacuum.
 - 2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.08 FUEL SUPPLY SYSTEM

- A. System complies with NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 37, "Standard for Stationary Combustion Engines and Gas Turbines."
 - 1. Furnish solenoid valve and unions for fuel supply line.

2.09 ENGINE EXHAUST SYSTEM

- A. Muffler: Critical grade type, sized as recommended by the engine manufacturer. Measured sound level, according to the "DEMA Test Code for the Measurement of Sound from Heavy-Duty Reciprocating Engines" at a distance of 10 feet from the exhaust discharge, is 85 dB "A" or less.
- B. Connections from Engine to Exhaust System: Flexible fitting of corrugated stainless steel pipe for vibration isolation. No other flexible piping allowed.
- C. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liners.
- D. Supports for Muffler and Exhaust Piping: Vibration isolating-type specified in Division 15 Section "Vibration Control."

2.10 STARTING SYSTEM

- A. Description: 24 V electric with negative ground and including the following items:
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with the ambient temperature at the maximum specified in paragraph "Environmental Conditions."
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from the engine flywheel without binding.
 - 3. Cranking Cycle: Programmable.
 - 4. Battery complies with SAE J537, "Storage Batteries," and has adequate capacity within the ambient temperature range specified in paragraph "Environmental Conditions" to provide the specified cranking cycle series at least twice without recharging.
 - 5. Battery Cable: Size as recommended by the generator set manufacturer for the cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Rack: Factory-fabricated of metal with acid-resistant finish and wood tray, floor standing.
 - 7. Battery Charger: Current limiting, automatic equalizing and float charging-type designed for operation from a 120 V 60 Hz supply source. Unit complies with UL 508, "Electrical Industrial Control Equipment," and includes the following features:
 - a. Operation: Equalizing charging rate of 10 amperes is initiated automatically after the battery has lost charge until an adjustable equalizing voltage is achieved at the battery terminals. The unit then automatically switches to a lower float-charging mode, and continues operating in that mode until the battery is discharged again.

- b. Automatic Temperature Compensation: Adjusts the float and equalizes voltages for variations in the ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters indicate charging rates.
- e. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing "low battery voltage" indication on control and monitoring panel. Also include sensing of high battery voltage and loss of a.c. input or d.c. output of battery charger. Either of these conditions closes contacts that provide "battery charger malfunction" indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA Class 1 wall-mounted cabinet.
- g. Fused input and output.

2.11 CONTROL AND MONITORING

- A. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages are mounted in the generator set enclosure. Mounting method isolates the control panel from generator set vibration.
 - 1. Generator Circuit Breaker: Low-voltage, insulated case-type, conforming to Division 16 Section "Overcurrent Protective Devices" mounted in generator enclosure.
 - 2. Shunt Trip Device: For generator breaker, connected to trip breaker when generator set is shut down by protective devices. 24VDC shall be supplied to shunt trip operator from engine batteries.
 - 3. Current and Potential Transformers: Instrument accuracy class.
 - 4. Ground fault relay with Type "C" dry contacts.
- B. Indicating and Protective Devices, and Controls: Include the following:
 - 1. A.C. Voltmeter.
 - 2. A.C. Ammeter.
 - 3. A.C. Frequency Meter.
 - 4. D.C. Voltmeter.
 - 5. Engine Coolant Temperature Gage.
 - 6. Engine-Lubricating Oil Pressure Gage.
 - 7. Running Time Meter.
 - 8. Ammeter/Voltmeter Phase Selector Switch or Switches.
 - 9. Generator Voltage-Adjusting Rheostat.
 - 10. Start-Stop Switch.
 - 11. Overspeed Shutdown Device.
 - 12. High Coolant-Temperature Shutdown Device.
 - 13. Low Coolant-Level Shutdown Device.
 - 14. Low Oil Pressure Shutdown Device.
 - 15. Fuel Tank Derangement Alarm.
 - 16. High Fuel Tank Level-Shutdown of Fuel Supply Alarm.
 - 17. Generator speed adjust potentiometer.

18. Approaching low oil pressure pre-alarm.
19. Approaching high coolant temperature pre-alarm.
20. Low battery voltage alarm.
21. Battery charger malfunction alarm.
22. Low fuel main tank.
23. Low fuel day tank.
24. High fuel day tank.

- C. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.
- D. Provide Modbus Ethernet communication port capable of providing operational run data and statistics back to SCADA.
- E. Remote Emergency Stop Switch: Flush wall-mounted except as otherwise indicated and prominently labeled. Pushbutton is protected from accidental operation. House in NEMA 3R enclosure.

2.12 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Alternator shall be 500 kw, 625 kva, 80 degree C temperature rise. Comply with NEMA MG 1, "Motors and Generators," and specified performance requirements.
- B. Drive: Generator is two bearing design connected to the engine shaft with flexible coupling. Exciter is rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator Windings: Form wound. Random wound is not acceptable. Include coastal insulation protection.
- E. Station Winding Leads: Brought out to terminal box.
- F. Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Excitation uses no-slip or collector rings, or brushes, and is arranged to sustain generator output under short circuit conditions as specified.
- H. Enclosure: Walk-in type of aluminum construction with a load center and step down transformer, complete with AC and DC lighting.

- I. Instrument Transformers: Mounted within generator enclosure.
- J. Voltage Regulator: Solid-state-type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel provides plus or minus 5 percent adjustment of output voltage operating band.
 - 2. Powered by permanent magnet exciter.
- K. Governor: Provide isochronous governor compatible with closed transition transfer switch requirements.
- L. Surge Protection: Conform to UL 1449, "Transient Voltage Surge Suppressors." Mount suppressors in generator enclosure and connect to load terminals.
- M. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above the dew point. Operate on 120 VAC single-phase power.
- N. Generator temperature rise 80 degree C, double oversized generator with starting capabilities of 5,164 skva at 30% voltage dip for plant motor loads.

2.133 ENCLOSURE

- A. One aluminum insulated weatherproof, walk-in style enclosure shall be provided to weatherproof a generator set complete in every detail and require no additional in field modification or assembly. The enclosure is to be accurately dimensioned so as to be in compliance with the National Electrical Code (NEC), and the National Fire Protection Association (NFPA) for clearance of all applicable fire codes for a structure and application of this type as assembled by Phoenix Products.
- B. Construction:
 - 1. The enclosure shall consist of a roof, two sidewalls and two end walls of pre-painted, aluminum, stressed skin, semi-monocoque construction. The roof shall be a one piece cambered sheet of .125 inch thick aluminum with 3/16 inch thick extruded aluminum recessed side and end rails with cast aluminum recessed side and end rails with cast aluminum corners. The entire assembly shall be suitable to withstand 140 MPH winds with a 1.3 gust factor or as directed by local codes.
 - 2. Enclosure dimensions shall be 184 inches long x 112 inches wide x 96 inches height, with end of the unit as walking clearance for maintenance and operating personnel.
 - 3. All doors on the enclosure shall be strategically located in areas as to allow ease of maintenance on the generator set and allow good access to and visibility of instruments, controls, engine gauges, etc. The doorframes shall be aluminum consisting of forged aluminum bolted to the side panels. Forged aluminum hinges with stainless steel pins and nylon bushings shall also be provided. Personnel doors shall be manufactured from

aluminum and be fully gasketed to form a weather-tight perimeter seal. A three-point latching assembly with interior latch release and exterior padlocking provisions shall also be provided on these doors.

4. Intake shall have sufficient free area to allow for 120 percent of the total engine/generator cooling air requirements used in this application. Intake shall be of all aluminum construction and shall be provided with bird screens. The radiator end of the enclosure shall be fitted air deflector plates, stainless steel exhaust deflectors and discharge plenum.
5. The manufacturer of the enclosure shall provide mounting brackets for the exhaust silencer(s) specified. In addition, a tail pipe extension(s) and rain cap to prevent the entrance of rainwater shall also be provided. Further, a stainless steel, seamless bellows, flexible exhaust tube(s) and all necessary bolts, flanges, and gaskets to mate with the engine and exhaust silencer(s) shall be provided.
6. Upon final assembly of the enclosure, it shall be prime painted with a minimum of two coats of aluminum primer. The final finish painting shall be a minimum of two coats of paint (color to be specified by the Owner).
7. All wiring within the enclosure shall be installed in EMT raceways. All connections to the generator set shall be flexible.
8. A battery operated light deriving its power from the engine cranking batteries shall be installed in a strategic location within the enclosure and shall be controlled by a switch located by one of the entrance doors. The lights shall be large enough to provide illumination in an emergency situation, yet not such that an overburdening drain will be placed on the starting batteries. The switch controlling this light shall be a wind-up timer type which automatically shuts off after a preset interval not to exceed one hour.
9. Six (6), forty-eight inch, dual-tube LED vaportight lights shall be installed within the enclosure and strategically located on either side of the generator set. They shall be ceiling mounted and parallel to the length of the unit. Their AC power source shall be taken from the commercial power supply at the job site and wired-in by way of the 120/208-volt, 3 phase, 4 wire load center located within the enclosure. The light switch box, located by one of the entrance doors, shall have its own-grounded duplex receptacle mounted therein for use by maintenance personnel.
10. The enclosure shall be equipped with a 10 kVA 480-120-208 volt, 3-phase, 4 wire load center as a single entry point for commercial power supply conduits and wiring by the installing contractor for the battery charger, jacket water heater(s), 4 feet LED lighting, receptacles, etc., as specified and as shown on the drawings. The load center shall be mounted within the enclosure and allow for site condition conduit entry from below. The placement of this load center shall be shown on the submittal drawings. All internal wiring and conduit runs to the various ancillary equipment supplied with the package shall be pre-wired at the factory in accordance with all governing codes pursuant to this

application. The load center shall be considered as part of the emergency load and shall derive its power source downstream from the load transfer switch specified elsewhere.

C. Enclosure design shall be sign and sealed by a Florida registered structural engineer.

2.144 FINISHES

A. Indoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

B. Outdoor Enclosures: Pre-painted aluminum.

2.155 SOURCE QUALITY CONTROL

A. Factory Tests: Include prototype testing and Project-specific equipment tests (equipment manufactured specifically for this Project).

B. Prototype Testing: Performed on a separate engine generator set using the same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Conform to those required for Level 1 energy converters in paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110.
2. Exhaust Emission Test: Conform to applicable government test criteria.
3. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype have been acceptably tested to demonstrate compatibility and reliability.

C. Project-Specific Equipment Tests: Test engine generator set and other system components and accessories prior to shipment. Test items individually and assembled and connected as a complete system at the factory in a manner equivalent to that required at the Project site. Record and report test data. Conform to SAE 8528, "Engine Power Test Code-Spark Ignition and Diesel," and the following:

1. Test Equipment: Use instruments calibrated within the previous 12 months and with accuracy directly traceable to the National Institute of Standards and Technology (NIST).
2. Hydrostatic Test: Perform on radiator and engine water jacket.
3. Generator Tests: Conform to IEEE 115, "Test Procedures for Synchronous Machines."
4. Complete System Performance Tests: Include the following to demonstrate conformance to specified performance requirements:
 - a. Load Test: Use variable load bank capable of simulating kVA, kW, and power factor of load for which unit is rated. Run unit at 100 percent for at least 1 hour. Make the 100 percent load run at 80 percent power factor. Record voltage, frequency, load current, battery-charging current, power output, oil pressure, and coolant temperature periodically during the test.
5. Report test results within 10 days of completion of test.

2.16 FUEL PIPING

A. Fuel Piping and Fittings:

1. Black iron pipe and fittings shall be used for all fuel piping. The fittings shall be black pattern malleable iron threaded and shall conform to ANSI B-16.3 standard weight and NFPA-30 and 37.
2. All pipe shall be above grade painted red.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Anchor generator set and other system components on concrete bases conforming to Division 3 Section "Cast-In-Place Concrete" and as indicated. Provide anchorage according to manufacturer's recommendations.
- B. Field Installation of Piping and Ductwork: As specified in Division 15 Sections "Basic Mechanical Materials and Methods" and "Hydronic Piping."
- C. Maintain minimum working space around components according to manufacturer's shop drawings and NEC.
- D. Manufacturer's Field Services: Arrange and pay for the services of a factory-authorized service representative to supervise the installing, connecting, testing, and adjusting of the unit.

3.02 IDENTIFICATION

- A. Identify system components according to Division 15 Section "Mechanical Identification" and Division 16 Section "Electrical Identification."

3.03 FIELD QUALITY CONTROL

- A. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to Specifications. Load system using a resistive load bank simulating kW of loads for which unit is rated.
- B. Tests: Use instruments bearing records of calibration within the last 12 months, traceable to NIST standards, and adequate for making positive observation of test results. Include the following tests:

1. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.
2. Battery Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
3. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
4. Simulation of malfunctions to verify proper operation of local and remote protective, alarm, and monitoring devices.
5. Load Test: Use variable load bank capable of simulating kW of load for which unit is rated. Run unit at 25, 50, and 75 percent of rated capacity for 30 minutes each, and at 100 percent for 3 hours. Record voltage, frequency, load current, battery-charging current, power output, oil pressure, and coolant temperature every 15 minutes.
6. Exhaust System Back-Pressure Test: Use a manometer with a scale exceeding 40 inches of water. Connect to the exhaust line close to the engine exhaust manifold. Verify that backpressure at full-rated load is within manufacturer's published allowable limits for the engine.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50-percent and 100-percent step-load increases and decreases and verify that performance is as specified.
8. Harmonic Content Tests: Measure harmonic content of input and output current under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

C. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.04 CLEANING

- A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.05 DEMONSTRATION

- A. Training: Arrange and pay for the services of a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of the system and to train Owner's personnel.
- B. Conduct a minimum of 8 hours of training as specified under Instructions to Owner's Employees in the Project Closeout Section of these Specifications.

C. Schedule training with at least 7-day advance notice.

3.06 COMMISSIONING

- A. Battery Equalization: Equalize charging of battery cells according to manufacturer's instructions. Record individual cell voltages. Provide all fuel for testing.
- B. Furnish five copies of operation and maintenance manuals specific to this installation on Compact Disc.

END OF SECTION

SECTION 16670

LIGHTNING PROTECTION SYSTEMS

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.
- B. Structures to include protection as follows:
 - 1. Light poles at Western Entrance
 - 2. Guard House at Western
 - 3. Oak Meadows Generator Enclosure

1.02 SUMMARY

- A. This Section includes lightning protection systems for guard house building and generator structures and includes requirements for lightning protection systems components.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Raceway, Boxes & Cabinets" for raceways enclosing lightning protection system conductors.
 - 2. Division 16 Section "Transient Voltage Surge Suppressors" for supplemental surge protection of electrical service.

1.03 SYSTEM DESCRIPTION

- A. Protect entire building, including roof projections, and roof-mounted equipment.
 - 1. Building Construction: Metal-framed building less than 75 feet (23 m) in height with single-ply membrane roof.
 - 2. Building Occupancy: Commercial.

1.04 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each component. Include data for roof adhesive when used. Submit accurate pictorial views of decorative air terminal components.
- C. Shop drawings detailing lightning protection system including, but not limited to, air terminal locations, conductor routing, and connections and grounding.

D. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

E. Field inspection reports indicating compliance with specified requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer to install lightning protection system.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled by an organization concerned with product evaluations, and that can determine compliance with appropriate standards for the current production of listed items.

1. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Conform to NFPA 780 and contract drawings.

D. Conform to the most stringent requirements when more than 1 standard is specified for products or installation.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate installation of lightning protection system with the installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection systems, and building finishes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide lightning protection components by of one of the following:

1. East Coast Lightning Equipment.
2. Harger Lightning Protection, Inc.
3. Heary Bros. Lightning Protection.
4. Robbins Lightning, Inc.
5. Thompson Lightning Protection Co.

2.02 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Lightning Protection System Products: Manufactured to LPI-176 and UL 96.

B. System Materials: Copper, with solid air terminals.

- C. System Materials: Aluminum, with solid air terminals (on ground storage tanks with cascade aeration due to hydrogen sulfide.)
- D. Air Terminals for Single-Ply Roof Mounting: Units with bases especially designed for single-ply roof materials.
- E. Ground Rods: Copper clad steel with a minimum of 27 percent of the rod weight in the copper cladding.
 - 1. Diameter: 3/4 inch (16 mm).
 - 2. Length: 20 feet (3 m).

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting performance of the lightning protection system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install lightning protection systems as indicated, according to manufacturer's written instructions.
- B. Install components according to LPI-175, UL 96A, and NFPA 780.
- C. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops. Where indicated, run conductors in nonmetallic raceway, Schedule 40, minimum.
- D. Conceal all down conductors.
- E. Conceal conductors from normal view from exterior. No exceptions.
- F. Notify Architect at least 24 hours before concealing lightning protection system components.
- G. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
- H. Air Terminals on Single-Ply Roofing: Use adhesive recommended by manufacturer of air terminals and approved by manufacturer of roofing material. Comply with adhesive manufacturer's installation instructions.
- I. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to the lightning protection system.

- J. Bond ground terminals with counterpoise conductor located below grade.
- K. Bond grounded media on building within 12 feet (4 m) of ground with counterpoise conductor located as indicated.
- L. Bond grounded media on building within 12 feet (4 m) of roof with counterpoise conductor.
- M. Bond grounded media on building within 12 feet (4 m) of roof with interconnecting loop at eave level or above.
- N. Bond lightning protection system to grounded media on building at every 60 feet (18 m) with intermediate-level interconnection loop conductors.

3.03 CORROSION PROTECTION

- A. Use no combination of materials to form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.
- B. Use conductors with suitable protective coatings where conditions would cause deterioration or corrosion of conductors.

3.04 FIELD QUALITY CONTROL

- A. Periodic Inspection: Provide the services of a qualified inspector to perform periodic inspection according to LPI-177.

END OF SECTION

APPENDIX A

ORANGE COUNTY UTILITIES Standards and Construction Specification Manual LIST OF APPROVED PRODUCTS

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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	Blue 36" Tall	AVG2036 Encl	Pantone 36" Tall	AVG2036 Encl	Green 36" Tall
			GP3232 Base		GP3232 Base		GP3232 Base	
			AVG2041 Encl	Blue 41" Tall	AVG2041 Encl	Pantone 41" Tall	AVG2041 Encl	Green 41" Tall
		GP3232 Base		GP3232 Base		GP3232 Base		
	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	

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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			4.0 - 10.0 mils	Hi-Build Epoxoline II	4.0 - 10.0 mils	Hi-Build Epoxoline II	4.0 - 10.0 mils	
Series N69			Series N69		Series N69			
PPG / Ameron	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils		
	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		

APPENDIX D

LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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 Meter	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	
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	

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LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	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
				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		

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Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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	
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	

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Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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
	Services	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
Services	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

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Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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
Line Stops	Line Stops							
	JCM							
	Romac							
	Smith Blair							
Tapping Sleeves and Valves	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	

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Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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	
	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		Reclaimed Water		Wastewater			
			Model #	Comments	Model #	Comments	Model #	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 minimum 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 (H2O 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	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	Blue Water Locking Lid	MVB050CR thru MVB130CR with Extension Stem	Purple Square Locking Reclaim Lid	MVB050C thru MVB130C with Extension Stem	Green Sewer locking Lid
				MVB875 Guide Plate		MVB875 Guide Plate		MVB875 Guide Plate		

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LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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		

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Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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	

APPENDIX D

LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	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		
	Joining Material	Joining 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		

APPENDIX D

LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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		
		Bioem	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 shall have Diaphragm Seals. Oil filled.						
Ashcroft		NA	NA	NA	NA	10 1008SL 02L 60# Gauge Diaphragm Seal		
						25 200SS 02T XYTSE		
Terice		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	Submersible Pumps							
	ABS	NA	NA	NA	NA			
	Flygt	NA	NA	NA	NA			

APPENDIX D

LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Pumps	Floats	Float Regulator (FR) - Duplex and Triplex Pump Stations						
		Atlantic Scientific	NA	NA	NA	NA	Roto-Float	
Pumps	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 Disconnect	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 IEEE C62, 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	
		Joslyn 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	

APPENDIX D

LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	Comments	
Pump Station Control Panel	AL	Alarm Light / With Base and Globe (AL)							
	American Electric	NA	NA	NA	NA	F32552			
	Red Dot Globe	NA	NA	NA	NA	VGLR-01			
	Red Dot Base					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				

APPENDIX D

LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	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		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Pump Station Control Pane	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 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	Variable Frequency Drives							
	Square D	NA	NA	NA	NA			

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APPENDIX B

ORANGE COUNTY UTILITIES

GENERAL ACCESS AND SECURITY GUIDELINES WATER SUPPLY FACILITIES

GENERAL ACCESS AND SECURITY GUIDELINES WATER SUPPLY FACILITIES

1. SECURITY:

- A. The Contractor agrees to adhere to all established security, safety and Emergency Action Plans and policies as required by the Owner.
- B. Prior to work at any water facility, the Contractor shall perform a Level 1 criminal background checks on all personnel who will be working on the project. The level of background check shall be in accordance with County standards. The results of these background checks shall be supplied to the County project manager prior to the start of work,
- C. For security reasons, the Contractor must provide the names of it's employees who will be on the site during the normal work day and for all after hours work to the Owner or access will be denied. Once these names and the appropriate background check information has been received the Owner will create an approved list of contractor's personnel.
- D. Access to the facility will be granted by calling the main SCADA control desk at 407-254-9509 who will open the facility gate provided the contractor's personnel are on the approved list.
- E. The Owner will designate locations for the Contractor to have an equipment lay down area, construction site office trailer and an employee parking area.
- F. The Contractor's employee's private vehicles shall be parked in the designated parking area only. Private vehicles parked on the job site other than the designated area will subject to be towed at the vehicles owner's expense.

2. IDENTIFICATION BADGES:

The Contractor will be responsible to:

- A. Supply the Owner with names of all employees including and sub-contractor's employees working on the job site.
- B. Ensure that all employees have current photo identification to gain access to the site.
- C. The ID list is to be updated any time a change is made by the Contractor or Sub-contractors.

3. FACILITY ACCESS:

Contractor and Sub-Contractor employees:

- A. All employees of the Contractor and Sub-Contractor's must call the SCADA desk for entry to the plant for approved work. SCADA will control access to the gate and open the gate to appropriately credentialed contractors. All persons are required to show a current picture ID such as a driver's license. The county inspector should also be on the

site to oversee the work. The gate is to be closed at all times except when taking deliveries or at the start or end of the work day.

Visitors, Vendors and Deliveries:

- A. All vendors and deliveries must call the SCADA desk for entry to the plant for approved work. SCADA will control access to the gate and open the gate to appropriately credentialed vendors and Contractor deliveries. The Contractor's staff shall be available to accept the delivery and ensure it is properly stowed in the area designated by the owner's on-site inspector.
- B. The Contractor will notify SCADA and provide the name and company name of Vendors or Contractor representatives that are not listed on the Access listing and when they have a scheduled visitor.
- C. Prior to facility access, SCADA will contact the Contractor to verify a visitor.
- D. Visitors, vendors or deliveries that can not be identified and approved for entry, even persons with a Contractor I.D that is not on the ID list, will not be allowed access to the facility.
- E. The Owner's employees will not accept deliveries designated for the Contractor. Contractor will be required to establish a separate project address for deliveries to the site. The Owner will not be responsible for lost or misplaced deliveries.

4. EMERGENCY ACTION PLAN:

- A. The Owner has a well-defined and approved Emergency Action Plan for each Facility. The Plan covers known emergencies that may occur on the facility. Including the most hazardous, a chlorine leak or chemical spill. The Owner will provide to the Contractor the most updated Emergency Action Plan.
- B. The Owner shall provide to the Contractor and the Contractor's initial employees, a training session for the Emergency Action Plan. The Facility's Safety Officer or the Division Safety Section staff will conduct this training. All Employees given this training will be required to sign the training class roster.
- C. After the initial training, the Contractor must provide new employee assigned to the Project this training and provide to the Owner training document for every employee trained by the Contractor.

This document may be revised to ensure that the Project progresses, to monitor and maintain communications, safety and security per the Contract, Local, State and Federal laws and ordinances.

**SECTION 01001
GENERAL WORK REQUIREMENTS**

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SECTION 01001
GENERAL WORK REQUIREMENTS

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SECTION 01001
GENERAL WORK REQUIREMENTS

PART 1 - GENERAL

1.01 NOTICE AND SERVICE

- A. In conformance with the requirements of Notice and Service of the General Conditions, all notices or other papers required to be delivered by the Contractor to the County shall be delivered to the office of the Engineering Division, Orange County Utilities Department, 9150 Curry Ford Road, Orlando, FL 32825.

1.02 WORK TO BE DONE

- A. The Contractor shall furnish all labor, materials, equipment, tools, services, and incidentals to complete all work required by these specifications and as shown on the Drawings, at a rate of progress that will ensure completion of the Work within the Contract Time stipulated.
- B. All materials, equipment, skills, tools, and labor that are 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 Specifications or Drawings shall be furnished and installed by the Contractor without additional compensation, whether specifically indicated in the Contract Documents or not.
- C. The Contractor shall perform the Work complete, in place, and ready for continuous service, and shall include repairs, testing, permits, clean up, replacements, and restoration required as a result of damages caused during this construction.
- D. The Contractor shall comply with all City, County, State, Federal, and other codes that are applicable to the proposed construction Work.
- E. All newly constructed Work shall be carefully protected from injury in any way. No wheeling, walking, or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his or her own expense.
- F. Scope of Work: See Section 01010 "Summary of Work" and the Bid Schedule for details.

1.03 DRAWINGS AND PROJECT MANUAL

- A. The Work shall be performed in accordance with the Drawings and Specifications prepared by the County/Professional. All work and materials shall conform to the Orange County Utilities Standards and Construction Specifications Manual, latest edition or as indicated in these Specifications or Drawings.
- B. The Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, Schedules, Specifications, or other data received from the County/Professional, and shall notify same, in writing, 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 or her own expense.

C. All schedules are given for the convenience of the County 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 quantity of materials and equipment included in the Work to be done under this Contract.

D. 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 either in 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. Items of material, equipment, machinery, and the like may be specified on the Drawings and not in the Specifications. Such items shall be provided by the Contractor in accordance with the specification on the Drawings.
3. 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.

E. When obtaining data and information from the Drawings, conflicts, errors, and discrepancies shall be resolved from the documents given the following order of precedence:

1. Agreement
2. Change Orders
3. Addenda
4. Supplementary Conditions
5. Instructions to Bidders
6. General Conditions
7. Specifications (Divisions. 1 through 16)
8. Drawings
9. Dimensions: when measurements are affected by conditions already established or where items are to be fitted into constructed conditions, it shall be the Contractor's responsibility to verify all such dimensions at the site and the actual job dimensions shall take precedence over scale and figure dimensions on the Drawings.
10. Full-size Drawing
11. Large-scale Drawing
12. Small-scale Drawing
13. Advertisement for Bids
14. Bid
15. Bonds
16. Insurance Certificates
17. Insurance Endorsements

18. Affidavits

1.04 PROTECTION AND RESTORATION

- A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every means of protection 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 or her expense, to a condition similar or equal to that existing before the damage was done, or s/he shall make good the damage in other manner acceptable to the County/Professional.
- B. Protection of Trees and Shrubs:
 - 1. Protect with boxes or other barricades.
 - 2. Do not place excavated material so as to injure trees or shrubs.
 - 3. Install pipelines in short tunnels between and under root systems.
 - 4. Support trees to prevent root disturbance during nearby excavation.
- C. Tree and Limb Removal:
 - 1. Tree limbs, which interfere with equipment operation and are approved for pruning, shall be neatly trimmed and the tree cut coated with tree paint.
 - 2. The County may order the Contractor, for the convenience of the County, to remove trees along the line or trench excavation. The Contractor shall obtain any permits required for removal of trees. Ordered tree removal shall be paid for under the appropriate Contract Items.
- D. Trees or shrubs destroyed by negligence of the Contractor or Contractor's employees shall be replaced by the Contractor with new stock of similar size and age, at the proper season and at his or her sole expense.
- E. Lawn Areas: All lawn areas disturbed by construction shall be replaced with like kind to a condition similar or equal to that existing before construction. Where sod is to be removed, it shall be carefully removed, and the same re-sodded, or the area where sod has been removed shall be restored with new sod in the manner described in the applicable section.
- F. Fences: 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.
- G. Where fencing, walls, shrubbery, grass strips or area must be removed or destroyed incident to the construction operation, the Contractor shall, after completion of the Work, replace or restore to the original condition all such destroyed or damaged landscaping and improvements.
- H. The cost of all labor, materials, equipment, and work for restoration 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.

1.05 PUBLIC NUISANCE

- A. The Contractor shall not create a public nuisance including, but not limited to, encroachment on adjacent lands, flooding of adjacent lands, or excessive noise.
- B. Sound levels measured by the County/Professional shall not exceed 45 dBA from 8 p.m. to 8 a.m. or 55 dBA 8 a.m. to 8 p.m. This sound level shall be measured at the exterior of the nearest exterior wall of the nearest residence. Levels at the 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 levels. Work stoppage by the County/Professional 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.
- C. No extra charge may be made for time lost due to work stoppage resulting from the creation of a public nuisance.

1.06 CONTRACTOR'S PAYMENTS TO COUNTY FOR OVERTIME WORK

- A. County Inspector Work Hours: Normal work hours for the County's inspector(s) are defined as any 10-hour period between the hours of 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday. Any County Inspector(s) work beyond the aforementioned normal work hours shall be requested in writing 48-hours in advance. All overtime and weekend work compensation to the County's Inspector(s) for working beyond the normal working hours are considered overtime compensation and shall be paid for by the Contractor at the overtime pay rate of \$50.00 per hour. This overtime pay rate is subject to adjustment by the County. The Contractor agrees that the County shall deduct charges for work outside normal work hours and for overtime pay from payments due the Contractor.

1.07 LABOR

- A. Supervision: The Contractor shall keep the Contract under his or her own control and it shall be his or her responsibility to see that the Work is properly supervised and carried on faithfully and efficiently. The Contractor shall supervise the Work personally or shall have a competent, English-speaking superintendent or representative who shall be on the site of the Project at all working hours, and who shall have full authority by the Contractor to direct the performance of the Work and make arrangements for all necessary materials, equipment, and labor without delay.
- B. Jurisdictional Disputes: It shall be the responsibility of the Contractor to pay all costs that may be required to perform any of the Work shown on the Drawings or specified herein to avoid any work stoppages due to jurisdictional disputes. The basis for subletting work in question, if any, shall conform to precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, dated June, 1973, including any amendments thereto.
- C. Apprenticeship: The Contractor shall comply with all of the requirements of Section 446, Florida Statutes, for all contracts in excess of \$25,000 excluding roadway, highway or

bridge contracts and the Contractor agrees to insert in any subcontract under this Contract the requirements of this Article.

1.08 MATERIALS AND EQUIPMENT

A. Manufacturer:

1. All transactions with the manufacturers or Subcontractors shall be through the Contractor, unless the Contractor shall request and at the County/Professional's option, that the manufacturer or Subcontractor communicate directly with the County/Professional. Any such transactions shall not in any way release the Contractor from his or her full responsibility under this Contract.
2. All work and materials shall be of the highest quality. The equipment shall be the product of manufacturers who are experienced and skilled in the field with an established record of research and development. No equipment will be considered unless the manufacturer has designed and manufactured equipment of comparable type and size and have demonstrated sufficient experience in such design and manufacture.
3. All materials and equipment furnished by the Contractor shall be subject to the inspection, review and acceptance of the County and meet the requirements as outlined in the Orange County Utilities Standards and Construction Specifications Manual. No material shall be delivered to the Work without prior approval of the County/Professional.
4. All apparatus, mechanisms, equipment, machinery, and manufactured articles for incorporation into the Project shall be the new (most current production at time of bid) and unused standard products of recognized reputable manufacturers.
5. Manufactured and fabricated products:
 - a. Design, fabricate, and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges to be interchangeable.
 - c. 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.
 - d. Products shall be suitable for service conditions as specified and as stated by manufacturer.
 - e. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - f. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.09 MANUFACTURER'S SERVICE

- A. Where service by the manufacturer is specified to be furnished as part of the cost of the item of equipment, the Work shall be at the Contractor's expense.
- B. The services provided shall be by a qualified manufacturer's service representative to check and verify the completed installation, place the equipment in operation, and instruct the County's operators in the operation and maintenance procedures. Such

services are to be for period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the job and does not include travel time.

- C. The services shall further demonstrate to the County/Professional's complete satisfaction that the equipment will satisfactorily perform the functions for which it has been installed.

1.10 INSPECTION AND TESTING

A. General:

1. If, in the testing of any material or equipment, it is ascertained by the County/Professional that the material or equipment does not comply with the Contract, the Contractor shall be notified thereof, and s/he 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 County.
2. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEE, except as may otherwise be stated herein.

B. Cost:

1. County shall employ and pay for the 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. The cost of field leakage and pressure tests and shop tests of materials and equipment 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. Notify County employed laboratory a minimum of 48-hours, 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.
4. The Contractor shall pay for all work required to uncover, remove, replace, retest, etc.; any work not tested due to the Contractor's failure to provide the 48-hours advance notice or due to failed tests. The Contractor shall also provide compensation for the County/Professional's personnel for required re-testing due to failed or rescheduled testing.

C. Shop Testing:

1. Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function, or special requirements are specified shall be tested in the shop of the manufacturer in a manner that shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents. No such equipment shall be shipped to the worksite until the County/Professional notifies the Contractor, in writing, that the results of such tests are acceptable.
2. Five (5) copies of the manufacturer's actual shop test data and interpreted results thereof, accompanied by a certificate of authenticity notarized and signed by a responsible official of the manufacturing company, shall be furnished to the County/Professional as a prerequisite for the acceptance of any equipment. The cost of shop tests (excluding cost of County's representative) and of furnishing

manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor and shall be included in the Contract price.

3. The Contractor shall give notice in writing to the County sufficiently in advance of his or 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 County shall arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials; or s/he will notify the Contractor that the inspection will be made at a point other than the point of manufacture; or s/he will notify the Contractor that inspection will be waived.
4. When inspection is waived or when the County/Professional so requires, the Contractor shall furnish to him or her authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the Work have been manufactured and tested in conformity with the Contract Documents. These certificates shall be notarized and shall include five (5) copies of the results of physical tests and chemical analysis, where necessary, that have been made directly on the product or on similar products of the manufacturer.
5. The Contractor must comply with these provisions before shipping any material. Such inspections by the County shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Field Testing:

1. The County shall employ and pay for services of an independent testing laboratory to perform testing specifically indicated in the Contract Documents. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract. The Contractor shall provide compensation for retesting of all failed tests.
2. The County may at any time during the progress of the Work, request additional testing beyond that which is specified in the Contract. This testing will be at the County's expense. The Contractor shall assist the testing laboratory personnel in all ways so as to facilitate access to the location of the material or equipment to be tested. Contractor shall:
 - a. Cooperate with laboratory personnel, provide access to the Project.
 - b. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.
 - c. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes, which require control by the testing laboratory.
3. The following schedule summarizes the responsibilities of various tests that may be required by the Contract Documents. Contractor shall notify the County in advance of work so that arrangements can be made with the testing laboratory.

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	County
Asbestos	Environmental testing of materials	County
All Other Testing	As specified in various sections of the Project Manual	As Indicated

- E. Demonstration Tests: Upon completion of the Work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance or demonstration tests as specified or required to provide compliance with the Contract Documents. The Contractor shall furnish all labor, fuel, energy, water and all other equipment necessary for the demonstration tests at no additional cost to the County.
- F. Final Inspection: Prior to preparation of the final payment application, a final inspection will be performed by the County to determine if the Work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents. See also Section 01700 "Project Closeout."
- G. Inspection by existing utility owners: The Contractor shall pay for all inspections during the progress of the Work required and provided by the owner of all existing public utilities paralleling or crossing the Work, as shown on the Drawings. All such inspection fees 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.
- H. Inspection by Other Agencies: The Florida Department of Transportation, the Florida Department of Environmental Protection, and other authorized governmental agencies shall have free access to the site for inspecting materials and work, and the Contractor shall afford them all necessary facilities and assistance for doing so. Any instructions to the Contractor resulting from these inspections shall be given through the County. These rights of inspections shall not be construed to create any contractual relationship between the Contractor and these agencies.

1.11 PROJECT SITE AND ACCESS

- A. Right-Of-Way and Easements:
 1. The use of public streets and alleys shall be such as to provide a minimum of inconvenience to the public and to other traffic. Any earth or other excavated material spilled from trucks shall be removed by the Contractor and the streets cleaned to the satisfaction of the County.
 2. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the property owner.
 3. At the time of the Pre-Construction meetings, the Contractor shall fully acquaint himself with the status of all easements required for the Work and the possibility of parcels remaining to be acquired, if any. Should easements not be acquired by the County in specific areas of the Work, the Contractor shall sequence and reschedule his or her work therein so as not to interfere with the progress of work in other areas of the Project. Such rescheduling of work shall be performed by the Contractor at no additional cost to the County. The County agrees that it will make every effort to

acquire all remaining easements with all speed and diligence possible so as to allow the completion of the Work within the Contract time.

B. Access:

1. Neither the material excavated nor the materials or equipment used in the construction of the Work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.
2. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business access with the business Owner. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored and all construction debris removed within 48-hours of backfilling trench.
3. Contractor agrees that representatives of the County and any governmental agents will have access to the Work wherever it is in preparation or progress and that the Contractor shall provide facilities for such access and inspection.

1.12 UTILITIES

A. Utility Construction:

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes, and all other appurtenances and facilities pertaining thereto, whether owned or controlled by governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage or water. Other public or private property, which may be affected by the Work, shall be deemed included hereunder.
2. 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 or her own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workers. Bridges provided for access to private property during construction shall be removed when no longer required.
3. The length of open trench will be controlled by the particular surrounding conditions, but shall always be confined to the limits described by the County. If any excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures. As a minimum, the Contractor shall conform to the following restoration procedures:
 - a. Interim Restoration: All excavations shall be backfilled and compacted as specified by the end of each working day. For excavations within existing paved areas; limerock base or soil cement base (match existing) shall be spread and compacted to provide a relatively smooth surface free of loose aggregate material. At the end of each workweek, the S-I asphaltic surface course shall be completed and opened to traffic. Contractor shall coordinate construction activity, including density tests and inspections, to allow sufficient time to achieve this requirement. All driveway cuts shall be backfilled, compacted, and limerock base spread and compacted immediately after installation. Contractor shall coordinate with the individual property owners prior to removing the driveway section. Any utility crossing an existing roadway, parking lot or other paved area shall be patched by the end of the working day.

- b. All pipe and fittings shall be neatly stored in a location, which will cause the least disturbance to the public. All debris shall be removed and properly disposed of by the end of each working day.
- c. Final Restoration Overlay: After completing all installations, and after testing of the pipe (but no sooner than 30-days after applying the S-I asphaltic surface), final restoration shall be performed. In no event shall final restoration begin after substantial completion. Final restoration shall provide an S-III asphaltic overlay as specified in an uninterrupted continuous operation until completion. Any additional restoration required after testing shall be repaired in a timely manner at no additional cost to the County.
- d. Maintenance of all restored facilities shall be the Contractor's responsibility. This maintenance shall be performed on an on-going basis during the course of construction. The Contractor's Progress Schedule shall reflect the above restoration requirements.
- e. Additional Restoration for Work in Business or Commercial Districts: The Contractor shall restore all private property, damaged by construction, to its original condition. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business accesses with the business owner. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored within 24-hours of backfilling trench.

B. Existing Utilities:

- 1. The locations of all existing underground piping, structures, and utilities have been taken from information received from the respective owner. The locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping, conduit and cables to be encountered. It is the Contractor's responsibility to verify all depths of marked locates as well as underground structures.
- 2. Contractor shall, at all times in performance of the Work, employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of existing 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.
- 3. Pipelines shall be located substantially as indicated on the Drawings, but the County reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. When the location of piping is dimensioned on the Drawings, it shall be installed in that location; when the location of piping is shown on a scaled drawing, without dimensions, the piping shall be installed in the scaled location unless the County approves an alternate location for the piping. Where 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. The County/Professional may require detailed pipe laying drawings and schedules for project control.
- 4. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities that do not interfere with the completed work shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his or her expense as

directed by the County. Any existing facilities that require operation to facilitate repairs shall be operated only by the owner of the respective utility.

5. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the proximity of excavation, be temporarily stayed and/or shored in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

C. Notices:

1. All governmental utility departments and other owners of public utilities that may be affected by the Work will be informed in writing by the Contractor two (2) weeks after the execution of the Contract or Contracts covering the Work. Such notice will be sent out in general and be directed to the attention of the governmental utility departments and other owners of public utilities for such installations and structures as may be affected by the Work.
2. The Contractor shall also comply with Florida Statute 553.851 regarding notification of existing gas and oil pipeline company owners. Evidence of such notice shall be furnished to the County within two (2) weeks after the execution of the Contract.
3. It shall be the Contractor's responsibility to contact utility companies at least 72-hours in advance of breaking ground in any area or on any unit of the Work so maintenance personnel can locate and protect facilities, if required by the utility company.
4. The Contractor shall give a minimum five (5) working day notice prior to utility personnel interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the utility owner and make arrangements for the utility personnel to isolate the existing lines thus providing interruption which will be satisfactory to the utility owner.

D. Exploratory Excavations:

1. Exploratory excavations shall be conducted by the Contractor for the purpose of locating underground pipelines or structures in advance of the construction. Test pits shall be excavated in areas of potential conflicts between existing and proposed facilities and at piping connections to existing facilities a minimum of 48-hours or 1,000-feet in advance of work. If there is a potential conflict, the Contractor is to notify the County/Professional immediately. Information on the obstruction to be furnished by the Contractor shall include: Location, Elevation, Utility Type, Material, and Size. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the County.

E. Utility Crossings:

1. It is intended that wherever existing utilities must be crossed, deflection of the pipe within specified limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the County this procedure is not feasible, s/he may direct the use of fittings for a utility crossing or conflict transition as detailed on the Drawings.

F. Relocations:

1. Relocations shown on the Drawings: Public utility installations or structures, including but not limited to light poles, signs, fences, piping, conduits, and drains that interfere with the positioning of the Work which are shown on the Drawings to be

- removed, relocated, replaced, or rebuilt by the Contractor shall be considered as part of the general cost of doing the Work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.
2. Relocations not shown on the Drawings:
 - a. Where public utility installations or structures 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 County, 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 County, for the Contractor to accomplish.
 - b. 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 a Change Order.
 3. All existing castings, including valve boxes, junction boxes, manholes, hand holes, pull boxes, inlets, and similar structures in the areas of construction that are to remain in service and in areas of trench restoration and pavement replacement, shall be adjusted by the Contractor to bring them flush with the surface of the finished work.
 4. All existing utility systems which conflict with the construction of the Work herein, which can be temporarily removed and replaced, shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the Work may be done by the Contractor.

1.13 RELATED CONSTRUCTION REQUIREMENTS

A. Traffic Maintenance:

1. Maintain public highway traffic within the limits of the Project for the duration of the construction period, including any temporary suspensions of Work. Work shall also include construction and maintenance of any necessary detour facilities; furnishing, installing, and maintaining of traffic control and safety devices during construction, control of dust, or any other special requirements for safe and expeditious movement of vehicular and pedestrian traffic.
2. Traffic Control shall be provided at the Contractor's expense by the Contractor's personnel or off-duty uniformed police officer, depending on and as required by the applicable traffic control requirements jurisdictional to the construction or road.
3. The Contractor shall prepare and submit a Maintenance of Traffic plan (MOT) to the County/Professional and to the County Public Works Department for review and acceptance prior to commencing any Work on the site. The Traffic Control Plan shall 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. All references to the respective agency in the above referenced standards shall be construed to also include the County for this Work.
 - d. The cost of any required road permits shall be borne by the Contractor.
 - e. The Contractor will notify the public one (1) week in advance of any scheduled work via the use of portable message boards. The message boards shall be located at each approach to the construction area.
4. Before closing any thoroughfare, the Contractor shall give written notice to, and if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction over the thoroughfare. Notice shall be given no less than 72-hours in advance of the time when it may be necessary in the process of construction to close such thoroughfare, or as may be otherwise provided in the acceptable Maintenance of Traffic plan (MOT).
 5. The Contractor shall sequence and plan construction operations and shall generally conduct his or her work in such a manner as not to unduly or unnecessarily restrict or impede existing normal traffic through the streets of the local community.
 6. Insofar as it is practicable, excavated material and spoil banks shall not be located in such a manner as to obstruct traffic. The traveled way of all streets, roads and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary.
 7. If required by duly constituted public authority, the Contractor shall, at his or her own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such a manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the County and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or property resulting from his or her work.
 8. The Contractor shall make provisions at all "open cut" street crossings to allow a minimum of one lane to be open for vehicular traffic at all times. Lane closing shall be as permitted by the local governing authority and shall be repaired to a smooth, safe driving surface immediately following the installation of pipe or conduit. Flaggers shall be required, in addition to barricades, signs and other protective devices at all lane closings.
 9. The Contractor shall make provisions at cross streets for the free passage of vehicles and pedestrians, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters.
 10. The Contractor shall immediately cart away all offensive matter; exercising such precaution as may be directed by the County. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences and adjacent property of all kinds.

B. Barrier And Lights:

1. The Contractor shall exercise extreme care in the conduct of the Work to protect health and safety of the workers and the public. The Contractor shall provide all

protective measures and devices necessary, in conformance with applicable local, state and federal regulations regarding their need and use. Protective measures shall include but are not limited to barricades, warning lights/flashers and safety ropes.

2. All equipment and vehicles operating within 10-feet of the roadway shall have flashing strobe lights attached.

C. Dewatering and Flotation:

1. The Contractor, with his or her own equipment, shall do all pumping necessary to dewater any part of the Work area during construction operations to insure dry working conditions. The Contractor shall be completely responsible for any tanks, wetwells or similar structures that may become buoyant during the construction and modification operations due to the ground water or floods and before the structure is put into operation. The proposed final structures have been designed against buoyancy; however the Contractor may employ methods, means, and techniques during the various stages of construction (or other conditions) that may affect the buoyancy of structures. Should there be any possibility of buoyancy of a structure; the Contractor shall take the necessary steps to prevent its buoyancy either by increasing the structure's weight, by filling it with approved material or other acceptable methods. Damage to any structures due to floating or flooding shall be repaired or the structures replaced at the Contractor's expense.
2. Contractor shall be responsible for any required permits for the discharge of ground water.

D. Dust and Erosion Control:

1. The Contractor shall prevent dust nuisance from his operations or from traffic by the use of water and deliquescent salts.
2. Erosion and Sedimentation Control:
 - a. Temporary erosion controls include, but are not limited to, grassing, mulching, netting, watering and reseeding on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations that will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the County, FDEP and any other agency having jurisdiction.
 - b. Temporary sedimentation controls include, but are not limited to; silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the County, FDEP and any other agency having jurisdiction.
 - c. The construction of temporary erosion and sedimentation control facilities shall be in accordance with the technical provision of section 104-6.4 of the 1991 Edition, FDOT Standard Specifications for Road and Bridge Construction.
 - d. Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective.

E. Lines and Grades:

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 County/Professional. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

2. The Contractor shall, at his or her own expense, establish all working or construction lines and grades as required from the project control points set by the County, and shall be solely responsible for the accuracy thereof.
3. Water main and forcemain shall have a minimum of 36-inches of cover over the top of the pipe. Cover shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The stationing shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed. All locations must be acceptable by the County.
4. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:
 - a. Gravity lines; continuous control, using laser beam technology.
 - b. Pressure lines; control stakes set at 50-foot intervals using surveyors' level instrument.

F. Cutting and Patching:

1. The Contractor shall do all cutting, fitting, or patching of his or her portion of the Work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the County and in accordance with the Drawings and Specifications.
2. Preparation:
 - a. Inspect the existing conditions of the Project, including elements subject to damage and/or movement during cutting and patching.
 - b. Provide adequate temporary support to assure the structural integrity of all facilities during completion of the Work.
3. Performance:
 - a. Execute cutting and demolition by methods, which will prevent damage to other existing facilities and will provide proper surfaces to receive installation of equipment and repair.
 - b. Excavation and backfilling shall be performed in a manner that will prevent settlement and/or damage to existing facilities.
 - c. All pipes, sleeves, ducts, conduits and other penetration through surfaces shall be made airtight.
 - d. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

G. Temporary Construction:

1. Temporary fences: If, during the course of the Work, it is necessary to remove or disturb any fencing, the Contractor shall, at his or her own expense, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The County/Professional will be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.
2. 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 save harmless the County from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

H. Daily Reports:

1. Contractor shall submit to the County's Representative daily reports of construction activities including non-work days. The reports shall be complete in detail and shall include the following information:
 - a. Days from Notice to Proceed; Days remaining to substantial and final completion;
 - b. Weather information;
 - c. Work activities with reference to the Critical Path Method (CPM) schedule activity numbers (including labor, equipment, and daily production quantities for each individual activity);
 - d. Major deliveries;
 - e. Visitors to site;
 - f. Test records;
 - g. New problems, and
 - h. Other pertinent information.
2. A similar report shall be submitted for/by each Subcontractor.
3. The report(s) shall be submitted to the County Representative's Field Office within 2 days of the respective report date. Each report shall be signed by the Contractor's Superintendent or Project Manager. Pay request will not be processed unless daily reports are current.
4. If a report is incomplete, in error, or contains misinformation, a copy of the report shall be returned by the County Representative to the Contractor's Superintendent or Project Manager with corrections noted. When chronic errors or omissions occur, the Contractor shall correct the procedures by which the reports are produced.

I. Cleaning:

1. During Construction:
 - a. During construction of the Work, the Contractor shall, at all times, keep the site of the Work 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 the County, such material, debris, or rubbish constitutes a nuisance or is objectionable.
 - b. Provide on-site containers for the collection of waste materials, debris, and rubbish and remove such from the site periodically by disposal at a legal disposal area away from the site.
 - c. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished. Use only those cleaning materials that will not create hazards to health or property and that will not damage surfaces. Use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
 - d. The Contractor shall remove from the site all surplus materials and temporary structures when no longer necessary to the Work at the direction of the County.
2. Final Cleaning:
 - a. At the conclusion of the Work, all equipment, tools, temporary structures, and materials belonging to the Contractor shall be promptly taken away, and s/he shall remove and promptly dispose of all water, dirt, rubbish, or any other foreign substances. Employ skilled workers for final cleaning. Thoroughly clean all installed equipment and materials to a bright, clean, polished, and new-appearing

condition. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

- b. The Work shall be left in a condition as shown on the Drawings and the remainder of the site shall be restored to a condition equal or better than what existed before the Work.
- c. Prior to final completion, or County occupancy, Contractor shall conduct an inspection of interior and exterior surfaces, and all work areas to verify that the entire Work is clean. The County will determine if the final cleaning is acceptable.

1.14 CONSTRUCTION NOT PERMITTED

A. Use Of Explosives:

- 1. No blasting shall be done except upon approval by the County and the governmental agency or political subdivision having jurisdiction. When the use of explosives is approved by the County as necessary for the execution of the Work, the Contractor shall use the utmost care so as not to endanger life or property, and assume responsibility for any such damage resulting from his or her blasting operations, and whenever directed, the number and size of the charges shall be reduced. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly, "DANGEROUS EXPLOSIVES" and shall be in care of competent watchers. All permits required for the use of explosives shall be obtained by the Contractor at his or her expense. All requirements of the governmental agency issuing permit shall be observed.

1.15 SPARE PARTS

- A. Spare parts for certain equipment provided under Divisions 11: Equipment; 13: Special Construction; 15: Mechanical; and 16: Electrical have been specified in the pertinent sections of the Specifications. The Contractor shall collect and store all spare parts so required in an area to be designated by the Engineer. In addition, the Contractor shall furnish to the Engineer an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier, and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivered cost. Contractor shall package in large plastic military grade containers with all information needed labelled on the outside of container such as equipment item, manufacturer, specification, facility, etc.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. This Contract is for the improvements at the following Orange County Utilities Department's Facilities as shown on the Drawings and specified herein: Oak Meadows Water Supply Facility (WSF), Western Regional WSF, and Bent Oak Storage and Repump Facility (SRF). The Work consists of furnishing all labor, equipment, and materials for the construction of the facilities consisting of, but not limited to, the expansion of or improvements to the equipment and structures associated with the following:

Oak Meadows WSF

1. Demolition of existing Generator.
2. Installation of new 500kW generator and above ground fuel piping to existing above ground fuel storage tank and enclosure.
3. Replace existing motor control center (MCC), automatic transfer switch and related breakers including cables, wires, and conduit.
4. Installation and removal of Temporary MCC, automatic transfer switch and related breakers including cables, wires, and conduit.

Western Regional WSF

1. Demolition of existing motorized entrance gate, chain-link fencing and guardhouse.
2. Installation of new motorized cantilevered gates and fence.
3. Installation of new pre-engineered guardhouse including electrical, communications, and HVAC.
4. Installation of card reader, arm gates and traffic loop detectors including asphalt road lane extension.
5. Retrofit two (2) constant speed motors with variable frequency drives.

Bent Oak SRF

1. Remove and replace existing 12-inch pressure sustaining control valve.

1.02 CONTRACTOR'S USE OF PREMISES/SECURITY

- 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.
- B. The Contractor shall comply with the Owner's security and access guidelines at all times. Refer the Security and Access Guidelines in Attachment B to these Specifications.

1.03 SEQUENCE OF WORK

See Special Project Procedures, Section 01030, 1.05, Sequence of Work

1.04 PUBLIC UTILITY INSTALLATIONS AND STRUCTURES

- A. The Contractor shall give written notice to all governmental utility departments and other owners of public utilities of the location of the proposed construction operations, at least seventy-two hours in advance of breaking ground in any area or on any unit of the Work.
- B. Some of the utility contacts are listed on the plans for the Contractor's convenience.
- C. The maintenance, repair, removal, relocation, or rebuilding of the public utility installation and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the utility involved.

1.05 CONSTRUCTION TRAILERS, STORAGE AND PARKING

- A. Provide construction trailers and other temporary facilities in accordance with the general requirements and Section 01590 at the Oak Meadows Water Supply Facility.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 GENERAL

- A. The Contractor shall receive and accept the compensation provided in the Proposal and the Contract as full payment for furnishing all materials, labor, tools, and equipment, for performing all operations necessary to complete the work under the Contract, and also in full payment for all loss or damages arising from the nature of the work, or from any discrepancy between the actual quantities of work and quantities herein estimated by the Engineer, or from the action of the elements or from any unforeseen difficulties that may be encountered during the prosecution of the work until the final acceptance by the Owner.
- B. The prices stated in the proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the work as shown on the Drawings and specified herein. The basis of payment for an item at the unit price shown in the proposal shall be in accordance with the description of that item in this Section.
- C. The Contractor's attention is again called to the fact that the quotations for the various items of work are intended to establish a total price for completing the work in its entirety. Should the Contractor feel that the cost for any item of work has not been established by the Bid Form or Payment Items, s/he shall include the cost for that work in some other applicable bid item, so that his or her proposal for the project does reflect the total price for completing the work in its entirety.

1.02 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.

1.03 PAYMENT ITEMS

- A. Items are as enumerated on the bid form.
 - Item 1 – General Requirements:
 - a. Measurement for various items covered under General Requirements, Mobilization and Demobilization will not be made for payment and all items shall be included in the lump sum price.

- b. Payment for General Requirements shall include all Insurance requirement costs, the cost of bonds, and all Administrative costs. This item will be paid upon each payment request made by the Contractor. The Contractor shall attach with the pay request invoices to substantiate that appropriate insurance and bonds have been obtained by the Contractor.
- c. Payment for Mobilization/Demobilization will be made at the Contract lump sum price for the item, which price and payment shall be full compensation for the preparatory work and operations in mobilizing for beginning Work on the project including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, and for the establishment of field office, building, safety equipment, and first aid supplies, sanitary and other facilities, as required by these Specifications and State and local laws and regulations; and any other preconstruction expense necessary for the start of the Work; the cost of field engineering, permits, and fees, construction schedules, shop drawings, temporary facilities, laydown storage area, construction aids, erosion control, work associated with contractor support during Owner/Engineer reviews and inspection, re-inspections and any re-work resulting from same, as described in Section 01700: Project Closeout; and Section 01720: Project Records Documents. The Contractor shall submit invoices substantiating the cost of mobilization with each pay request. Mobilization/demobilization shall not be more than five percent (5%) of the Total Base Bid price. Ten percent of the cost for mobilization will be withheld until substantial completion and site clean-up.

Item 2 – Indemnification:

- a. Payment for Indemnification: In consideration of the Contractor's Indemnity Agreement as set out in the Contract Documents, Owner specifically agrees to give the Contractor \$100.00 and other good and valuable consideration, receipt of which is acknowledged upon signing of the Agreement.

Item 3 – Construction of the Oak Meadows Water Supply Facility Improvements:

- a. Measurement: Measurement for this item shall be based on satisfactory replacement of the generator, motor control center (MCC) and automatic transfer switch complete and ready for continuous operation.
- b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, equipment, temporary power and control system, testing, permits, and appurtenances required for the Oak Meadows Water Supply Facility Improvements, including all demolition and salvage of the existing generator and enclosure, installation of a new generator and enclosure, fuel piping, temporary power and control system, replacement of the existing MCC, automatic transfer switch and related breakers, cables, wires, conduit, structural, mechanical, instrumentation, and electrical improvements required to complete the work as specified and training. Additionally, Power System Studies and distribution system field testing shall be performed including a short circuit study, a protective device evaluation study, an arc flash study and a protective device coordination study.

Item 4 – Construction of the Western Regional Water Supply Facility Improvements:

- a. Measurement: Measurement for this item shall be based on satisfactory replacement of the motorized entrance gate, guardhouse, arm gates, and retrofit of two constant speed motors with variable frequency drives complete and ready for operation.
- b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, equipment, testing, permits, and appurtenances required for the Western Regional Water Supply Facility Improvements, including demolition and salvage of the existing motorized entrance gate, arm gates, fencing and guardhouse; installation of new motorized cantilevered gates and a new pre-engineered guardhouse including electrical, HVAC, arm gates, fencing, traffic loop detectors, traffic striping, entrance card reader system, lighting, structural, mechanical, and electrical improvements asphalt road extension, asphalt milling and resurfacing. Work also includes retrofit of two constant speed motors with variable frequency drives including cables, wires, conduit, structural, mechanical, instrumentation, and electrical improvements required to complete the work as specified. Additionally, Power System Studies update and distribution system field testing shall be performed including a short circuit study, a protective device evaluation study, an arc flash study and a protective device coordination study.

Item 5 – Construction of the Bent Oak Storage and Repump Facility Improvements:

- a. Measurement: Measurement for this item shall be based on satisfactory replacement of the 12-inch pressure sustaining control valve complete and ready for operation.
- b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, equipment, testing, permits, and appurtenances required for the Bent Oak Storage and Repump Facility Improvements, including removal and salvage of the existing pressure sustaining control valve and installation of a new pressure sustaining control valve, air release valve, pressure gauge, restraint devices, instrumentation, and electrical improvements required to complete the work as specified.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01027
APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.01 REQUIREMENT

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings and As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables shall be accepted by the County.
- C. Progressive As-Built Drawings shall 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 Asset Attribute Data, Gravity Main, and Pipe Deflection Tables 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 specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies.

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 and payments as certified and paid for by the County.
 - 1. The initial Application for Payment: The Application for Payment at time of Substantial Completion and the final Application for Payment involve additional requirements.
- B. Payment Application Times: As stated in the General Conditions, Payment applications

are to be submitted monthly on a day of the month to be established by the County at the Pre-Construction conference.

- C. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Contractor. Incomplete applications will be returned without action.
 - 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 an extension or continuation sheet, listing Change Order number and dollar amount as for an 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. Submit a stored material log with each application for payment which identifies the type, quantity and value of all stored material, and that tracks when the stored materials are installed and deducts them from stored quantity at that time. Include original invoices for all stored materials that payment is requested.

- E. Waivers of Claims and Mechanics Lien: With each Application for Payment submit waivers of claims and mechanics liens from Subcontractors or Sub-subcontractors and suppliers for the construction period covered by the previous applications.
 - 1. 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, submit final or full waivers.
 - 3. The County reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by 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.
 - 5. Waiver Forms: Submit waivers of claims and lien on forms and executed in a manner acceptable to the County.

- F. Transmittal: Submit seven (7) executed copies of each Application for Payment to the County by means ensuring receipt within 24-hours. One (1) copy shall be complete, including waivers of lien and similar attachments when required.
 - 1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner 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 by prior applications for payment, and 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: Administrative actions and submittals that must precede

or coincide with submittal of the first 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 policies
9. Performance and Payment bonds (if required)
10. Data needed to acquire County's insurance

H. Monthly Application for Partial Payment: Administrative actions and submittals that must precede or coincide with submittal of Monthly Partial Payments include the following:

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 Example (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
14. Responsibility + Liability for materials & equipment
15. Draw Schedule

I. Substantial Completion Application for Payment: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for County 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: 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. Completion of project close-out requirements.
 - 3. Completion of items specified for completion after Substantial Completion.
 - 4. Assurance that unsettled claims are settled.
 - 5. Assurance that work not complete and accepted is now completed.
 - 6. Transmittal of required project construction records to the County.
 - 7. Proof those taxes, fees and similar obligations have been paid.
 - 8. Removal of temporary facilities and services has been completed.
 - 9. Removal of surplus materials, rubbish and similar elements.
 - 10. Change of door locks to County's access.
 - 11. Execute certification by signature of authorized officer.
 - 12. Prepare Application for Final Payment as required in General Conditions.

1.04 SUBMITTAL PROCEDURES

- A. Submit seven (7) copies of each Application for Payment at time stipulated in Agreement.
- B. Submit under transmittal letter.

1.05 SUBSTANTIATING DATA

- A. When the County requires substantiating information, submit data justifying line item amounts in question.
- B. Provide one (1) copy of data with cover letter for each copy of submittal. Show Application number and date, and line item by number and description.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01030

SPECIAL PROJECT PROCEDURES

PART 1 – GENERAL

1.01 SECURITY

- A. The 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 Western Regional Water Supply Facility, the Oak Meadows Water Supply Facility, and the Bent Oak Storage and Repump Facility.
- B. The County requires special security measures to protect the public water system. The Contractor shall provide the same level of security. The Contractor shall comply with all provisions of "General Access and Security Guidelines Water Supply Facilities", attached as Appendix B.
- C. No Claim shall be made against the County by reason of any act of an employee or trespasser, and Contractor shall make good all damage to the County's property resulting from the Contractor's failure to provide security measures as specified.

1.02 TEMPORARY POWER SYSTEM (Oak Meadows WSF)

- A. The existing Oak Meadows WSF shall not be shutdown for longer than a 4 hour maximum period. The existing electrical system consisting of a main breaker, automatic transfer switch, motor control center and related control/power wiring cannot be removed and replaced within the maximum period. A Temporary Power System consisting of the components noted above shall be installed by the Contractor.
- B. Prior to initiating any shutdown of the existing electrical system, the Contractor shall construct a temporary power system including generator, ATS, motor starters and controls, cables, and wiring capable of fully operating the facility during construction of the proposed electrical system and controls.
- C. The temporary electrical system shall interface with the automatic control system to control the high service and well pumps.
- D. The Contractor shall remove the temporary electrical system after completion, testing and acceptance of the proposed electrical and control system modifications and/or replacement.
- E. The Contractor shall furnish a written temporary and permanent construction sequence plan for review and approval by the Owner before commencing work.

1.03 POWER DISTRIBUTION SYSTEM COORDINATION STUDY

- A. The Contractor shall perform a Power System Study and distribution system field testing on the Oak Meadows WSF power system and a Power System Study Update and distribution system field testing shall be performed on the Western Regional WSF power system.
- B. The Power System Studies shall include a Short Circuit Study, a Protective Device Evaluation Study, an Arc Flash Study and a Protective Device Coordination Study for a completely coordinated Power Distribution System.
- C. The existing Western Regional WSF power system study by Eaton Powering #GOSOR00516809 dated September 2014, software is SKM, is available for use.

1.04 INSTRUMENTATION and CONTROLS

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The Contractor shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, connection, to calibrate, to place into operation of all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein. The I&C supplier shall have a maintenance repair facility within a 150 mile radius of the project.
- B. Instrumentation and Controls supplier shall be **Curry Controls**.

1.05 SUSPENSION OF WORK

- A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. The orders and decisions of the RPR as to suspensions shall be final and binding. During suspension of the work from any cause, the work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise; and, if the RPR shall so direct, rubbish and surplus materials shall be removed.

1.06 SEQUENCE OF WORK

- A. The Contractor shall submit a detailed Sequence of Construction Plan indicating equipment and material deliveries, installation and testing of proposed temporary facilities, demolition, proposed periods of shutdowns, and demonstrating that the Water Supply Facilities and Storage and Repump Facility remain online.
- B. The sequence of demolition and renovation of existing facilities will be in accordance with the approved Sequence of Construction Plan. All shutdowns shall be coordinated with and approved by the Owner. The Sequence of Construction plan for each facility shall include the following:

1. The Work shall be phased so that the improvements are under construction at only one facility at a time.
 2. The Work shall be phased so that the WSFs and SRF shall remain secure at all times. Access to the Facilities for Orange County Staff and Maintenance shall be maintained at all times. Gate work at Western Regional WSF shall be phased so that gate equipment, gate arms, card readers, etc., are functional at all times for security purposes and to allow access to the facility.
 3. The WSFs and SRF must remain in continuous, permit compliant operation at all times.
 4. The WSFs and SRF shall not be taken offline (Shut-down) for more than four (4) hours for tie-ins or switchovers
- C. The Contractor shall establish a sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time.

1.07 SHUT-DOWN COORDINATION/PREPARATION

- A. As noted above, the WSFs and SRF shall not be taken offline for more than four (4) hours for tie-ins or switchovers, including major equipment and components or systems. The Contractor shall coordinate needed shut-down of any equipment, component or facility in advance of the work by providing a written plan with their proposed schedule of events at least sixty (60) days in advance of the planned shutdown. It is the responsibility of the Contractor to look ahead and plan enough notice to sufficiently coordinate for shut-downs ahead of the work to avoid delay of the work progress.
1. The Contractor shall submit a written plan for the Shut-down to the County for approval and coordination. The plan will indicate the work to be performed, the equipment or components or the entire WSF or SRF to be off-line and the proposed date and duration of the shut-down. The Contractor shall submit a C.A.R (Construction Assistance Request) form a minimum of thirty (30) days following the acceptance of the plan for the County to schedule personnel or other operation systems to be available to allow the shut-down. The Contractor shall indicate what materials are needed to complete the work that is to be performed during the Shut-down as well as any required material deliveries that are needed prior to the work. The Contractors lack of material, equipment, approved shop drawings, tools, etc. are grounds for the plan to be rejected or delayed by the County.
 2. The County will review the plan and make recommendations as needed. After acceptance of the shut-down plan, the County will coordinate the scheduled date with the Contractor. The Contractor and County shall confirm with each other that they are prepared and ready for the shut-down 24-hours prior to the start of the shut-down. All equipment, materials, manpower, tools, etc. that are needed to perform the work, shall be on-site prior to the shut-down. The shut-down will not proceed if the Contractor is not fully prepared per the shut-down plan.

1.08 TRAINING

- A. Unless otherwise specified, a minimum of two (2) separate training sessions shall be provided for each piece of equipment or system supplied, including all electrical installation, instruments, and testing equipment. The duration of each training session shall be as specified or as required in the individual specification section. Each session of training shall be complete and include all training needed for the required purpose. The Contractor shall video and audio record the training session in accordance with Section 01380. The Contractor shall submit a C.A.R (Construction Assistance Request) form seven days prior to beginning of training. Contractor shall submit training agenda, instructor names and resumes, and training handouts to be used. Training shall be based on the O&M manuals supplied by the Contractor.
- B. Upon successful completion of the Start-up, Demonstration and Testing, the Owner's Personnel will receive the specified training for each system. Training of the Owner's personnel will not be considered valid unless it takes place using a system that has successfully passed the start-up, demonstration and testing. Training shall be a minimum of two (2) days for each system, unless the individual equipment specification requires more. All training required by the specifications shall be videotaped with approved equipment and microphones in accordance with Section 01380 and shall be submitted to the County on individual writable DVD's.

1.09 HAULING AND CONSTRUCTION OPERATIONS

- A. Contractor shall conduct access, hauling, filling and storage operations to minimize interference with surrounding activities and in accordance with the Contract Documents.
- B. Contractor shall provide both maintenance of traffic and access to properties during construction.

1.10 OWNER'S ACCESS TO FACILITIES

- A. The Contractor is responsible for coordinating with the Owner and maintaining access to the Owner's existing facilities, including the Western Regional WSF, Oak Meadows WSF, and Bent Oak SRF at all times and scheduling potential site access disruptions at least seven (7) days in advance of performing the work required.

1.11 OWNER'S WORK SCHEDULE

- A. The Owner requires that their Orange County Utilities Resident Project Representative (RPR) be present to witness and inspect all Work performed by the Contractor. Normal working hours for the RPR are any 10-hour period between the hours of 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday. Any Work beyond the normal working hours shall be considered overtime and shall be requested in writing 24 hours in advance. Contractor, with approval of the RPR, may work additional hours 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 Owner in advance. Under emergency situations a verbal request may be made with a follow-up written request within 24 hours of the emergency.
- C. Owner observes the following holidays: New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day and the day after.
- D. Contractor shall pay for the RPR's overtime. Overtime shall be defined as time beyond the normal 10- hour working period between 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday, and all time on Saturdays, Sundays, and on holidays observed by the Owner. Hourly rates for the Owner's RPR shall be \$50.00 per hour. This overtime pay rate is subject to adjustment by the Owner. Contractor agrees that Owner shall deduct such charges from payments due to the Contractor.

1.12 SUBSURFACE UTILITIES ENGINEERING SERVICES

- A. In addition to the requirements specified in the Contract Documents, the Contractor shall employ subsurface utility engineering services prior to excavation along the fence corridor to precisely locate the existing utilities including gas, electrical, fiber optic, instrumentation, water pipes, reclaimed water pipes, wastewater pipes, and process pipes to eliminate any unexpected conflicts, damage to these utilities and pipes, and ensure safety of existing structures. Subsurface utility engineering services shall include designation, ground penetrating radar and test holes by hand excavation and vacuum excavation.
- B. Utility lines that are damaged during construction shall be repaired by the Contractor at his expenses and service restored within 1 hour of the breakage. If the repair is not made in a timely and approved manner, as determined by the Owner's RPR, the Owner may perform the repairs and the Contractor will be charged for the repairs. Owner's RPR must be present during all repairs.

1.13 TOBACCO FREE CAMPUS

- A. All Orange County Facilities and operations under the Board of County Commissioners shall be tobacco free. This policy shall apply to parking lots, parks, break areas and work sites. It is also applicable to the Contractor, their personnel and subcontractors during contract performance on County-owned property. Tobacco is defined as tobacco products including, but not limited to, cigars, cigarettes, E-cigarettes, pipes, chewing tobacco and snuff. This requirement shall be enforced from the beginning of construction and violators will be removed from the property. Failure to abide by this policy may result in civil penalties levied under Chapter 386, Florida Statutes and/ or contract enforcement remedies.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01050
SURVEYING AND FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Professional Surveyor: 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.
- B. Professional Engineer: The Contractor shall provide the services of a Registered Professional Engineer currently licensed in the State of Florida for the following specific services as applicable to the Work.

1.02 REQUIREMENTS

A. Survey Services

- 1. The Contractor shall retain the services of a registered Surveyor and Mapper licensed in the State of Florida to provide professional surveying and mapping services, and maintain both a control survey and an as-built survey during construction. The Surveyor will identify control points (monuments and benchmarks noted on the Drawings). The construction layout survey shall be established from the control points shown on the Construction Drawings and confirmed. The method of field staking for the construction of the Work shall be at the option of Contractor. The accuracy of any method of staking shall be the responsibility of Surveyor. All staking shall be done to provide for easy verification of the Work by the County. The Contractor shall provide all surveys necessary for the construction of the Work.

B. Engineering Services

- 1. The Engineer shall be responsible for duties during Construction to include, but not limited to:
 - a. Inspections, testing, witnessing requiring a licensed Professional Engineer.
 - b. Design of temporary shoring, bridging, scaffolding or other temporary construction, formwork and protection of existing structures.
 - c. Other requirements as specified herein.
- 2. Engineering related designs, tests and inspections shall be signed by the licensed Professional Engineer as required by the County.

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 s/he has the hardware, software, and adequate scope of services in his or her 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 Pre-Construction meeting. Any Surveyor who has not previously performed work for the County shall attend the Pre-Construction meeting.

1.04 SUBMITTALS

- A. Provide qualifications of the Surveyor or Engineer.
 - 1. A Florida Registered Professional Engineer or Registered Surveyor and Mapper who is proposed by the Contractor to provide services for the Work shall be acceptable to the County prior to field services being performed.
 - 2. A Professional Engineer shall be of the discipline required for the specific service for the Work.
 - 3. Submit name, address and telephone number of the Surveyor and/or Engineer, as appropriate to the County for acceptance before starting survey or engineering work.
- B. On request, submit documentation verifying accuracy of survey work.
- C. Surveyor shall certify all elevations and locations included in Table 01050- 2, 3, and 4.

PART 2 - PRODUCTS

2.01 SURVEY DOCUMENTS

- A. Survey documents shall comply with the Minimum Technical Standards of Chapter 5J-17 of the Florida Administrative Code (FAC) and Table 01050-1 Minimum Survey Accuracies, whichever are more stringent. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract Drawings control points for horizontal and vertical controls.
- B. The Surveyor shall not copyright any of their Work related to this project.

**Table 01050-1
Minimum Survey Accuracies**

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
Bench Marks	0.01	0.01	Point
Baseline Control Locational Accuracy	0.01	N/A	Point
Tract and Easement Corners	*	N/A	Survey Monuments
Mains at 100-foot maximum intervals	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
PVC pipe >16-inch at every pipe joint	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
Fittings, Sleeve, Tapping Saddle, and end of the pipe if Plugged or Capped.	0.1	0.1	Fitting
Restrained Pipe	0.1	N/A	Restrained Joint Limits
Connections	0.1	0.1	Pipe
Bore & Jack Casing	0.1	0.1	Top of Casing at the Casing Limits
Directional Drill	0.1	0.1	10-foot intervals during the directional drill operation
Hydrants	0.1	N/A	Operating Nut of Hydrant
Valves	0.1	0.1	Operating Nut
Air Release, Blow off, and Backflow Valves	0.1	N/A	Valve Enclosure
Master Meters, Deduct Meters & Wastewater Meters	0.1	N/A	Register
Meter Box	0.1	N/A	Meter Box
Clean out	0.1	N/A	Clean out
Manhole Rim	0.1	0.1	Manhole
Manhole Inverts	N/A	0.01	Pipe Inverts
Pump Station (Public & Private)	0.1	0.01	Wetwell and Pipe Inverts
Production Well or Monitoring Well	0.1	0.1	Well
Grease Interceptor	0.1	0.1	
Oil / Water Separators	0.1	0.1	
Demolished Pipe (abandoned in place or removed)	0.1	0.1	Limits of Abandoned or Removed Pipe
Existing Utilities water, wastewater, reclaimed water, and appurtenant structures **	0.1	0.1	Pipe or Structure
* Shall conform to the requirements of the "Chapter 5J-17, 'Minimum Technical Standards', FAC", certified by a SURVEYOR.			
** Existing utilities including but not limited to water, wastewater, reclaimed water, stormwater, fiber optic cable, electric, gas and structures within the limits of construction.			

**TABLE 01050-2
Asset Attribute Data Form Examples**

Hydrants Worksheet

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Manufacturer	Model #	Comments
2	FH-1	C-7	518456.40	1483743.63	49.53	Brand B	XJ7-B	
3	FH-2	C-9	518477.68	1483758.95	54.23	Brand B	XJ7-B	

Valves Worksheet

	A	C	D	E	F	G	H	I	J
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Valve Type	Main Type	Valve Size	Valve Manufacture
2	ARV-1	C301	518060.09	1483231.33	81.72	ARV - Combination	Water Main	2	Brand H
3	ARV-1	C303	518083.55	1483280.50	81.15	ARV - Vacuum	Force Main	4	Brand G
4	BFP-1	C303	518086.00	1483282.88	78.21	Backflow Preventer	Reclaimed Water Main	8	Brand F
5	BO-9	C405	518088.83	1483289.43	78.20	Blowoff	Water Main	2	Brand E
6	BFV-1	C405	518088.11	1483295.00	81.95	Butterfly	Water Main	30	Brand D
7	GV-3	C405	518132.54	1483372.75	81.23	Gate	Water Main	16	Brand C
8	LS-W1	C405	576779.36	1539706.97	64.30	Line Stop	Water Main	16	Brand B
9	PV-22	C405	576880.60	1539718.32	64.52	Plug	Force Main	12	Brand A

	J	K	L	M	N	O	P	Q
1	Valve Manufacturer	Valve Model #	# of Turns to Close	Gear Actuator	Gear Ratio	Side Actuator	uator Manufact	Comments
2	Brand H	100XT						
3	Brand G	1000						
4	Brand F	2000 fgs						
5	Brand E	14 turbo						
6	Brand D	230 xls	200	Yes	3 to 1	Yes	Brand C	
7	Brand C	2225846	300	Yes	3 to 1	NO		
8	Brand B	7n6r44						
9	Brand A	Z100	200	Yes	3 to 1	Yes	Brand A	

Manhole Worksheet

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID Number	Plan Sheet #	Easting	Northing	Rim Elevation	Invert Elv II	Invert Elv IE	Invert Elv SE	Invert Elv S	Invert Elv SW	Invert Elv W	Invert Elv IW	Manufacturer	
2	MH-1	C-20	517999.15	1483092.24	82.96	76.96		76.96					Brand X	
3	MH-2	C-20	517999.15	1483492.24	83.54	75.63			75.58				Brand X	

Meter Worksheet

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Comments
2	MM-1	C-6	576533.64	1539520.08	58.01	Water Main	
3	RWMM-1	C-6	576937.42	1539598.78	64.84	Reclaimed Water Main	

Fitting Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls								
	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Fitting Type	Comments
2	FM-1	C-3	572399.28	1539339.13	46.27	Force Main	Bend 11 1/4°	
3	FM-2	C-3	574840.74	1539856.91	51.73	Force Main	Bend 22-1/2°	
4	FM-3	C-3	574844.01	1539856.71	52.48	Force Main	Bend 45°	
5	FM-4	C-3	574845.72	1539856.61	52.33	Water Main	Bend 90°	
6	FM-5	C-3	574845.85	1539858.77	51.98	Water Main	Cap	
7	RW-1	C-4	574884.06	1539849.64	51.75	Reclaimed Water Main	Cross	
8	RW-2	C-4	574887.22	1539849.56	48.98	Reclaimed Water Main	Reducer	
9	RW-3	C-4	574904.30	1539849.10	49.39	Reclaimed Water Main	Plug	
10	RW-4	C-4	574907.42	1539849.01	52.32	Reclaimed Water Main	Sleeve	
11	WM-1	C-5	574938.65	1539848.16	54.42	Water Main	Tapping Saddle	
12	WM-2	C-5	572532.38	1539337.10	45.27	Water Main	Tee	
13	WM-3	C-5	572631.00	1539338.00	44.13	Water Main	Wye	
14	WM-4	C-5	572731.00	1539334.00	43.77	Water Main	Tapping Sleeve	

Cleanout Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls						
	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	CO-1	C-6	576533.64	1539520.08	58.01	
3	CO-2	C-6	576937.42	1539598.78	64.84	

Pipes Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls												
	A	C	D	E	F	G	H	I	J	K	L	M
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Type of Shot	Instruction Method	Material	Pressure Class	Manufacturer	Color
2	CSNG-1	C-4	517827.57	1482195.46	78.83	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A	
3	CSNG-2	C-4	517848.20	1482195.31	78.38	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A	
4	RW-1	C-7	517731.98	1482237.24	80.42	Reclaimed Water Main	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B	
5	RW-2	C-7	517732.848	1482338.1	80.943	Reclaimed Water Main	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B	
6	WM-1	C-9	573309.068	1539372.9	56.10	Water main	Shot on Pipe	Open Cut	PVC	DR18	Brand C	
7	WM-2	C-9	573308.752	1539375	54.66	Water main	Shot on Pipe	Open Cut	PVC	DR18	Brand C	
8	FMDD-1	C-4	504345.94	1488969.2	114.14	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X	
9	FMDD-2	C-4	504360.86	1488970.5	112.74	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X	
10	FMDD-3	C-4	504377.19	1488971.2	106.14	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X	
11	FM-9	C-4	504480.47	1488982.9	105.24	Force Main	Shot on Pipe	Open Cut	PVC	DR18	Brand C	

Well Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls						
	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	PS-1	C-40	517914.346	1482906.562	83.912	

Easements Worksheet

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Boundary Corner Type	Comments
2	Corner-1	C-8	463484.59	1511029.72		Pump Station Tract	N.W. CORNER
3	Corner-2	C-8	463523.24	1511040.01		Pump Station Tract	N.E. CORNER
4	Corner-3	C-8	463480.45	1511015.23		Pump Station Tract	S.W. CORNER
5	Corner-4	C-8	463526.97	1511025.49		Pump Station Tract	S.E. CORNER
6						Easement	
7						Property	

Existing OC Utility Crossing

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Existing Pipe Elevation	Proposed Crossing Elevation	Existing Main Type	Comments
3	Conf-1	C-750	463464.47	1511013.75	100.54	104.88	Water main	
4	Conf-2	C-750	463163.91	1510693.49	98.32	103.57	Storm Main	

Grease Interceptor

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Volume (Gallons)	Comments
2	GI-1	C-400	508387.3	1487203.18	89.70	1000.00	

For ease of calculating pipe deflections in Table 01050-3, begin by providing a unique asset ID (top of pipe shots and fittings) for each utility and type, numbered sequentially along the pipe run (including changes in direction) from start to finish of the pipe in the Table 01050-2. Then branches and services of the same utility type can be numbered. It is recommended that each utility (water, wastewater or reclaimed water) numbering format be distinguishable from the other. This will allow organization and convenient sorting after the individual asset table worksheet tabs are combined in the spreadsheet program prior to copying and pasting to the deflection table spreadsheet.

**TABLE 01050-3
PIPE DEFLECTION TABLE EXAMPLE**

Project Contractor: Progress Mtg Date: Contract # Dwg Sheet # Utility Type Pipe Manufacturer Pipe size & material PVC Manufacturer Deflection County Allowable Deflection 75% Allowable Angle of Offset Allowable Radius of Curvature Laying Length of Pipe	FM National Pipe 16" PVC C905 6 inches 4.5 inches 1.5 degrees 764 feet 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 ft	Length BC ft	Length AC ft	XYZ (w elevation) degrees	XYZ (w elevation) ft	per laying length degrees	per laying length 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 been inputted
 Values in yellow are over spec

*Uses law of cosines to determine angle ABC and Ø.
 $\text{angle } ABC = \arccos((AB^2 + BC^2 - AC^2) / (2 * AB * BC))$
 $180 - \text{angle } ABC = \text{angle } \phi$
 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 law of sines, using the chord length AC and radius R.
 Since $\sin((\phi/2) * (\pi/180)) = (\text{Chord}/2) / R$ and length AC = Chord
 $R = AC / (2 * \sin(\phi * \pi / 360))$
 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 5J-17. 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 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. Only a Surveyor licensed in the State of Florida shall be employed for this Work. All control points shall be protected by the Contractor from disturbance. If the monuments are disturbed, any Work that is governed by these monuments shall be held in abeyance until the monuments are reestablished by the Contractor and approved by the County. The accuracy of all the Contractor's stakes, alignments, and grades is the responsibility of the Contractor. However, the County has the discretionary right to check the Contractor's stakes, alignments, and grades at any time.
- C. Use survey control points to layout such work tasks including but not limited to:
 1. Clearing, grubbing, work limits, right-of-way lines and easements.
 2. Locations for pipelines and all associated structures and appurtenances.
- D. 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 SURVEYING

- A. Locate and protect existing horizontal and vertical control points shown on the construction Drawings prior to starting any work. If the Surveyor performing the Work finds differences that will effect the Work, the Contractor must immediately report the findings to the County. Establish control points, lines and levels by instrumentation and similar appropriate means. The location of these points should minimize the number of sightings necessary to control the Work and the likelihood of the points being disturbed. Preserve and reference all permanent reference points during Construction. If permanent reference 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 shall be provided to the County.
 - 1. Record locations, with horizontal and vertical data, on project As-Built survey.
 - 2. Make no changes or relocations without prior written notice to the County or without receipt of written approval from the County.
 - 3. Report to the County when any control point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
- B. Cover for water, reclaimed water and force mains shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The locations shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed.
- C. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:
 - 1. Gravity lines: Continuous control, using laser beam technology.
 - 2. Pressure lines: Control stakes set at 50 ft. intervals using Surveyor's level instrument.

3.03 SURVEY DOCUMENTS

- A. The Tables 01050-2 Asset Attribute Data, 01050-3 Pipe Deflection Table, and 01050-4 Gravity Main Table shall be signed, sealed and dated by the Surveyor with each pay request as specified in Section 01027 "Application for Payment" and the requirements of Section 01720 "Project Record Documents."

END OF SECTION

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SECTION 01065
PERMITS AND FEES

PART 1 - GENERAL

1.01 REQUIREMENTS

A. General:

1. Upon Notice of Award, obtain and pay for all appropriate and applicable 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. Provide copies of all applications and supporting documents; and permits received by the Contractor for the Project.
4. Strictly adhere to the specific requirements of the governmental unit(s) or agency (cies) having jurisdiction over the Work. Whenever there is a difference in the requirements of a jurisdictional body and the Contract Documents, the more stringent shall apply.
5. A copy of the permits obtained by the County are furnished in Appendix C "Permits Obtained by County" of these specifications.
 - a. FDEP has exempted this work following a Permit Determination, no FDEP is required for the work included in this project.
6. The Contractor shall review and become familiar with all permits for the Project, complete with all conditions, attachments, exhibits and permit modifications. A copy of all permits for the Project shall be maintained by the Contractor at the project site and shall be available for review upon request.
7. Unless otherwise specified, the cost of work specified in this section, will not be paid for separately but the cost therefore shall be considered incidental to and included in the bid prices of the various Contract items.

B. Building Permit (Orange County):

1. The County will pay the general building permit fee and any related impact fees or assessments to be paid to Orange County for the issuance of that permit only.
2. The Contractor shall pay all fees associated with obtaining Orange County trade permits and any and all inspection fees for the Orange County Building Department providing inspections for this project. The Contractor shall apply for and obtain the building permits from Orange County and schedule and obtain final approval from the building inspectors.
3. Information on Orange County Building Department fees is included in the Instructions to Bidders in Division 0.
4. The Contractor shall be responsible for scheduling all permit inspections and obtaining inspection approval from Orange County, as required by the building and sub-discipline construction permits.

- C. Construction Dewatering Permit: The Contractor shall apply and pay for all fees associated with obtaining Florida Department of Environmental Protection District Office construction dewatering permits, if required. The Contractor shall provide all materials and equipment to comply with the permit requirements at no additional cost to the County.

- D. Stormwater Permit: The Contractor shall apply and pay for all fees associated with obtaining construction stormwater management including but not limited to FDEP Generic Permit for Stormwater Discharge from Large and Small Construction Activities, if required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION