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IFB NO. Y17-786-PH **ISSUED: August 8, 2017**

INVITATION FOR BIDS

FOR

NORTHWEST WATER RECLAMATION FACILITY AND EASTERN WATER RECLAMATION FACILITY DISK FILTER INSTALLATION

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PART H
TECHNICAL SPECIFICATIONS

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Orange County Utilities

Northwest Water Reclamation Facility & Eastern Water Reclamation Facility Disk Filter Installation

Technical Specifications

Prepared By:

AECOM

Bid Set
60316063 July 2017

ORANGE COUNTY UTILITIES
NORTHWEST WATER RECLAMATION FACILITY &
EASTERN WATER RECLAMATION FACILITY
DISK FILTER IMPROVEMENTS
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February 11, 2011

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Nodarse & Associates – A Terracon Company
August 8, 2012

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SECTION 01010 SUMMARY OF WORK

PART 1 - GENERAL

A. Work Under This Contract

The project will provide 30 MGD & 36 MGD of filtration capacity at the Eastern Water Reclamation Facility (EWRF) and Northwestern Water Reclamation Facility (NWRF), respectively. The Disk Filter Improvements at the EWRF will enable rerating the EWRF from 19 MGD to 24 MGD, based upon an annual average daily flowrate (AADF). The scope of work for this project is to install the procured disk filter units.

The term “Manufacturer”, “Disk Filter Manufacturer”, or “Vendor” used in these specifications shall refer to the party responsible for the manufacture, storage, delivery, and startup of the disk filter units as specified herein. The term “Contractor” in these specifications shall refer to the general contractor which will be retained by the Owner under this contract to install the disk filter units as well as perform all other work defined in the drawings and specifications.

The “Disk Filter Units” as described below have been pre-purchased by the Owner under separate contract and will be delivered by the disk filter manufacturer to the site no later than January 1st, 2018. The Contractor shall coordinate with the Owner in order to relocate the Disk Filter Units from the Owner designated storage area installation location on the NWRF and EWRF sites.

Disk filter units shall include filter units, control panels, backwash pumps, valves, appurtenances, backwash piping mounted to the filter skid, and all other appurtenances which will be supplied by the disk filter manufacturer. Filters shall be installed to match the elevations shown in the Drawings. The required installed elevations have also been provided in the disk filter pre-purchase specification that has been included as an appendix of these specifications. The shop drawing review for the Disk Filter Units will take place under the disk filter pre-purchase contract. Final approved shop drawings shall be provided to the Contractor once they are available.

The Contractor shall be responsible for certain aspects of startup and testing of the disk filters as defined in Section 01664 and the specifications in general. Section

01664 defines the Contractor's interaction with the Disk Filter Manufacturer. Coordination between the Contractor and Disk Filter Manufacturer is required during the installation, startup, and testing of the disk filters.

The Contractor shall be responsible for furnishment (with the exception of the Disk Filter Units), installation, startup, and testing of the following as shown on the drawings and technical specifications:

1. NWRF

    a. Six (6) 6.0 MGD disk filter units at the NWRF; Process 065. Disk filters at the NWRF will be installed in an existing concrete structure. New equipment pads, metal grating walkway with structural supports, and pipe supports will be required within the existing structure. All piling and structures located outside of the disk filter structure are existing with the exception of the potable water main and hypochlorite service.

2. EWRF

    a. Install five (5) 6.0 MGD disk filter units at the EWRF; Process 570. Disk filters at the EWRF will be installed in an existing concrete structure. All piping and structures located outside the disk filter structure as shown on the contract drawings will be existing. New equipment pads, metal grating walkway with structural supports, and pipe supports will be required within the existing structure.

    b. A filtered effluent sampling station located at the influent EWRF Chlorine Contact Basin.

    c. Relocation of the existing disk filter at the EWRF facility to the South Water Reclamation Facility. Demolition of the existing disk filter piping and appurtenances at the EWRF site.

3. NWRF and EWRF

    a. All piping necessary to connect the existing NWRF and EWRF plant piping to each disk filter unit. Chemical injection assemblies, chemical piping, hose bibbs, emergency showers, grading, curb, sidewalk, and miscellaneous site work modifications at both the EWRF and NWRF sites.

b. Electrical, instrumentation, and control system improvements at both sites.

c. Integration of the Disk Filter Units into the existing SCADA system at both the NWRF and EWRF sites. Integration includes necessary modifications, to hardware, software, licensing, and HMI screens in order to integrate the disk filter process into the existing SCADA system.

B. Work Performed by Others

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

2. As stated above the Disk Filter Units shall be manufactured and delivered to the NWRF and EWRF sites by the Disk Filter Manufacturer. Contractor shall coordinate with Manufacturer and Owner for delivery and unloading. NWRF Filter Units shall be stored at a location predetermined by the Owner in the general area north of clarifiers 3 and 4. EWRF Filter Units shall be stored at a location predetermined by the Owner along the Curry Ford access road.

C. Training

1. Submit a construction submittal with the format, trainers and course material and specify whether training will be hands on or in a classroom setting for review and acceptance by the Owner and Engineer.

2. Contractor shall prepare a list of all equipment and electrical installations for owner to review and choose training.

3. The Vendor shall coordinate with the Contractor regarding training. Unless otherwise specified, a minimum of 2 days of training shall be provided by the Vendor for each piece of equipment supplied, including all electrical installations and testing equipment. Contractor shall video and audio record to a DVD all training given to operations staff, a copy of the DVD will be supplied to the County. The Contractor shall submit a C.A.R (Construction Assistance Request) form

seven days prior to beginning of training. Coordinate training schedule with Owner. Owner shall approve training schedule to ensure critical staff is available during training. Video equipment shall be accompanied with independent microphone for instructor to speak into for audio recording.

D. Intended Mode of Operation

EWRF - Secondary effluent will flow from the existing Phase V Filter Splitter Box (Process 360) to the proposed EWRF disk filters (Process 570). Secondary effluent will then be split to the five (5) EWRF disk filter units as necessary based on flow using the actuated filter influent valve associated with each filter. Filtered effluent will then be directed to the existing Phase V Chlorine Contact Basin (Process 580). Each filter control panel will initiate a backwash based upon a high level setpoint. Each filter will remain in operation during filter backwash. Should the overflow level switch of any filter be activated, the filter control panel shall provide an alarm to SCADA for operator intervention.

NWRF - Secondary effluent will flow from the existing secondary clarifiers to the proposed NWRF disk filters (Process 065). Secondary effluent will then be split to the six (6) NWRF disk filter units as necessary based on flow using the actuated filter influent valve associated with each filter. Filtered effluent will then be directed to the existing chlorine contact basins (Process 070 & 090). Each filter control panel will initiate a backwash based upon a high level setpoint. Each filter will remain in operation during filter backwash. Should the overflow level switch of any filter be activated, the filter control panel shall provide an alarm to SCADA for operator intervention.

E. Demolition

1. Prior to demolition, Contractor shall coordinate with Owner to confirm materials to be salvaged.

2. Perform demolition as designated within the Contract Documents.

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

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

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

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

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

8. Abandoned and exposed conduits are to be disconnected and removed.

F. Mutilation

All damage or mutilation of concrete structures, equipment, pipes, ducts, fixtures, etc., shall be properly repaired by the Contractor at no expense to the County.

G. Electrical Interlocks

Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, the Contractor shall provide wiring diagrams and coordinate between the various subcontractors and suppliers so that proper wiring of the equipment involved is effected.

H. Disturbed Areas

Restore all areas disturbed by construction to a condition at least equal to the preconstruction condition including, but not limited to, all landscaping, driveways, roads, sprinkler systems, and other improvements. Grassed areas shall be sodded. Maintain ingress and egress to all properties adjacent to the construction and minimize inconvenience to abutting property occupants.

I. Permits

1. The County has obtained Domestic Wastewater Facility Operating permits for this project from the Florida Department of Environmental Protection (FDEP).

2. The County has obtained an Environmental Resource permits for this project from the Florida Department of Environmental Protection (FDEP).

3. The County will also apply for and pay for the General Commercial Building Permit as issued by the Orange County Division of Building Safety. As set forth in the

General Conditions and Section 01065, the Contractor shall obtain the General Commercial Building Permit.

4. The Contractor shall pay for and obtain all the Sub-trade Commercial Building Permits associated with the General Building Permit as administered and issued by the Orange County Division of Building Safety. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.

5. The Contractor shall pay for and obtain a Notice of Intent to use the Generic Construction NPDES permit from the Florida Department of Environmental Protection (FDEP).

6. The Contractor shall pay for and obtain all other permits as required to perform the Work.

7. The Contractor shall reference Appendix ___ for the existing building permit at EWRF.

J. Containers for Spare Parts

1. Spare parts shall be packaged in sealed, rotationally moulded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Vendor shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

2. Pertaining to general inventory of all containers, the Vendor shall provide a general ascending alpha-numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

3. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum; Process description and Process number, equipment description, equipment tag, Manufacturer’s information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

4. The Vendor shall provide an electronic log in MS Excel of all containers which include the following at a minimum; container alpha-numerical designation, content

description, site storage location, O&M Manual volume subsection reference.

5. A copy of all inventory and manufactures product information data sheets shall be provided within a file pocket attached within the container.

6. Containers shall be positioned on site as designated by the Owner’s Representative

PART 2 - PRODUCTS

A. Manufacturers and Materials

At a minimum, all manufacturers and materials shall conform to the current Orange County Utilities List of Approved Manufacturers and Materials unless otherwise noted. See Attachment A.

PART 3 – EXECUTION (Not Used)

END OF SECTION

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SECTION 01015 PROJECT REQUIREMENTS

A. General Description of Work

The Work to be performed under these Contract Documents is presented in the drawings and specifications. The Work is generally described in Section 01010 Summary of Work.

B. Site Administration

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

Access to the Site during construction will be limited to Contractor’s and/or Subcontractor’s employees, agents, and vendors (hereinafter “Representatives”) for the sole purpose of performing the Work. Contractor/Subcontractor Representative’s identity and business purpose will be subject to verification by Owner's security representative. Access to the EWRF Site will be limited to the main gate off Alafaya Trail unless specific alternate arrangements are made with the Owner. Access to the NWRF Site will be limited to the main gate off McCormick Road unless specific alternate arrangements are made with Owner. Contractor will supply list, and periodically update it, which will contain the names of all personnel with driver licenses numbers and license plate numbers of all vehicles that will be on-site during construction.

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

C. Working Hours

Normal Working hours shall be defined as the period occurring between the hours beginning at 7:00 a.m. and ending at 7:00 p.m. Work during other than normal Working hours may be scheduled by CONTRACTOR with notice to Owner. The County Resident Project Representative shall be notified a minimum of 48-hrs in advance in anticipation of working on the weekends, Holidays or durations outside of the 7:00 a.m. to 7:00 p.m. period.

D. County Resident Project Representative (RPR) Working Hours

The normal daily work period for the County's RPR(s) is any 10 hour period between the hours of 7:00 A.M. and 7:00 P.M. on the weekdays of Monday through Friday. County's RPR(s) work outside the 10 hour period shall be paid for by the Contractor and is to be requested, in writing, 48 hours in advance. Any County's RPR(s) weekend work required on Saturday or Sunday shall be paid for by the Contractor and is to be requested, in writing, 48 hours in advance.

E. County RPR Overtime and Weekend Work Pay Rate

All overtime and weekend work by the County's RPR(s) shall be paid for by the Contractor at the overtime work pay rate of $47.00 per hour. This rate is subject to adjustment by the County.

F. Method of Payment

Contractor agrees that the County shall deduct charges for the County's RPR's work outside normal work hours and for overtime pay from payments due the Contractor.

G. Communication with Owner

All communication with Owner personnel for any purpose shall be administered solely though the County R.P.R. Any other communication with the Owner personnel that is not initiated through the County R.P.R. will be null and void.

H. Security

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 Eastern Water Reclamation

Facility (EWRF) and Northwest Water Reclamation (NWRF) sites.

The OWNER is implementing special security measures to protect the public wastewater system and the CONTRACTOR shall provide the same level of security. The CONTRACTOR shall provide the following security measures:

1. Contractor will supply list of all personal that will be on the EWRF and NWRF site each morning to OWNER’s R.P.R.

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

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

4. Contractor shall perform background checks to identify any historical crimes dealing with terrorism, sabotage, or other government related illegal activities for all personnel passing through the security perimeter.

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

6. If access other than the main EWRF gate off Alafaya Trail or the main NWRF gate off McCormick Road is utilized, a full time guard shall be provided at the construction gate during contractor working hours. All arrangements for alternative access shall be pre-arranged with the Owner. All alternative access must be secured and locked when not in use.

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

I. Construction Administration Request (CAR) Form

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

J. Smoking Policy – Tobacco Free Campus

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

K. Operator Training

1. Submit a construction submittal with the format, trainers and course material and specify whether training will be hands on or in a classroom setting for review and acceptance by the Owner and Engineer.

2. Contractor shall prepare a list of all equipment and electrical installations for owner to review and choose training.

3. Unless otherwise specified, a minimum of 2 days of training shall be provided for each piece of equipment supplied, including all electrical installations and testing equipment. Contractor shall video and audio record to a DVD all training given to operations staff, a copy of the DVD will be supplied to the County. The Contractor shall submit a C.A.R (Construction Assistance Request) form seven days prior to beginning of training. Coordinate training schedule with Owner. Owner shall approve training schedule to ensure critical staff is available during training. Video equipment shall be accompanied with independent microphone for instructor to speak into for audio recording.

CONTRACTOR'S ASSISTANCE REQUEST
FOR ACCESS TO COUNTY FACILITIES

PROJECT: EWRF & NWRF Disk Filter Improvements

DATE: _____ **NUMBER:** _____

LOCATION/STRUCTURE: _____

_____

PURPOSE: _____

_____

_____

ADDITIONAL ASSISTANCE REQUESTED: _____

_____

_____

_____

DATE ACCESS NEEDED: _____

DURATION OF WORK: _____

_____ _____

Contractor **O.C.U. Construction**

COMMENTS/RESTRICTIONS: _____

_____

_____

_____

_____

_____

_____

PLANT SUPERVISOR

SECTION 01025 MEASUREMENT AND PAYMENT

A. Payment

1. Work under this contract will be paid for on a lump sum basis as described on the Bid Schedule. The amount of payment will be as defined in the Contract.

2. The quotations for the work are intended to establish a total price cost for completing the work in its entirety.

3. Additions, deletions, modifications or changes to the work as defined by this contract will be performed by change order according to the General Conditions.

B. General

1. All work under this contract shall be included in the lump sum amount listed on the Bid Schedule.

2. Any items not shown or omitted that are required for a complete installation shall be installed by the Contractor at no additional cost to the County.

3. The prices shall include all labor, materials, tools, and equipment required to complete the work.

4. Payment for lump sum items shall be on a percentage of completion of the particular item basis.

C. Partial Pay Request

1. The installation of pipe and fittings includes backfilling, compacting, hydrostatic testing, fine grading, property restoration, clean up, and placing the facilities in operation. When measurements of the amount of work constructed each month are made, for the purpose of partial payment, the following will be considered:

   a. In addition to the retainage as set out in the Construction Contract, 10% of the amount of footage of pipe shall be withheld if the trench has not been backfilled, compacted, and tested.

b. In addition to the above, 10% of the amount of footage of pipe shall be withheld if the area has not been fine graded, properly restored to its previous condition, cleaned up, sodded, pressure tested, and ready to be placed in operation.

2. No less than 2% of the contract price shall be retained until the record drawings, specifications, addenda, modifications, and shop drawings are delivered and accepted by the County.

3. The Contractor will provide the following with each Partial Pay Request:

   a. Current record drawings for the County's review.

   b. Partial release of liens from all Vendors and Subcontractors.

   c. Photos of work completed.

   d. Consent of Surety Company for Partial Payment.

D. Description of Lump Sum Pay Items – EWRF/NWRF Disk Filter Improvements

Described below is a brief summary of the work to be accomplished for the amount in the Bid Schedule. The amount will include shop drawings, sample submittals, record drawing submittals, O&M manual submittals, clean-up, start-up, testing, and placing in operation. The summary is not intended to describe all items in detail, but to clarify the items on which the price is to be based. The summary does not relieve the Contractor of his responsibility to supply all items complete.

Description of Base Bid Pay Items:

1. **Base Bid Item No. 1 (NWRF Disk Filter System**) - This includes all labor, materials, supplies and equipment to furnish (with the exception of the Disk Filter Units), install, startup, and test the new disk filter improvements located at the NWRF site. This lump sum bid item is for the following elements as generally defined within the Contract Documents;

   a. Installation of six (6) new Disk Filter Units, furnished by others.

b. Installation of backwash system (furnished by others) for each filter unit including backwash manifold, backwash pumps, 3-inch backwash piping up to the connection with the 18" DR-1 riser, valves, and appurtenances, and backwash drive mechanism.

c. Installation of disk filter instrumentation and disk filter control panel (furnished by others).

d. Startup, testing and coordination with the Disk Filter Manufacturer as outlined in Section 01664.

e. Actuated influent valves for each filter unit.

f. All filter influent, effluent, backwash, waste, potable water and chemical piping located inside the concrete filter containment area which is not existing or supplied by the disk filter manufacturer.

g. Chemical injection assemblies, hose bibbs, emergency showers/eyewashes, and all other small diameter piping as shown on the drawings.

h. Grading modifications, concrete slabs, curbs, drainage ditches, sidewalks, process yard piping (secondary effluent, filtered effluent, reject, drainage, potable water, chemical, reuse, NPW etc.) manholes, stormwater conveyance, cleanouts, valve boxes, valves, concrete, reinforcement, excavation, fill, crushed stone, sheeting/shoring, dewatering, backfilling, restoration, testing, and other items shown on the drawings or specified herein, or as necessary to provide a complete operating system.

i. Electrical Improvements - This includes all labor, materials, supplies and equipment for the various electrical improvements associated with the NWRF Disk Filter Improvements including but not limited to ductbanks, wiring, transformers, pull boxes, vaults, pedestals, reinforcement, concrete pads, and other elements associated with the electrical system. It should be noted that the disk filter and the disk filter control panel are to be installed as shown on the drawings. This bid item includes all electrical

improvements including wiring, and terminations necessary to connect the Disk Filter Manufacturer furnished control panel with the various components mounted on the disk filter itself.

j. Instrumentation & Control Improvements - This includes all labor, materials, supplies and equipment for the various instrumentation and control improvements associated with the NWRF Disk Filter Improvements including but not limited to field instruments not supplied by the filter manufacturer, control panels & PLC's not supplied by the filter manufacturer, integration of the new filter control panels into the NWRF SCADA system, programming associated with all new PLC's as well as existing equipment in order to fully integrate the new disk filter system. All necessary licensing, and all other instrumentation and control elements necessary to fully integrate the proposed disk filters.

k. This includes all demolition/miscellaneous at the NWRF facility as shown in the drawings and detailed in the specifications.

l. General Requirements/Mobilization/Demobilization – This includes all costs associated with mobilization, temporary control facilities, utilities, permits and demobilization as specified herein.

m. Bonds/Permits/Indemnification – This includes all costs associated with bonds and permits as specified herein. The item shall include an amount for indemnifications specified in the Contract Documents and any addenda and modifications made thereto.

2. **Base Bid Item No. 2 (EWRF Disk Filter System)** - This includes all labor, materials, supplies and equipment to furnish (with the exception of the Disk Filter Units), install, startup, and test the new disk filter improvements located at the EWRF site. This lump sum bid item is for the following elements as generally defined within the Contract Documents;

a. Installation of five (5) new Disk Filter Units, furnished by others.

b. Installation of backwash system (furnished by others) for each filter unit including backwash manifold, backwash pumps, 3-inch backwash piping up to the connection with the 6-inch DR-1 riser, valves, and appurtenances, and backwash drive mechanism.

c. Installation of disk filter instrumentation and disk filter control panel (furnished by others).

d. Startup, testing and coordination with the Disk Filter Manufacturer as outlined in Section 01664.

e. All filter influent, effluent, backwash, waste, potable water and chemical piping located inside the concrete filter containment area which is not existing or supplied by the disk filter manufacturer.

f. Chemical injection assemblies, hose bibbs, emergency showers/eyewashes, and all other small diameter piping as shown on the drawings.

g. Grading modifications, concrete slabs, curbs, drainage ditches, sidewalks, process yard piping (secondary effluent, filtered effluent, reject, drainage, potable water, chemical, reuse, NPW etc.) manholes, stormwater conveyance, cleanouts, valve boxes, valves, concrete, reinforcement, excavation, fill, crushed stone, sheeting/shoring, dewatering, backfilling, restoration, testing, and other items shown on the drawings or specified herein, or as necessary to provide a complete operating system.

h. Electrical Improvements - This includes all labor, materials, supplies and equipment for the various electrical improvements associated with the EWRF Disk Filter Improvements including but not limited to ductbanks, wiring, transformers, pull boxes, vaults, pedestals, reinforcement, concrete pads, and other elements associated with the electrical system. It should be noted that the disk filter and the

disk filter control panel are to be installed as shown on the drawings. This bid item includes all electrical improvements including wiring, and terminations necessary to connect the Disk Filter Manufacturer furnished control panel with the various components mounted on the disk filter itself.

i. Instrumentation & Control Improvements - This includes all labor, materials, supplies and equipment for the various instrumentation and control improvements associated with the EWRF Disk Filter Improvements including but not limited to field instruments not supplied by the filter manufacturer, control panels & PLC's not supplied by the filter manufacturer, filtered effluent sample station, integration of the new filter control panels into the EWRF SCADA system, programming associated with all new and existing PLC's in order to fully integrate the new disk filter system. All necessary licensing, and all other instrumentation and control elements necessary to fully integrate the proposed disk filters.

j. This includes all demolition/miscellaneous at the EWRF facility as shown in the drawings and detailed in the specifications.

k. General Requirements/Mobilization/Demobilization – This includes all costs associated with mobilization, temporary control facilities, utilities, permits and demobilization as specified herein.

l. Bonds/Permits/Indemnification – This includes all costs associated with bonds and permits as specified herein. The item shall include an amount for indemnifications specified in the Contract Documents and any addenda and modifications made thereto.

m. This bid item includes the demolition and relocation of the existing Aqua-Aerobic Disk Filter. Piping and appurtenances are to be demolished as shown in the drawings and the existing filter will be relocated to the Orange

County South Water Reclamation Facility (SWRF) as described on the drawings.

END OF SECTION

SECTION 01027 APPLICATIONS FOR PAYMENT

PART 1 GENERAL

A. Requirement

1. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

2. 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.

3. 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.

B. Format

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.

C. Preparation of Application

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

   a. The initial Application for Payment: The Application for Payment at time of Substantial Completion and the final Application for Payment involve additional requirements.

2. 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.

3. 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.

   a. Submit applications typed on forms provided by the County.

   b. 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.

   c. 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.

   d. Each item shall have an assigned dollar value for the current pay period and a cumulative value for the project to-date.

   e. Submit stored material log, partial waivers of claims and mechanic liens, and consent of surety with each application, as further explained below.

4. 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.

5. 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.

    a. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.

    b. When an application shows completion of an item, submit final or full waivers.

    c. The County reserves the right to designate which entities involved in the Work must submit waivers.

    d. 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.

    e. Waiver Forms: Submit waivers of claims and lien on forms and executed in a manner acceptable to the County.

6. Transmittal: Submit six (6) 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.

    a. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the County.

    b. 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.

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

   a. List of Subcontractors

   b. List of principal suppliers and fabricators

   c. Schedule of Values

   d. Contractor's Construction Progress Schedule (accepted)

   e. List of Contractor's staff assignments

   f. Copies of building permits

   g. Copies of authorizations and licenses from governing authorities for performance of the Work

   h. Certificates of insurance and insurance polices

   i. Performance and Payment bonds (if required)

   j. Data needed to acquire County's insurance

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

   a. Relevant tests

   b. Progressive As-builts (one (1) paper copy and electronic copy)

   c. Table 01050-2 Asset Attribute Data Form Examples (one (1) paper copy and electronic copy)

   d. Table 01050-3 Pipe Deflection Table Example (one (1) paper copy and electronic copy)

e. Table 01050-4 Gravity Main Table (one (1) paper copy and electronic copy)

f. An electronic copy of all survey field notes

g. Partial Release of lien

h. Partial consent of surety

i. Site photographs

j. Updated Progress Schedule: submit one (1) electronic copy and five (5) copies

k. Summary of Values

l. Pay Request

m. On-Site Storage

9. 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.

   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

10. 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:

a. 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.

b. Completion of project close-out requirements

c. Completion of items specified for completion after Substantial Completion

d. Assurance that unsettled claims are settled

e. Assurance that work not complete and accepted is now completed

f. Transmittal of required project construction records to the County

g. Proof those taxes, fees and similar obligations have been paid

h. Removal of temporary facilities and services has been completed.

i. Removal of surplus materials, rubbish and similar elements

j. Change of door locks to County's access

k. Execute certification by signature of authorized officer.

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

D. Submittal Procedures

1. Submit four (4) copies of each Application for Payment at time stipulated in Agreement.

2. Submit under transmittal letter.

E. Substantiating Data

1. When the County requires substantiating information, submit data justifying line item amounts in question.

2. 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

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SECTION 01040 CONSTRUCTION COORDINATION

A. Coordination

1. Other phases of construction may begin before this contract is completed which will interface with this work. Additionally, other projects will be constructed adjacent to the Work during the life of this contract. Coordinate your activities with the other contractors to allow orderly and timely completion of all the work.

2. When access through interfacing and/or overlapping construction areas must be disrupted, provide alternate acceptable access for other contractors.

3. Coordinate your activities in the interface or common areas with these other contractors. Submit to the Owner and Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors.

4. The existing wastewater treatment facilities must remain in service at all times during construction.

5. All contact, request, coordination with all County Personnel including but not limited to the EWRF/NWRF Operation staff for any reason shall be initiated through Owner's Resident Project Representative (R.P.R.)in writing by the Contractor processing a Construction Assistance Request (C.A.R.). Contractor will not have contact with any County personnel without processing of a C.A.R. through the County's R.P.R.

6. Unless otherwise noted within the Contract Documents, for all activities affecting treatment process operation, a CAR shall be submitted a minimum of thirty (30) days in advance of the scheduled activity. Unless otherwise noted within the Contract Documents, the schedule for performing work which will require shutting down a unit process must be coordinated with the Owner by CAR submittal a minimum of sixty (60) days in advance of the scheduled activity. Connections to existing piping and structures must be coordinated with the Owner as described herein or other pertinent Sections. The Owner will provide the Contractor with the day and start/stop points for the aforementioned allotted time period.

B. Utilities

Coordinate the activities of all utility companies with equipment in the construction area with the Contractor's and subcontractors' work.

C. Cutting and Patching

No cutting and patching of new work will be accepted. All work must be new and continuous in its final form.

D. Scheduling

Certain items cannot be removed, replaced, abandoned, or demolished until certain other work has been accomplished. The following describes the other work to be accomplished before such work may be performed. The contractor shall take the following items into account when creating the construction schedule required by Section 01310:

1. Sequence of Construction - EWRF

    a. The Contractor shall prioritize the installation of the disk filters at EWRF.

    b. Install storm water Best Management Practices prior to any work on the sites.

    c. Perform demolition and abandonment of existing utilities. Reference the Drawings and other Sections for areas of demolition and abandonment that require coordination with replacement utilities or other process improvements. Refer to Item “g” of this section for decommissioning of existing disk filters.

    d. Clear and grub site. Install filter vessels and appurtenances, yard piping, above ground process piping and electrical/instrumentation & control improvements.

    e. Perform field testing of individual process equipment, as described in the equipment specifications. Perform start-up testing and system testing of treatment process, as described in Section 01664.

    f. The south side of the Phase V splitter box (Process 360) and the Phase V Chlorine Contact Basin (Process 580) can be isolated from the plant and utilized for testing of the EWRF disk filters.

g. The proposed turbidity analyzers shall be installed, and calibrated prior to testing of the disk filters. Secondary effluent can be supplied from the Phase V Splitter Box (Process 360) to the disk filters for testing, the filtered effluent during testing can be discharged to the Phase V Chlorine Contact Basin (Process 580). If the disk filter effluent during testing is less than the maximum TSS limit as described in Section 11399 it can be discharged from the chlorine contact basin (Process 390) into the effluent pump station. If the effluent exceeds the allowable TSS limit in Section 11399 it shall be discharged into the north side of the Phase V splitter box (Process 360). All required pumping, temporary piping, and other requirements to discharge filtered effluent to the Phase V splitter box, should it be required, shall be the responsibility of the contractor.

h. Once the new EWRF disk filters are substantially complete and in operation the existing Aqua disk filter may be taken out of service and relocated. Contractor to relocate Aqua disk filter to SWRF disk filter location four (4). Contractor shall connect filter to existing piping. Start-up will be provided by Owner.

i. As described in Section 01664, Part 1.A., the Contractor is to perform system start-up and system testing procedure for the following major facilities;

(1) Tertiary Treatment

(a) NWRF Disk Filters (Process 065)

(b) EWRF Disk Filters (Process 570)

(2) As described in Section 01664, the Contractor is to perform system start-up and system testing procedure for the remaining facilities

(3) Existing roadway & storm drain repairs, sidewalks and perform fine grading over the site.

END OF SECTION

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SECTION 01050 SURVEYING AND FIELD ENGINEERING

PART 1 - GENERAL

A. Description

1. 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.

2. 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.

B. REQUIREMENTS

1. Survey Services

a. 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.

2. Engineering Services

a. The Engineer shall be responsible for duties during Construction to include, but not limited to:

1) Inspections, testing, witnessing requiring a licensed Professional Engineer.

2) Design of temporary shoring, bridging, scaffolding or other temporary construction, formwork and protection of existing structures.

3) Other requirements as specified herein.

b. Engineering related designs, tests and inspections shall be signed by the licensed Professional Engineer as required by the County.

C. Qualifications of the Surveyor

The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the County. Prior to any services being performed, the Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the County prior to Notice to Proceed. It is recommended that the Surveyor attend the Pre-Construction meeting. Any Surveyor, who has not previously performed work for the County shall attend the Pre-Construction meeting.

D. Submittals

1. Provide qualifications of the Surveyor or Engineer.

a. 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.

b. A Professional Engineer shall be of the discipline required for the specific service for the Work.

c. 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.

2. On request, submit documentation verifying accuracy of survey work.

3. Surveyor shall certify all elevations and locations included in Table 01050- 2, 3, and 4.

PART 2 - PRODUCTS

A. Survey Documents

1. 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.

2. 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-feet 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

Table 01050-1
Minimum Survey Accuracies

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
			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

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	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	

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe

Valves Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	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

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe | Pumpstation | Well

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	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	

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe | Pumpstation | Well

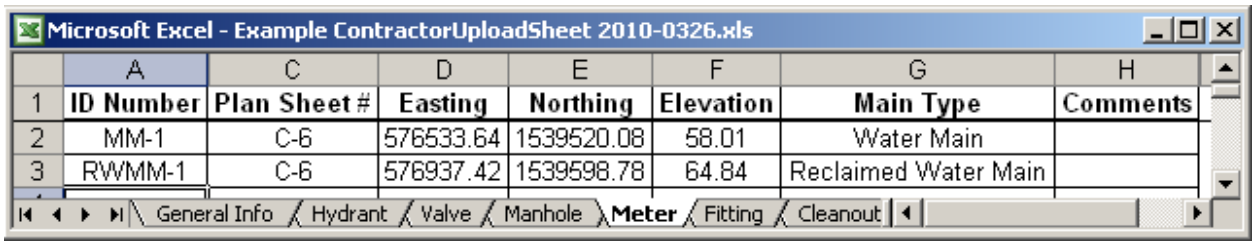
Manhole Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	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 N	Invert Elv NE	Invert Elv E	Invert Elv SE	Invert Elv S	Invert Elv SW	Invert Elv W	Invert Elv NW	Manufacturer
2	MH-1	C-20	517999.15	1483092.24	82.96	76.96		76.96		76.91				Brand X
3	MH-2	C-20	517999.15	1483492.24	83.54	75.63				75.58				Brand X

Manhole | Meter | Fitting | Cleanout | Pipe | Pumpstation | Well | Property or Easement Corner | Existing OC Utility

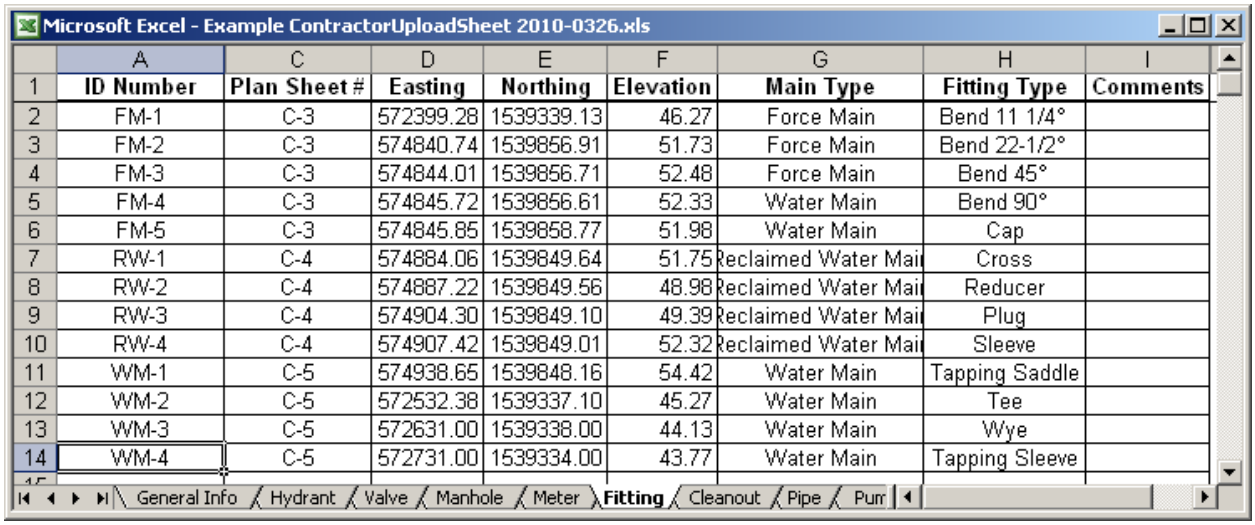
Meter Worksheet


Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	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	

General Info | Hydrant | Valve | Manhole | **Meter** | Fitting | Cleanout

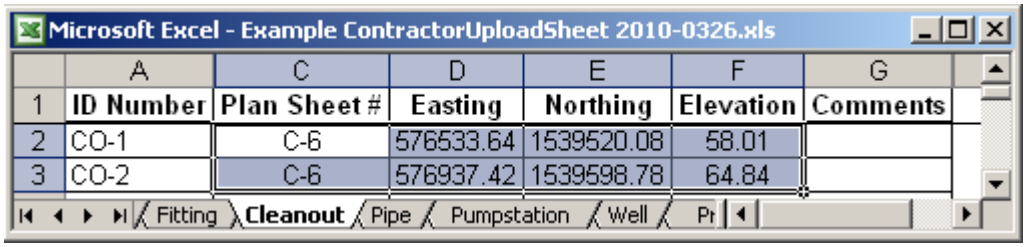
Fitting Worksheet


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 Mai	Cross	
8	RW-2	C-4	574887.22	1539849.56	48.98	Reclaimed Water Mai	Reducer	
9	RW-3	C-4	574904.30	1539849.10	49.39	Reclaimed Water Mai	Plug	
10	RW-4	C-4	574907.42	1539849.01	52.32	Reclaimed Water Mai	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	

General Info | Hydrant | Valve | Manhole | Meter | **Fitting** | Cleanout | Pipe | Pum

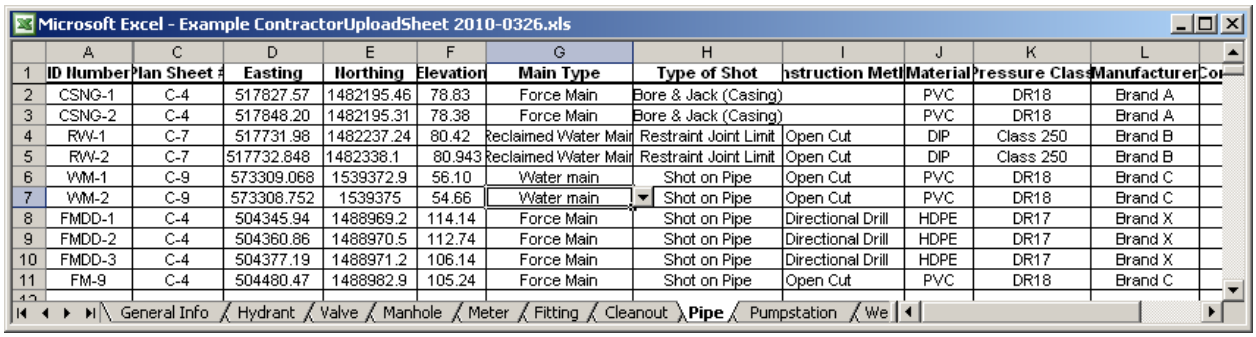
Cleanout Worksheet


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	

Fitting | **Cleanout** | Pipe | Pumpstation | Well | Pr

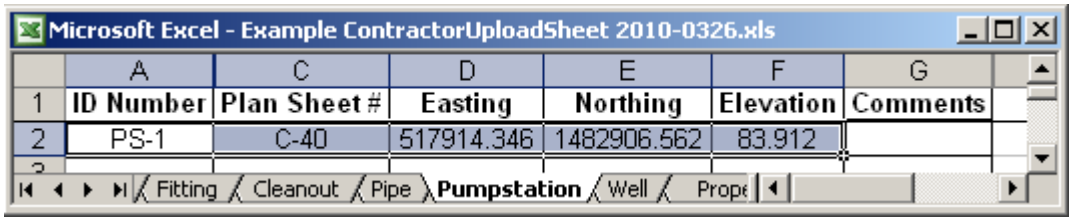
Pipes Worksheet


Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

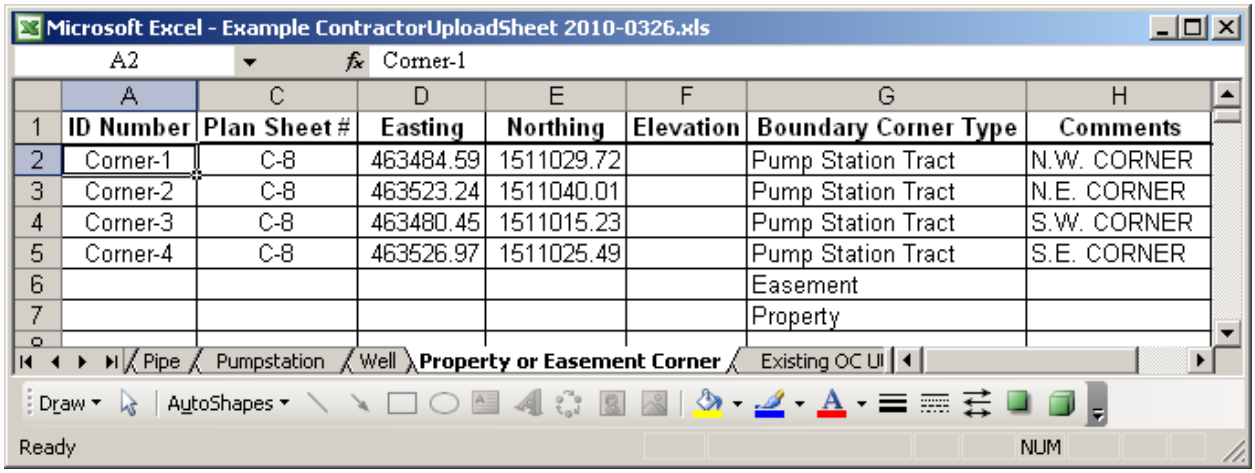
	A	C	D	E	F	G	H	I	J	K	L
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Type of Shot	nstruction Meth	Material	Pressure Class	Manufacturer
2	CSNG-1	C-4	517827.57	1482195.46	78.83	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A
3	CSNG-2	C-4	517848.20	1482195.31	78.38	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A
4	RW-1	C-7	517731.98	1482237.24	80.42	Reclaimed Water Mai	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B
5	RW-2	C-7	517732.848	1482338.1	80.943	Reclaimed Water Mai	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

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | **Pipe** | Pumpstation | We

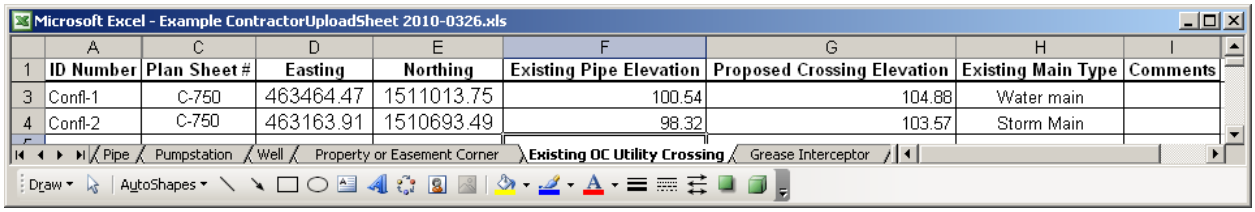
Well Worksheet



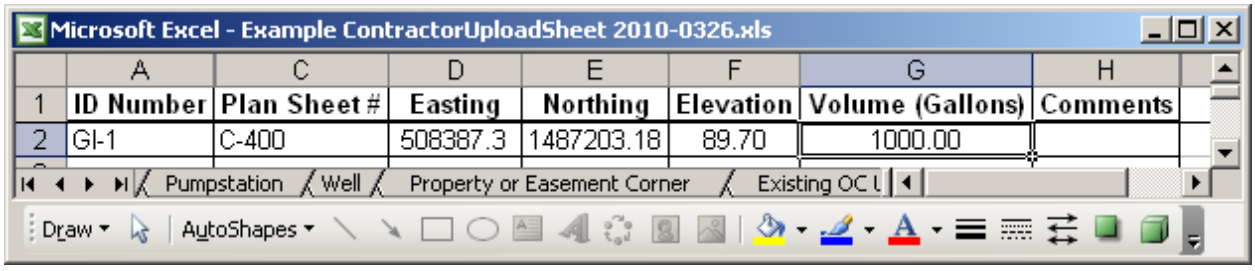
Easements Worksheet



Existing OC Utility Crossing



Grease Interceptor

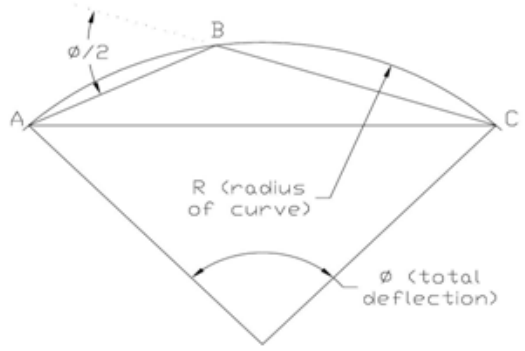


For ease of calculating pipe deflections in Table 01050-3, begin by providing a unique asset ID (top of pipe shots and fittings) for each utility and type, numbered sequentially along the pipe run (including changes in direction) from start to finish of the pipe in the Table 01050-2. Then branches and 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		FM	
Pipe Manufacturer		National Pipe	
Pipe size & material		16" PVC C905	
PVC Manufacturer Deflection		6	**inches**
County Allowable Deflection	75%	4.5	**inches**
Allowable Angle of Offset		1.5	**degrees**
Allowable Radius of Curvature		764	**feet**
Laying Length of Pipe		20	**feet**



ID	Size and Type	Northing	Easting	Elev.	Calculations Including Elevation (XYZ)						
					Distance between points AB	Distance between points BC	Distance between points AC	Total Deflection Ø*	Radius of Curve**	Average Offset Angle***	Average Offset****
					Length AB	Length BC	Length AC	XYZ (w/ elevation)	XYZ (w/ elevation)	per laying length	per laying length
					ft	ft	ft	degrees	ft	degrees	inches
14041	16" FM	1505131.50	468948.53	107.68	-	-	-	-	-	-	-
7000	16" FM	1505059.60	468932.08	108.15	73.76	38.93	112.66	5.48	1,178.35	0.97	4.07
2128	16" FM	1505022.11	468921.60	108.55	38.93	39.61	78.54	2.29	1,961.65	0.58	2.45
2127	16" FM	1504983.85	468911.35	108.29	39.61	38.35	77.96	1.78	2,505.50	0.46	1.92
2126	16" FM	1504946.67	468901.96	107.81	38.35	39.13	77.42	8.79	505.16	2.27	9.51
2125	16" FM	1504908.11	468895.31	107.48							

Data that has be inputted

Values in yelloware over spec

*Uses law of cosines to determine angle ABC and Ø.
angle ABC = arccos((AB²+BC²-AC²)/(2*AB*BC))
180-Ø/2 = angle ABC
Calculate the total deflection Ø.
to the outer point (A or C) is equal in angle to
the approach from the next point along the

** Uses law of sines, using the chord length AC and radius R.
Since sin((Ø/2)*(PI/180))=(Chord/2)/R and length AC=Chord
R=AC/(2*sin(Ø*PI/360)
This calculation assumes an average radius over the bend between three points.

*** Adds the lengths of AB + BC / 20ft to get an approximate number of bends over the span.
This value is divided by the total deflection
angle to calculate the average bend angle of
This assumes that the bend angle consistent across the entire length.

**** Uses average offset angle and laying length of pipe.

PART 3 - EXECUTION

A. Survey Field Work

1. 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.

    a. 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.

b. 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.

2. 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.

3. Use survey control points to layout such work tasks including but not limited to:

   a. Clearing, grubbing, work limits, right-of-way lines and easements

   b. Locations for pipelines and all associated structures and appurtenances

4. 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.

B. Surveying

1. 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.

a. Record locations, with horizontal and vertical data, on project As-Built survey.

b. Make no changes or relocations without prior written notice to the County or without receipt of written approval from the County.

c. Report to the County when any control point is lost or destroyed or requires relocation because of necessary changes in grades or locations.

2. 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.

3. 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 ft. intervals using Surveyor's level instrument.

C. Survey Documents

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

SECTION 01065 PERMITS AND FEES

A. General

The Contractor shall:

1. Obtain and pay for all permits and licenses as provided for in the General Conditions, except as otherwise provided herein.

2. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.

3. Comply with all conditions specified in each of the permits and licenses.

4. The Contractor shall, within 14 days of the date of the Notice-to-Proceed, prepare for and attend a meeting with representatives from the Owner and the Engineer to review requirements for preparation of a Florida Department of Environmental Protection (FDEP) Notice-of-Intent (NOI) application and Storm Water Pollution Prevention Plan (SWPPP) for compliance with the USEPA's NPDES General Permit for construction activities.

B. Permits by Contractor

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

1. FDEP Notice of Intent to use the Generic Construction NPDES permit (See Section 02270).

2. St. John's River Water Management District Dewatering Permit. Refer to Section D below.

3. Orange County Division of Building Safety - Commercial Building Permit(s).

   a. General Commercial Building Permit – The County will pay all fees associated with the General Commercial Building Permit from the Orange County Division of Building Safety. Orange County Utilities Engineering will provide Resident Project Representatives for inspection services associated with the Utilities Engineering Division.

   b. Subtrade Commercial Building Permit(s) - The Contractor shall pay for and obtain all the Sub-

trade Commercial Building Permits associated with the General Building Permit. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.

4. The Contractor shall pay for and obtain all other permits as required to perform the Work.

C. Permits by County

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

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

D. Dewatering Activities

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

END OF SECTION

SECTION 01118 OWNER-FURNISHED EQUIPMENT

1.01 GENERAL

The Owner will furnish the following items of equipment:

Item	Quantity
Disk Filter Units and Appurtenances EWRF	5
Disk Filter Units and Appurtenances NWRF	6

1.02 DELIVERY DATES FOR OWNER-FURNISHED EQUIPMENT

The Owner anticipates the following delivery dates for the Owner-furnished equipment to arrive at NWRF and EWRF by the Manufacturer and unloaded by the Contractor. Contractor shall store equipment at locations pre-determined by the Owner.

Item	Anticipated Delivery Dates
EWRF Disk Filter Units	12/2017 to 01/2018
NWRF Disk Filter Units	12/2017 to 01/2018

1.03 CUSTODY

The Contractor shall assume custody of the above equipment when the Contractor takes delivery at the Owner's storage facility and shall assume liability for damage to the equipment thereafter. The Owner will not accept title to the equipment until the project is substantially complete in accordance with the General Requirements.

1.04 INSPECTION

Upon transferal of the Owner-furnished equipment to the Contractor, the Contractor and the Owner shall make a joint inspection of the condition of each piece of equipment and shall note, in writing, the defects in said equipment. Damage or loss of equipment and materials after the date of their transfer to the Contractor shall be repaired or replaced at the Contractor's expense.

1.05 DELIVERY OF EQUIPMENT

A. The Contractor shall unload valves, pumps, disk filter units, and appurtenances upon delivery by the Manufacturer. Contractor shall store equipment at locations pre-determined by the Owner at NWRF and EWRF. The Contractor shall provide a crane as

required and load the equipment onto the Contractor's truck as necessary to relocate to the direct area of work as needed for installation. The Contractor shall coordinate with the Owner prior to relocating the equipment to the area of work.

1.06 EQUIPMENT STORAGE--GENERAL

Equipment shall be stored at locations pre-determined by the Owner at both NWRF and EWRF. Disk Filter Units shall be covered by tarps securely fastened by means determined by the Contractor.

1.07 STORAGE OF PUMPS

Pumps shall be stored and maintained as described by the Manufacturer. When extended storage is required, pumps shall be moved to an enclosed structure as to remove it from environmental conditions.

1.08 STORAGE OF ELECTRIC MOTORS

If electric motors are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer’s recommended procedures for extended storage. Provide temporary covers over the motor electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Inspect electrical contacts during installation.

1.09 OWNER-FURNISHED TECHNICAL ASSISTANCE

A. A field service representative from the manufacturers of the following Owner-furnished equipment will be available to provide technical direction and certain other services:

Item	Name of Manufacturer
Disk Filter Units	Alfa Laval

B. Contractor will be responsible for coordinating with manufacturer's representative for providing necessary services.

END OF SECTION

SECTION 01200 PROJECT MEETINGS

A. Preconstruction Conference

Pursuant to Article 5 of the General Conditions, a pre-construction conference will be held to discuss submittals as indicated in Section 01300 of this division and the Contractor’s responsibilities described in the General Conditions.

B. Monthly Progress Meetings

On days as mutually agreed upon in the pre-construction conference, monthly progress meetings shall be held at the County's office or Contractor's project office to review the progress of the work and required submittals. The Engineer shall prepare the meeting agenda and meeting minutes for the monthly meetings.

C. Field Meetings

At strategic times during the construction process, as specified in the standard specifications and other locations in the Contract Documents, field inspection meetings shall be requested by the Contractor. Contractor shall coordinate such field inspection meetings as to fulfill requirements of these documents prior to the approval of progress pay requests for such items. The Contractor shall document the decisions and directives administered during Field Meetings within the Contractor’s Daily logs.

D. HMI Screen Workshop

As part of the submittal process the Contractor shall schedule and attend a HMI screen submittal workshop. The Contractor shall coordinate with the Orange County RPR via a CAR in order to schedule the workshop with the ISS, APS, Engineer, Orange County Field Services, Operations staff, and Orange County SCADA. Prior to the workshop the Contractor/ISS/APS shall coordinate with the equipment manufacturer in order to incorporate any information from local equipment control panel HMI screens. The draft HMI screens shall be distributed no later than seven days prior to the workshop so that all parties may review. The Contractor shall provide color copies of all proposed HMI screens to all attendees at the meeting. Should substantial revisions be necessary to the HMI screens following the workshop an additional workshop will be scheduled at no cost to the Owner.

E. Project Close-Out Meeting

A project close-out meeting shall be held to finalize and secure the requirements as specified in Section 01700 of this division.

F. Attendance

The Contractor's relations with his subcontractors and material suppliers and discussions relative thereto are the Contractor's responsibility as described in the General Conditions and are not part of the project meetings content. Persons designated by the Contractor to attend and participate in project meetings shall have all required authority to commit the Contractor to solutions as agreed upon in the project meetings.

G. Minutes of Progress Meetings

The County’s Consultant will compile a report of each progress meeting and will distribute copies to the Owner and the Contractor. The Contractor shall make and distribute other copies as necessary to subcontractors.

END OF SECTION

SECTION 01300 SUBMITTALS

A. General

1. This section includes the submissions of shop drawings, samples, operation and maintenance manuals and record drawings. There are other requirements in the Contract documents for submittals that are not addressed herein.

2. The submittal shall contain a copy of the pertinent specification Section(s) respective to that submittal, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Accompanying a copy of the pertinent specification Section(s) as noted in Part A.2, the submittal shall contain a copy of the contract mechanical process, structural, electrical and instrumentation drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

4. Submittals shall be identified per the respective specification Sections which the elements are specified within.

5. The Contractor shall group all elements specified within a respective specification Section into a singular submittal per that specification Section. For certain specification Sections with a large volume of content, the Contractor may provide no more than three (3) submittals for inclusive content within a singular specification Section.

6. Shop drawings and other submittals will be reviewed no more than twice at the Owner’s expense. All subsequent reviews will be performed at times convenient to the Engineer and at the Contractor’s expense, based on the Engineer’s then prevailing rates. The Contractor shall reimburse the Owner for all such fees invoiced to the Owner by the Engineer. Submittals are required until accepted. Any need for more than one (1) resubmission, or any other delay in obtaining Engineer’s review of submittals, will not entitle Contractor to extension of the Contract Time.

7. Partial submittals will not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor and will be considered “Not Accepted” until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

8. Identify submittals with the name of the project, date, and accompany each lot submitted with a letter of transmittal referring to the name of the project, the specification page number, and/or drawing number, and tag number for identification for each item. Submittals for each type of work shall be numbered per specification consecutively, and the numbering system shall be retained throughout all revisions.

9. In all submittals and schedules, allow 30 days for the Engineer's review of each shop drawing submittal or resubmittal.

10. Resubmittals will be handled in the same manner as first submittals. On resubmittals, the Contractor shall identify all revisions made to the submittals, either in writing on the letter of transmittal or on the shop drawing by use of revision triangles or other similar

methods. The resubmittal shall clearly respond to each comment made by the Engineer on the previous submission. Additionally, the Contractor shall direct specific attention to any revisions made other than the corrections requested by the Engineer on previous submissions.

B. Shop Drawings

1. Prepare shop drawings in accordance with Article 9 of the General Conditions and send to the Engineer carriage prepaid. Submit shop drawings and product data for all materials and equipment to be incorporated into the Work.

2. The term "shop drawing" as used herein includes fabrication, erection and installation, layout, and setting drawings, manufacturer's drawings, descriptive literature, catalogs and brochures, performance and test data, mix design, wiring and control diagrams, all other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems, and the positions thereof conform to the Contract requirements. As used herein, the term "manufactured" applies to standard units usually mass-produced; and "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements.

3. Shop Drawings shall be prepared and submitted with identification per specification section wherein the elements are specified, e.g. 15100-001A for Manual, Check, and Process Valves.

4. Multiple shop drawings shall not be submitted for individual respective elements within a single specification section. One shop drawing shall be prepared per specification section in order to encompass all elements within that specification. For large specification sections, a group of no greater than three shop drawings shall be prepared for those sections.

5. Shop drawings shall establish the actual detail of all manufactured or fabricated items, indicate proper relation of adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual

conditions. Shop drawings shall be drawn to scale and shall be completely dimensioned.

6. If shop drawings cover more than one piece of equipment or components, the shop drawing shall show the entire assembly and the relationship and connections between all components.

7. Supply short and long term storage procedures on all equipment submitted.

8. Coordinate the shop drawings from different manufacturers and supplies so that all equipment and material will fit and work together.

9. The contract drawings are diagrammatic and are intended to indicate general arrangement of equipment, ducts, conduits, piping, and fixtures. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposes to supply both as pertains to his own work and any work affected under other parts, headings, or divisions of drawings and specifications. Changes shall be reviewed in advance by the Engineer.

10. Shop drawings, including manufacturer's literature, catalog cuts, or other printed material shall be entitled with the name of the project on each sheet and shall otherwise be identified by listing the particular Division, Section, Article, or reference of the work pertaining thereto. Differing items shall not be submitted on the same sheet. For acceptance of differing items, any deviations shall be highlighted and annotated.

11. Once a final shop drawing has been approved, two hard copies shall be printed and delivered to the Orange County R.P.R. for their records within 14 days of the shop drawing approval.

C. Samples

Submit physical examples to illustrate materials, equipment, or workmanship and to establish standards by which work is to be evaluated.

D. Equipment Operation and Maintenance Manuals

1. Provide installation, operation, and maintenance manuals from manufacturers and suppliers. Submit three (3) hard copies and one (1) electronic copy of manuals to the RPR within 30 days after review of shop drawings, product data, and samples and not later than the date of shipment of each item of equipment to the project site. Electronic copies shall be submitted in “PDF” format.

2. Provide manuals for each piece of equipment including individual components and subsystems of complete assemblies. Line out all non-applicable text and illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

3. The manual shall contain the following:

   a. Manufacturer's identification, including order number, model, and serial number.

   b. Blue line prints or reviewed shop drawings and diagrams of all systems, including temperature control system.

   c. Certified equipment drawings or reviewed shop drawing data clearly marked for equipment furnished.

   d. Complete operating and maintenance instructions for each and every items of equipment, setting forth in detail and step-by-step the procedure for starting, stopping, operating and maintaining the entire system as installed. A schedule of recommended maintenance intervals shall also be included.

   e. Complete parts list of all replaceable parts, their part numbers, and the name and address of their nearest vendor.

   f. A complete valve tag list including the name and function of the pipe in which the valve is mounted.

   g. Any special emergency operating instruction and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

h. All manufacturer's equipment guarantees and warranties.

4. Brochures shall be loose leaf with durable plastic or fiberboard covers. Each sheet shall be reinforced to prevent tearing from continued use, and each brochure shall have the following information clearly printed on its cover:

   a. Project name, name of County and address.

   b. Name and address of Engineers.

   c. Name and addresses of Contractors and subcontractors and department to contact.

   d. Telephone number of contractors, including night and emergency numbers.

   e. Major equipment vendors' names and telephone numbers.

5. In addition to these written instructions, fully and carefully instruct the County or his selected representatives as to the proper care and maintenance of each system and its equipment, and provide signed statements from personnel receiving such instructions to the Engineer.

6. Submit complete manuals at least two weeks before the date of the instruction.

7. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start up equipment.

E. Disk Filter Operation and Maintenance Manual

The Contractor is required to retain a Professional Engineer that is licensed in the State of Florida in order to prepare an Operations and Maintenance Manual for the new disk filter improvements. The Operations and Maintenance Manual shall meet the requirements and criteria noted within Rule 62-620 FAC and for preparation of Form 62-620.910(13) for the Notice of Availability of Record Drawings and Final Operations and Maintenance Manuals. The Engineer shall prepare a draft O&M Manual that will be submitted to Orange County Utilities for final review and acceptance.

F. Compilation of Manufacturer's Warranties & Certification Letters

The Contractor shall provide and compile all documentation and pertinent information regarding all warranties on the disk filter improvements into compilation notebook(s). The warranties shall be collated in a series of notebooks that shall be indexed by equipment tag number, unit processes and/or other pertinent organizational method as directed by Orange County Utilities. The notebooks shall include a singular table which shall document the commencement and expiration dates of all warranties on the project. The table shall be electronically transmitted to Orange County Utilities in MS Excel format. The information shall be formatted in a manner, as directed by the Orange County Utilities Operations staff, for input and incorporation into the County's Maximo Asset Management software. The warranties shall be accompanied by the manufacturer's certification letters that are supplied to the County for each respective piece of equipment furnished. The letters provide certification from the manufacturer that the equipment was properly installed in accordance with the contract documents, manufacturer's requirements and is operating properly at commencement of service. The letters shall be provided in the same divider as the warranty information.

G. Maximo Asset Management Software – Equipment Data

The Contractor shall prepare an MS Excel based spreadsheet in a format as provided or directed by the Orange County Utilities Operations staff, for pertinent specification data from all equipment furnished within the Project for input into the County's Maximo Asset Management software.

END OF SECTION

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SECTION 01310 PROGRESS SCHEDULES

PART 1 GENERAL

A. Requirement

1. 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.

2. The Progress Schedule will consist of the Initial Submittal, Payment Submittals and Revision Submittals. Upon acceptance by the Project Manager, 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.

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

B. Glossary Of Terms

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

a. 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.

b. 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 Project Manager or returned as no resubmittal required.

c. 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.

d. 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.

e. 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.

f. 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.

g. Official Schedule – The Initial or most recent Revision Submittal accepted by the Project Manager 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.

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

i. 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.

C. Quality Assurance

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

2. The Contractor will obtain a written interpretation from the Project Manager, 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.

3. 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.

4. 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.

5. 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 Project Manager through a written interpretation or by a separate, written notation on the returned Progress Schedule Submittal.

D. Allowances

Work covered by contractual allowances will be completed within the Contract Times. The Progress Schedule will incorporate the Contractor's best estimate of the activities, logic and restraints required, using the information in the Contract Documents or as indicated by the Project Manager in writing.

E. "Or Equals" And Substitutions

Activities in the Initial Submittal will be based strictly on the products named or specified in the Contract Documents and will not reflect any "or equal" or substitute materials or equipment, even if the Contractor intends to pursue "or equal" and substitution proposals. This limitation also applies to Means and Methods indicated in or required by the Contract Documents.

F. Milestones And Schedule Recovery

1. The Project Manager 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.

2. Whenever any Activity slips by fourteen (14) or more Days from the Late Date for an activity in the Official Schedule, Milestone Dates selected by the Project Manger, 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).

3. Upon evaluation of that Revision Submittal, if the Project Manager 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.

G. PROGRESS SCHEDULE SOFTWARE

1. The scheduling software employed by the Contractor to process the Progress Schedule will be the current version of Oracle's Primavera P6 Professional Project Management, or Oracle's Primavera Contractor CPM scheduling software.

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

H. NON-PERFORMANCE

1. The Project Manager 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.

2. In the event the Contractor fails, refuses or neglects to comply to a significant extent with the Progress Schedule submittal requirements of this Section, the Owner may reduce progress payments by the Project Managers estimate of the value of scheduling services not performed. A final Change Order will adjust the Contract Amount accordingly.

3. If justified under the circumstances, the Owner 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.

I. Non-Performance

1. The Project Manager 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.

2. If justified under the circumstances, the Owner 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

J. Reports, Schedules And Plots

1. 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.

2. CPM Schedule Plots will be plotted on a suitable time scale and identify the Contract Times, Critical Paths, phases and work areas on 24"x 36" 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.

3. 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.

4. 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.

K. Narrative Requirements

1. 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 periods, shifts, weekend Work and multiple calendars applied to activities and an explanation of the basis for restraint dates

2. 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.

3. 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.

4. 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 Submittals 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 or Project Manager, except as otherwise specifically stated.

L. Activity Requirements

1. 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. Separate Activities will be used for County-furnished equipment, interfaces with other work and other responsibilities of the County, Project Manager and Professional.

2. Activities will be detailed to the extent required to show the transition of trade Work. Activities will delineate the progression of the Work through mass excavation, substructure, superstructure, equipment installation, start of piping and conduit rough-in, building enclosure, mechanical and electrical equipment hook–up phase, building mechanical, electrical and plumbing (MEP), interior finishes, training of County personnel, equipment checkout & testing and start–up.

3. Submittal Activities will segregate long-lead items, any item requiring structural access and other procurements that, in the Contractor’s judgment, may bear on the rate of progress. If the Contract Documents require MEP coordination drawings, separate MEP coordination drawing Activities will be used for each floor. Allow time for reviews per Section 01300 and the General Conditions, and revisions and re-submittals. Also include activities for or provide a separate tabular schedule of submittal dates for all shop drawings, product data, and samples including County furnished products and the dates reviewed submittals will be required from the Project Manager. Indicate decision dates for selection of finishes.

4. Activities will not combine separate or non-concurrent items of Unit Price or lump sum Work, Work in separate structures and Work in distinct areas, locations or floors within an area or structure; or rough-in and finish Work.

5. Activity durations will equal the work Days required to sufficiently complete the Work designated by the Activity, Installation Activities will last from zero (0) to fifteen (15) workdays. Submittal review activity durations shall conform to specified timeframes.

6. Activities will be assigned consistent descriptions and identification codes. Sort codes will group Activities by building or structure, floor or area, Change Order and other meaningful schemes.

7. 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.

M. Float Tolerances And Float Ownership

1. 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 twenty (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.

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

3. 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.

4. The critical path shall include a minimum 10% float time as part of the Contract Time for unforeseen conditions. Contractor shall provide additional float time above the required minimum 10% based on his experience, understanding of the scope, and inspection of the site. The float time should be represented in the schedule by an activity with the contingency time represented by the activity duration. This activity should be sequenced to between the completion of all final work activities and the Substantial Completion milestone for the project.

N. Submittals

1. Each Progress Schedule Submittal will consist of a narrative, five (5) copies of the required reports and

plots and an optical ROM data disk with the Contractor's corresponding schedule.

2. The Project Manager 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.

3. Requirements for the Initial Submittal:

   a. Within forty-five (45) Days after receipt of Notice to Proceed and prior to commencing Work on the Project, prepare and submit to the Project Manager 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.

      (1) 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.

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

   c. If the Project Manager 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 Project Manager will rely on the available Payment and Revision Submittals, subject to whatever adjustments it determines appropriate.

4. Requirements for Payment Submittals:

   a. 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.

b. 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 time's 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.

c. 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.

5. Requirements for Revision Submittals:

a. 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 Project Manger 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.

b. 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 Project Manager using the electronic files and data furnished by the Contractor, any such extension in Contract Time will not be granted.

6. Retrospective Delay Analysis.

   a. If the Project Manager 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.

   b. 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 Project Manager consented to contemporaneously (i.e., before the closing date) in writing. Second, they reflect comments or objections raised by or on behalf of the Project Manager 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

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SECTION 01323 SCHEDULE OF VALUES

A. Preliminary Schedule of Values

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

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

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

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

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

5. The total value of electrical work.

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

7. Record Drawings/Operations and Maintenance (O&M) Manuals/Warranty and Certification Documentation. A minimum of 0.5% of the total Contract Amount shall be included within the Schedule of Values for the Contractor's preparation of Record Drawings, Operations and Maintenance Manuals and the Warranty and Certification Documentation.

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

9. The Contractor and Engineer shall meet and jointly review the preliminary schedule of values and make any adjustments in value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major work components. Front-end loading will not be permitted. The Engineer may require reallocation of major work components from items in the above listing if, in the opinion of the Engineer, such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of the notification of the required reallocation.

B. Detailed Schedule of Values

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

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

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

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

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

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

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

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

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

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

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

C. Incorporation of Schedule of Values into CPM Schedule

1. In conjunction with each submittal of the construction schedule, submit a cash flow projection indicating estimated earnings by month during the entire contract period and a schedule of values of the work using the "Schedule of Values" described above, including quantities and prices. The aggregate of these extended

prices shall equal the contract price. Costs shall include all materials, labor, equipment, and appurtenant items necessary to accomplish the work in accordance with the contract documents. This schedule shall be satisfactory in form and substance to the Engineer and shall subdivide the work into the specified component parts. Upon review by the Engineer, incorporate the schedule into the form for Application for Payment. The Owner reserves the right to delete (or add) items of work from the contract and the total contract amount shall be reduced (or increased) by the total amount shown in the schedule of values.

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

D. Cross-Reference Listing

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

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

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

E. Changes to Schedule of Values

1. Changes to the CPM schedule which add activities not included in the original schedule but are included in the original work (schedule omissions) shall have values assigned as reviewed by the Engineer. Other activity

values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer.

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

END OF SECTION

SECTION 01380 CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

A. Quality Assurance

1. Aerial Photographer: Qualified as a commercial photographer, engaged as a professional in business for a period of not less than three years. Electronic ground level photos do not require a professional photographer.

2. Site photos may be submitted digitally as photographed by the Contractor.

B. Submittals

1. Submit sample photographs, aerial vantage points, monthly vantage points, file structure, etc…

2. Submit a proof of the final completion aerial.

PART 2 - PRODUCTS

A. Monthly Progress Photos – Digital

1. The Contractor may furnish monthly progress photos in digital format from typical monthly vantage points and site locations as mutually agreed upon with the County R.P.R.

2. Format and resolution shall be as mutually agreed upon with the County R.P.R.

3. Provide monthly photos within a CD or DVD. Furnish a file index that lists photo number or file name and description of view per respective date, unit process and/or vantage point within a file structure as mutually agreed upon with the County R.P.R.

B. Aerial Prints

1. Full color.

2. Finish: Matte finish.

3. Minimum Size: 15 inches x 21 inches.

4. Paper Weight: Single.

5. Mounting: In plastic sheets in loose leaf, three ring binders.

6. Provide a CD with electronic photo files. Furnish a file index that lists photo number or file name and description of view.

C. Identification:

1. Digital photographs shall be categorized and saved based upon the date which they were photographed.

2. Under the main folder in which the photographs were taken, photos are to be organized into categorized subfolders based upon unit process number, specific construction activity, recurring vantage point(s), or other means necessary to properly index them in coordination with respective areas of the Work.

PART 3 - EXECUTION

A. Technique

1. Factual presentation.

2. Correct exposure and focus.

a. High resolution and sharpness

b. Maximum depth-of-field

c. Minimum distortion

B. Pre-Construction Photographs

See Section 01500.

C. Views Required

1. Consult with Engineer for instructions concerning views required at each specified visit to site. At a minimum provide four (4) views of each Process area included within the Work.

2. Photograph from locations to adequately illustrate state of project, or condition of construction.

3. Take photographs from as close to the same position for each period as practical.

4. Take a series of ground level photographs for each area under construction during the photographic visit, areas of construction completion from previous months “under construction views” and undisturbed areas where Contractor anticipates construction during the one month period prior to the next scheduled photographic visit.

5. Schedule and conduct photographic visits during the first work day of each month.

6. In addition, provide and conduct up to seven (7) additional photographic visits prior to, at critical stages of, and at the end of construction, when they do not coincide with scheduled photographic visit days. The timing of these additional photographic visits shall be subject to the prior approval of the Owner or Engineer.

D. Delivery of Prints

1. Deliver three (3) DVDs or CDs containing the copies of the monthly progress photos to accompany each request for progress payment.

2. If the submitted photographs do not meet the requirements of this section, submit another series within one week.

END OF SECTION

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SECTION 01390 COLOR AUDIO-VIDEO CONSTRUCTION RECORDS

PART 1 - GENERAL

A. Scope

Prior to commencing work on the Project and after Final Completion of the Project, the CONTRACTOR shall provide a continuous color audio-video DVD recording of the entire construction area of the Project to serve as a record of the site's pre- and post-construction conditions. The entire length shall be defined as the entrances to the EWRF and NWRF plants that are to be traveled by vehicles of the Contractor, subcontractors, suppliers, work areas, staging areas, etc. The CONTRACTOR shall submit three (3) copies of the pre-construction DVD to the ENGINEER prior to construction for approval. A copy of the pre-construction DVD shall be kept at the site by the CONTRACTOR until completion of the Project. As a condition of Final Completion, the CONTRACTOR shall have a continuous color-video DVD recording taken of the entire site to serve as a record of post-construction conditions and shall submit one (1) copy to the ENGINEER and two (2) copies to the COUNTY prior to the submittal of the Final Payment Application.

B. Approval

The DVD recording shall be made less than six (6) weeks prior to commencement of construction. The COUNTY and ENGINEER shall have the County to reject all or any portion of a DVD not conforming to this specification and require that it be redone at no additional cost to the COUNTY. The CONTRACTOR shall reschedule unacceptable coverage within five (5) days after being notified. All tapes and written records shall be well-maintained without any damage and shall become property of COUNTY. All videotaping shall be done in the presence of a COUNTY representative of the ENGINEER and who will designate areas to be covered by the DVD. The CONTRACTOR shall provide the COUNTY with a minimum of 48-hrs notice prior to filming. The COUNTY shall have the authority all or any portion of a DVD not conforming to specifications and order that it be redone at no additional charge to the COUNTY. The COUNTY shall accept the DVD recording prior to the start of construction.

C. Professional Electrographers(Videographers)

The CONTRACTOR shall engage the services of a professional electrographer. The color audio-video tape recordings shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of preconstruction color audio-video DVD documentation. The electrographer through the CONTRACTOR shall furnish to the ENGINEER a list of all equipment to be used for the audio-video taping, i.e., supplier's (manufacturer's) name, model number, specifications and other pertinent information. Additional information to be furnished to the ENGINEER by the electrographer through the CONTRACTOR shall include the names and addresses of two (2) references for which the electrographer has performed color audio-video taping on projects of a similar nature within the last twelve (12) months.

PART 2 - PRODUCTS

A. General

1. The total audio-video recording system and the procedures employed in its use shall be such as to produce a finished product that will fulfill the technical requirements of the Project. The video portion of the recording shall produce bright, sharp, and clear pictures with accurate colors and shall be free from distortion, tearing, rolls, and any other form of picture imperfection. All video recordings shall, by electronic means, display on the screen the time of day, the month, day, and year of the recording. This date and time information shall be continuously and simultaneously generated with the actual recording. The audio portion of the recording shall produce the commentary of the camera operator with proper volume, clarity, and be free from distortion.

2. The recording system shall utilize AIA Standard Video and NTSC compatible color (American TV Standard).

PART 3 - EXECUTION

A. Equipment

1. Camera: the color video camera used in the recording system shall be of Industrial Grade and shall have EIA standard NTSC type color – 1.0v 75 ohms. Video output from the camera(s) shall be capable of a horizontal resolution of 350 lines at center and utilize a minimum of 8:1 zoom with 2/3" Newvicon tube or CCD pick-up element for optimum color imagery plus minimum lag through one foot candle (10 LUX).

2. Recorder: the recording shall be made with an industrial grade DVD recorder. The recorder shall record the signal with a minimum horizontal resolution of 525 lines, 60 fields; NTSC color signal; RF modulated 72db. The construction documentation shall be recorded in SP mode.

3. Digital Video Disc: the DVDs used for the recordings shall be the 4.7GB industry standard dics.

4. DVD playback compatibility: the recorded DVD's shall be compatible for playback with any American TV standard DVD player.

B. Recorded Information – Video

1. All video recordings shall contain coverage of all surface features located within the construction zone of influence and shall include but not be limited to: all designated easements staking, all roadways, pavements, detention ponds, ditches, walls, railroad tracks, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, treatment structures, pipe systems, pump stations, buildings, landscaping, trees, shrubbery, fences and CONTRACTOR staging areas. Of particular concern shall be pre-existing faults, fractures, or defects with existing infrastructure noted. Taped coverage shall be limited to one side of the site, street, easement or right of way at any one time. Tape coverage shall include all surface conditions located within the zone of influence of construction supported by appropriate audio description including the location relative to construction stations. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object.

2. All video recordings shall, by electronic means, display continuously and simultaneously generated with the actual taping transparent digital information to include the date and time of recording and coordinate locations as shown on the Drawings. The date information shall contain the month, day and year. The time information shall contain the hour, minutes, and seconds. Additional information shall be displayed periodically. Such information shall include, but not be limited to. Project Name, direction of travel and location. This transparent information shall appear on the extreme upper left hand third of the screen.

C. Recorded Information – Audio

1. Accompanying the video recording shall be a corresponding and simultaneously recorded audio recording. Each tape shall begin with the recording date and project name and COUNTY'S Project Number and be followed by the general location, i.e., structure or process. The audio track shall consist of an original live recording. The recording shall contain exclusively the narrative commentary of the electrographer, recorded simultaneously with the video record of the zone of influence of construction. The recording shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording, including location relative to construction stations. The audio recording shall be free from any conversations between the camera operator and any other production technicians.

2. The COUNTY and ENGINEER reserve the right to supplement the audio portion of the taping as deemed necessary.

D. DVD Indexing

1. DVD identification: All DVDs shall be permanently labeled and shall be properly identified by DVD number and Project Name.

2. DVD logs: Each DVD shall have a log of that DVD's contents. The log shall describe the various segments of coverage contained on that DVD in terms of the names of the streets or easements, coverage beginning and end, directions of coverage, video unit counter numbers, engineering station numbers, and date.

3. DVD index: The CONTRACTOR shall provide an index listing, in order by DVD number, each DVD, including DVD number and a brief description of coverage contained on that DVD, including engineering station numbers.

E. Time of Execution

All recording shall be performed during times of good visibility. No recording shall be done during period of significant precipitation, mist, or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subject, and to produce bright, sharp video recordings of those subjects. No taping shall be performed when more than 10% of the area to be taped contains debris or obstructions unless otherwise authorized by the ENGINEER.

F. Continuity of Coverage

In order to increase the continuity of the coverage, the coverage shall consist of a single, continuous, unedited recording which begins at one end of a particular construction area and proceeds uninterrupted to the other end of the construction area. Such coverage shall consist of an organized, interrelated sequence of recordings at various positions within that proposed construction area (e.g., high service pump station). Such coverage shall be obtained by walking or special approval by the Engineer.

G. Camera Operation

1. Camera Height and Stability: If conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed ten (10) feet. The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.

2. Camera Control: Camera pan, tilt, zoom-in, and zoom-out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during DVD playback. In addition, all other camera and recording system controls such as lens focus and aperture, video level, pedestal, chroma, white balance, and electrical focus shall be properly controlled or adjusted to maximize picture quality.

3. Viewer Orientation Techniques: The audio and video portions of the recording shall maintain viewer orientation. In easements where the proposed construction location will not be readily apparent to the DVD viewer, highly visible yellow flags shall be placed by the CONTRACTOR in such a fashion as to clearly indicate the proposed centerline of construction.

4. Electrographer Experience: The electrographer in charge shall have had previous experience with audio-video documenting preconstruction work.

H. DVD Viewer

The CONTRACTOR shall make available for use by the COUNTY and ENGINEER, at the site, one (1) DVD viewer system. The system shall be provided as requested by the ENGINEER, for the duration of the Project and be made available for on-site viewing until Final Completion. The system shall consist of the following components:

1. DVD Player: The DVD player shall be capable of playback standard DVD(s) as hereinafter specified and shall be powered by a standard 120 volt, 60 HZ service. Player features shall include resettable digital counter, and 10-foot uhf coaxial output connecting cable for connection to any conventional TV set. The player shall consist of a videocassette player/recorder or similar type as used for recording with corresponding digital counter number sequence so as to be compatible with the documentation. It shall be capable of speed search, clear still frame and frame-by-frame advance.

2. TV receiver: TV receiver shall be a color American TV Standard VHP 2-13 channel coverage. It shall have a viewing area, diagonally measured, of no less than fourteen (14) inches and shall have direct video and audio input. The cables for the video and audio connections shall also be supplied.

END OF SECTION

SECTION 01420 GENERAL ABBREVIATIONS

PART 1 - GENERAL

A. General

Interpret abbreviations used on the drawings and in the specifications as tabulated below. If an abbreviation on a drawing is not explained below, it shall be as explained in ANSI Y1.1. The interpretation of abbreviations shall consider the context or discipline in which they are used, for example:

1. FF usually means "finish floor" when referring to a floor slab.

2. FF usually means "flat face" when referring to a pipe flange.

B. List of General Abbreviations

Abbreviation	**Term**
A	
A	Ampere/Area
AA	Aluminum Association
AABC	Associated Air Balance Council
AADF	Annual Average Daily Flow
AAMA	Architectural Aluminum Manufacturer's Association
AAS	Airport Advisory Service
AASHTO	American Association of State Highway and Transportation Officials
AB	Anchor Bolt/Aggregate Base
ABAN	Abandoned
ABC	Asphalt Base Course
ABT	About
AC	Acre/Asphaltic Concrete/Alternating Current/Air Conditioning
ACCU	Air Cooled Condensing Unit
ACGIH	American Conference of Governmental Industrial Hygienists

Abbreviation	Term
ACI	American Concrete Institute
ACP	Asbestos-Cement Pipe
ACU	Air Conditioning Unit
AD	Access Door
ADDL	Additional
AE	Architect-Engineer
AF	Air Filter/Ampere Frame
AFB	Air Force Base
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturer's Association
AHD	Ahead
AHU	Air Handling Unit
AI	The Asphalt Institute
AIA	American Institute of Architects
AICS	Amperes Interrupting Capacity, Symmetrical
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AL	Aluminum
ALIGN	Alignment
ALM	Alarm
ALTN	Alternate
AMB	Ambient
AMCA	Air Movement and Control Association
AMP	Ampere
ANCH	Anchor
ANG	Angle
ANSI	American National Standards Institute
API	American Petroleum Institute
APPROX	Approximate
APWA	American Public Works Association
ARCH	Architecture/Architectural
AREA	American Railway Engineering Association

Abbreviation	Term
ARI	Air Conditioning and Refrigeration Institute
ARV	Air-Release Valve
ARVV	Air-Release/Vacuum Valve
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPH	Asphalt
ASSY	Assembly
ASTM	American Society of Testing and Materials
ATS	Automatic Transfer Switch
AVE	Avenue
AVG	Average
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
B	
BB	Back-to-Back
BC	Beginning of Curve/Back of Curve/Bolt Circle
BCR	Begin Curb Return
BEG	Begin
BETW	Between
BF	Blind Flange
BFV	Butter Fly Valve
BHP	Brake Horsepower
BK	Back/Brake
BKR	Breaker
BL	Base Line
BLDG	Building
BLK	Block
BM	Bench Mark/Beam
BO	Blowoff

Abbreviation	Term
BOCA	Building Officials Code Administration International, Inc.
BOD	Biochemical Oxygen Demand
BOT	Bottom
BP	Baseplate
BR	Bronze/Branch
BRG	Bearing
BTN	Button
BTU	British Thermal Unit
BUR CBL	Buried Cable
BVC	Begin Vertical Curve
BW	Block Wall
C	
C	Conduit/Celsius
CAB	Crushed Aggregate Base
CANTIL	Cantilevered
CAP	Capacity
C.A.R.	Construction Assistance Request
CATV	Cable Television
CB	Catch Basin/Circuit Breaker
CC	Cooling Coil
C-C	Center-to-Center
CCB	Concrete Block
CCP	Concrete Cylinder Pipe
CCS	Central Control Station
CCT	Chlorine Contact Tank
CD	Cross Drain/Condensate Drain/Ceiling Diffuser
CEM	Cement
CF	Cubic Feet/Curb Face
CFH	Cubic Feet Per Hour
CFM	Cubic Feet Per Minute
CFS	Cubic Feet Per Second
CG	Ceiling Grill
C & G	Curb and Gutter
CH	Chiller

Abbreviation	Term
CHG	Change
CHKD PL	Checkered Plate
CI	Cast Iron
CIP	Cast in Place/Cast-Iron Pipe
CISP	Cast Iron Soil Pipe
CISPI	Cast-Iron Soil Pipe Institute
CJ	Construction Joint
CL	Centerline/Class/Clearance
CLR	Clear
CMAA	Crane Manufacturer's Association of America
CMC	Cement-Mortar Coated or Coating
CML	Cement-Mortar Lined or Lining
CMLCSP	Cement-Mortar Lined and Coated Steel Pipe
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CMU	Concrete Masonry Unit
CO	Cleanout/Conduit Only
COL	Column
COMM	Communication
COMP	Composite
COMPL	Complete
CONC	Concrete
CONN	Connection
CONST	Construct or Construction
CONT	Continuous
CONTR	Contractor
COORD	Coordinate/Coordinated
COP	Copper
COR	Corner
CPLG	Coupling
CPU	Central Processing Unit
CRES	Corrosion Resistant Steel
CRSI	Concrete Reinforcing Steel Institute
CS	Carbon Steel/Commercial Standard

Abbreviation	Term
CSP	Corrugated Steel Pipe
CT	Center Top/Current Transformer
CTG	Coating
CTR	Center
CTV	Cable Television
CULV	Culvert
CU YD, CY	Cubic Yard
CYL	Cylinder
D	
D	Degree of Curvature
DB	Direct Buried/Decibel
DBL	Double
DC	Direct Current
DEPT	Department
DET	Detail/Detour
DG	Decomposed Granite
DI	Drop Inlet/Ductile Iron
DIA	Diameter
DIAG	Diagonal
DIM	Dimension
DIMJ	Ductile-Iron Mechanical Joint
DIP	Ductile-Iron Pipe
DIPRA	Ductile-Iron Pipe Research Association
DISCH	Discharge
DIST	Distance
DIV	Divide/Division
DO	Dissolved Oxygen
DMH	Drop Manhole
DN	Down
DP	Differential Pressure
DPI	Differential Pressure Indicator
DPNL	Distribution Panel
DR	Drain/Door
DSL	Diesel

Abbreviation	Term
DWG	Drawing
DWY	Driveway
E	
E	East
EA	Each
EC	End of Curve
ECC	Eccentric
ECR	End of Curb Return
ED	External Distance
EDUC	Eductor
EE	Each End
EF	Each Face/Exhaust Fan
EFF	Efficiency
EFL	Effluent
EG	Exhaust Grill
EGL	Energy Grade Line
EL	Elevation/Each Layer
E/L	Easement Line
ELEC	Electric
ELEV	Elevation
ELP	Elliptical
EMB	Embankment
ENC	Encasement
ENCL	Enclosure
ENG	Engine
ENGR	Engineer
EOP	Edge of Pavement
EOS	Equivalent Opening Size
EOTW	Edge of Traveled Way
EP	Explosion Proof/Edge of Pavement
EPA	Environmental Protection Agency (Federal)
EPS	Effluent Pump Station
EQ	Equation
EQL	Equal

Abbreviation	Term
ESMT	Easement
EST	Estimate or Estimated
ETC	And so Forth
ETM	Elapsed Time Meter
EVAP	Evaporator
EVC	End Vertical Curve
EW	Each Way
EWC	Electric Water Cooler
EWRF	Eastern Water Reclamation Facility
EXC	Excavate or Excavation
EXP	Expansion
EXST	Existing
EXT	Exterior/Extension
F	
F	Fahrenheit/Floor
FAA	Federal Aviation Administration
FAB	Fabricate
FBC	Florida Building Code
FBRBD	Fiberboard
FC	Foot-Candle
FCC	Filter Control Console
FCO	Floor Cleanout
FCV	Flow Control Valve
FD	Floor Drain
FDEP	Florida Department of Environmental Protection
FDN	Foundation
FDOT	Florida Department of Transportation
FE	Flanged End
FF	Finished Floor/Flat Face
FG	Finished Grade
FHY	Fire Hydrant
F&I	Furnish and Install
FIG	Figure
FIN	Final

Abbreviation	Term
FIT	Fitting
FL	Floor/Flow Line
FLEX	Flexible/Flexure
FLG	Flange
FLT	Float
FLUOR	Fluorescent
FM	Force Main/Factory Mutual
FMH	Flexible Metal Hose
FNSH	Finish
FOC	Face of Concrete
FOS	Face of Stud
FPC	Flexible Pipe Coupling
FPM	Feet Per Minute
FPS	Feet Per Second
FPT	Female Pipe Thread
FS	Finished Surface/Floor Sink/Federal Specifications
FSTNR	Fastener
FT	Feet or Foot
FTG	Footing
FUT	Future
FWY	Freeway
G	
G	Gas
GA	Gauge
GAL	Gallon
GALV	Galvanized
GAS	Gasoline
GB	Grade Break
GDR	Guard Rail
GE	Grooved End
GEN	Generator
GENL	General
GFI	Ground Fault Interrupter
GM	Gas Main

Abbreviation	Term
GMT	Greenwich Mean Time
GND	Ground
GPD	Gallons Per Day
GPM	Gallons Per Minute
GR	Grade
GRTG	Grating
GSKT	Gasket
GUT	Gutter
GV	Gate Valve
GWB	Gypsum Wallboard
GWBX	Gypsum Wallboard, Fire Rated
GYP	Gypsum
H	
H	Humidistat
HARN	Harness
HB	Hose Bibb
HC	Heating Coil
HD	Heavy Duty
HDPE	High Density Polyethylene
HEPA	High Efficiency Particulate Air
HGL	Hydraulic Grade Line
HGT	Height
HID	High Intensity Discharge
HOA	Hand-Off-Automatic
HOR	Hand-Off-Remote
HORIZ	Horizontal
HP	Horsepower/High Pressure
HPS	High Pressure Sodium
HPT	High Point
HR	Hour/Handrail
HS	High Strength
HTG	Heating
HTR	Heater
HV	Hose Valve

Abbreviation	Term
HVAC	Heating, Ventilating, and Air Conditioning
HVY	Heavy
HW	Headwall/Hot Water
HWL	High Water Level
HWY	Highway
HYDR	Hydraulic
HZ	Hertz (cycles per second)
I	
I	Intersection Angle
ICBO	International Conference of Building Officials
ID	Inside Diameter
IE	Invert Elevation
IEEE	Institute of Electrical and Electronics Engineers
IN	Inches
INCAND	Incandescent
INCL	Include
INL	Inlet
INS	Insulating
INSTL	Install or Installation
INTR	Interior/Intersection
INV	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
IPT	Iron Pipe Thread
IRR	Irrigation
ISA	Instrument Society of America
J	
J	Joist
JB	Junction Box
JCT	Junction
JN	Join
JT	Joint
K	
KG	Kilogram

Abbreviation	Term
KM	Kilometer
KIPS	Thousands of Pounds
KV	Kilovolt
KVA	Kilovolt-Ampere
KW	Kilowatt
KWH	Kilowatt-Hour
KWHM	Kilowatt-Hour Meter
L	
L	Length of Curve/Long/Left
LATL	Lateral
LAV	Lavatory
LB	Pound
LBR	Lumber
LCL	Local
LF	Linear Foot
LG	Long
LI	Level Indicator
LLO	Long Leg Outstanding
LOC	Location/Locate
LOS	Lockout Stop
LP	Light Pole
LPT	Low Point
LR	Long Radius
LS	Lift Station
LT	Left/Light
LTG	Lighting
LWC	Lightweight Concrete
LWIC	Lightweight Insulating Concrete
LWL	Low Water Level
M	
MA	Milliampere
MAG	Magnet/Magnetic
MATL	Material
MAX	Maximum

Abbreviation	Term
MB	Machine Bolt/Megabyte/Millibars
MBH	Thousand BTU Per Hour
MECH	Mechanical
MC	Metal Channel
MCC	Motor Control Center
MCM	Thousand Circular Mils
MCP	Motor Circuit Protector
MD	Motorized Damper
MFR	Manufacturer
MG	Million Gallons/Milligram
MGD	Million Gallons Per Day
MH	Manhole
MHZ	Megahertz
MI	Malleable Iron/Mile
MIL	Military Specifications
MIN	Minimum
MISC	Miscellaneous
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
MJ	Mechanical Joint
MMA	Monorail Manufacturer's Association
MO	Motor Operator/Motor Operated/Masonry Opening
MOD	Modification
MON	Monument
MOT	Motor
MPT	Male Pipe Thread
MSL	Mean Sea Level
MSS	Manufacturer's Standardization Society
MTD	Mounted
N	
N	North/Neutral/Nitrogen
NA	Not Applicable
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards

Abbreviation	Term
N & C	Nail and Cap
NC	Normally Closed
NE	Northeast
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code
NIC	Not in Contract
NIP	Nipple
NO	Number/Normally Open
NOM	Nominal
NPT	National Pipe Taper
NRS	Nonrising Stem
NTS	Not to Scale
NW	Northwest
NWL	Normal Water Level
O	
OA	Overall/Outside Air
OC	On Center/Overcurrent
OD	Outside Diameter
ODP	Open Dripproof
OE	Or Equal
OF	Outside Face
OPER	Operator
OPNG	Opening
OPP	Opposite
ORIG	Original
OSA	Outside Air
OSHA	Occupational Safety and Health Administration
O TO O	Out to Out
OVFL	Overflow
OVHD	Overhead
P	
P	Pole
PARA	Paragraph

Abbreviation	Term
PB	Push Button/Pull Box
PC	Point of Curvature/Programmable Controller
PCA	Portland Cement Association
PCC	Point of Compound Curvature/Portland Cement Concrete
PDI	Plumbing and Drainage Institute
PE	Plain End/Polyethylene/Professional Engineer
PEN	Penetration
PERF	Perforated
PF	Power Factor
PG	Pressure Gauge
PI	Point of Intersection
PJTN	Projection
PKWY	Parkway
PL	Plate/Property Line
PLATF	Platform
PLF	Pounds Per Lineal Foot
PNL	Panel
POB	Point of Beginning
POC	Point of Connection
POJ	Push-On Joint
PP	Power Pole/Polypropylene
PPB	Parts Per Billion
PPM	Parts Per Million
PR	Pair
PRC	Point of Reverse Curve
PRESS	Pressure
PRL	Parallel
PROV	Provisions
PRPSD	Proposed
PRVC	Point of Reverse Vertical Curve
PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch Gauge
PSF	Pounds Per Square Foot
PT	Point of Tangency

Abbreviation	Term
PTS	Preliminary Treatment Structure
PV	Plug Valve
PVC	Polyvinyl Chloride
PVMT	Pavement
PWR	Power
Q	
Q	Flow Rate
QTY	Quantity
R	
R	Right/Radius
RAD	Radius/Radial
RAF	Return Air Fan
RAG	Return Air Grille
RC	Reinforced Concrete
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch
RD	Road
RDC	Reduce
RDCR	Reducer
RDWY	Roadway
REF	Reference
REINF	Reinforce or Reinforced
RELOC	Relocated
REQ	Required/Requirement
REQD	Required
REV	Revise/Revision
RF	Raised Face
RH	Relative Humidity
RJ	Restrained Joint
RLG	Railing
RND	Round
RPM	Revolutions Per Minute
RR	Railroad

Abbreviation	Term
RST	Reinforcing Steel
RT	Right
RTD	Resistance Temperature Detector
R/W	Right-of-Way
S	
S	South/Slope in Feet Per Foot/Sewer
SAE	Society of Automotive Engineers
SAN	Sanitary
SAR	Supply Air Register
SBCCI	Southern Building Codes Congress International
SC	Seal Coat
SCFM	Standard Cubic Feet Per Minute
SCHED	Schedule
SCR	Silicon-Controlled Rectifier
SCRN	Screen
SD	Storm Drain
SDG	Siding
SDI	Steel Deck Institute
SDWK	Sidewalk
SE	Southeast
SECT	Section
SF	Square Feet
SGL	Single
SH	Sheet/Sheeting/Shielded
SIM	Similar
SLP	Slope
SLV	Sleeve
SM	Sheet Metal
SOL	Solenoid
SOV	Solenoid-Operated Valve
SP	Space/Steel Pipe/Static Pressure/Spare
SPCG	Spacing
SPEC	Specification
SPLC	Splice

Abbreviation	Term
SPRT	Support
SQ	Square
SQ FT	Square Feet
SR	Short Radius
SS	Sanitary Sewer
SSPC	Steel Structures Painting Council
SST	Stainless Steel
ST	Street
STA	Station
STBY	Standby
STD	Standard
STK	Stake
STL	Steel
STR	Straight
STRL	Structural
STRUCT	Structure
STS	Storm Sewer
STGR	Stringer
STWY	Stairway
SURF	Surface
SW	Southwest
SWG	Swing
SYMM	Symmetrical
SYS	System
T	
T	Ton/Tangent Length of Curve/Telephone
TAN	Tangent
T/B	Top of Beam
TB	Top of Bank/Terminal Board
T & B	Top and Bottom
TBG	Tubing
TBM	Temporary Bench Mark
TC	Top of Curb
TD	Time Delay

Abbreviation	Term
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
TEFC	Totally Enclosed Fan Cooled
TEL	Telephone
TEMP	Temperature/Temporary
TENV	Totally Enclosed Nonventilated
THB	Thrust Block
THD	Thread or Threaded
THH	Thrust Harness
THK	Thick
TIR	Total Indicator Reading
TO	Turnout
T/O	Top of
TOC	Top of Concrete
TOS	Top of Slab
TOT	Total
TP	Telephone Pole
TRD	Tread
TRA	Tie Rod Assembly
TS	Tube Steel
TV	Television
TYP	Typical
U	
UBC	Uniform Building Code
UD	Underdrain
UG	Underground
UH	Unit Heater
UL	Underwriters' Laboratories, Inc.
ULT	Ultimate
UNO	Unless Noted Otherwise
UPS	Uninterruptible Power Supply
UR	Urinal
USGS	United States Geological Survey
UTC	Underground Telephone Cable

Abbreviation	Term
UTR	Up Through Roof
V	
V	Vent/Valve/Volt
VAC	Vacuum/Volts, Alternating Current
VC	Vertical Curve
VCP	Vitrified Clay Pipe
VEL	Velocity
VERT	Vertical
VFD	Variable Frequency Drive
VOL	Volume
VPC	Vertical Point of Curve
VPI	Vertical Point of Intersection
VPT	Vertical Point of Tangency
VSS	Volatile Suspended Solids
VTR	Vent Through Roof
W	
W	West/Watt/Wide/Water
W/	With
WC	Water Closet
WCO	Wall Cleanout
WG	Water Gauge
WH	Wall Hydrant
WL	Waterline
WLD	Welded
WM	Water Meter/Water Main
W/O	Without
WP	Waterproof/Working Point
WRF	Water Reclamation Facility
WRGWB	Water-Resistant Gypsum Wallboard
WSE	Water Surface Elevation
WSP	Water Stop
WT	Weight
WTR	Water
WWF	Welded Wire Fabric

Abbreviation	Term
WWM	Woven Wire Mesh
X	
XFMR	Transformer
XFR	Transfer
Y	
YCO	Yard Cleanout
YD	Yard
YP	Yield Point
YR	Year
YS	Yield Strength
Z	

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

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SECTION 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

A. Temporary Electric Power

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

B. Temporary Water

1. Make arrangements for developing water sources and supply all labor and equipment to collect, load, transport, and apply water as necessary for compaction of materials, concrete construction operations, testing, dust control, and other construction use.

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

C. Temporary Sanitary Facilities

1. Provide temporary toilet facilities separate from the job office. Maintain these during the entire period of construction under this Contract for the use of all construction personnel on the job. Provide enough chemical toilets to conveniently serve the needs of all personnel.

2. Chemical toilets and their maintenance shall meet the requirements of the State and local health regulations and ordinances. Any facilities or maintenance methods failing to meet these requirements shall be corrected immediately.

D. Construction Staking

The Contractor shall provide all construction staking for the work.

E. Silt Barriers, Turbidity Curtains, and Screens

Install silt barriers, turbidity curtains and screens for capturing sediments-solids from erosion.

F. Site Administration and Security

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

   Access to the Site during construction will be limited to Contractor's and/or Subcontractor's employees, agents, and vendors (hereinafter "Representatives") for the sole purpose of performing the Work. All Representatives shall have photo identification issued by the Contractor. Contractor/Subcontractor Representative's identity and business purpose will be subject to verification by County's security representative. Access to the EWRF Site and NWRF Site will be limited to the main gate off Alafaya Trail and McCormick Road, respectively, unless specific alternate arrangements are made with the County. Contractor will supply, and update, a list with the names, driver's license and license plate numbers of all personnel.

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

2. Security: 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.

   The County is implementing special security measures to protect the public wastewater system and the Contractor shall provide the same level of security. The Contractor shall provide the following security measures:

   a. All personnel, employees, and/or subcontractors and suppliers that pass through the security perimeter

shall wear Contractor issued photo identification badges.

b. Contractor will supply, and update, a list with the names, driver's license and license plate numbers of all personnel.

c. All personnel passing through the security perimeter shall be subject to background checks to identify any historical crimes dealing with terrorism, sabotage, or other government related illegal activities.

d. All project deliveries shall be inspected prior to entering the security perimeter of the Facility in order to verify contents. All delivery personnel and delivery vehicles shall be under supervision while within the security perimeter of the Facility in lieu of issuance of photo identification badges.

e. If access other than the main gate off Alafaya Trail (EWRF) or McCormick Road (NWRF) is utilized, a full time guard shall be provided at the construction gate during contractor working hours. All arrangements for alternative access shall be pre-arranged with the County. All alternative access must be secured and locked when not in use.

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

G. Access Road and Parking Areas

1. Obtain access to project site through the existing gates from Alafaya Trail (EWRF) or McCormick Road (NWRF). Keep the existing gate accessible at all times so that the County's vehicles have access to the site.

2. The Contractor and his employees will be permitted to park their vehicles on the County's property. The County will designate a location for the Contractor and employee parking.

H. Drainage, Erosion, Dust, and Mud Control

1. Provide for the drainage of stormwater as it flows/ discharges from the site in performance of the work.

Drainage facilities shall be adequate to prevent damage to the work, the site, and adjacent property.

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

3. Prevent erosion of soil on the site and adjacent property resulting from the construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection. Install silt barriers or screens for capturing sediments/solids from erosion.

4. Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.

5. Perform dust and mud control operations to prevent construction operations from producing dust and mud in amounts harmful to persons or causing a nuisance to persons living nearby or occupying buildings in the vicinity of the work. Use water or dust preventative to control dust during dry weather. Take necessary steps to prevent the tracking of mud onto adjacent streets and highways.

I. Project Sign(s)

Provide and erect one sign near the project site in accordance with the drawings. Construct the sign of 3/4-inch exterior grade plywood with 4-inch by 4-inch posts. Brace each sign with at least 2-inch x 4-inch lumber. Paint the sign as indicated on Drawing C-501.

J. Contractor's Field Office and Storage Sheds

Provide field office with parking spaces, a telephone and storage sheds for the performance of the work, and protection of materials and equipment. Provide personnel to answer the telephone during working hours.

K. Removal of Temporary Construction When No Longer Needed

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

L. Construction Solid Waste Disposal

Provide a roll-off container for construction debris for the duration of the construction contract.

M. County’s Construction Inspector Work Hours

See Section 01015.

N. Overtime and Weekend Work Pay Rate

See Section 01015.

O. Method of Payment

See Section 01015.

P. Emergency Wastewater Spill and Water Main Break Procedures

1. Excavate Cautiously: The Contractor shall exercise extreme caution when excavating in proximity of wastewater force mains and gravity sewers. Force main and sewer locations shown on the plans are not exact or guaranteed. The Contractor is responsible for field verifying existing utility locations.

2. Telephone Notification: The Orange County dispatch operator and County R.P.R shall be notified immediately in the event of a force main, gravity sewer, or water main break or damage at 407-836-2777.

3. Repair Immediately: All damage to Orange County’s mains shall be repaired immediately by the Contractor at the Contractor’s expense, in accordance with the current edition of the Orange County Utilities Standards and Construction Specifications Manual. If the repair is not made in a timely manner, as determined by the Orange County Utilities Inspector, Orange County may perform

repairs and the Contractor will be charged for the repairs.

4. Orange County Utilities Department General Telephone Numbers:

   a. Orange County Utilities Construction Inspection Section…407-836-5550

   b. Orange County Utilities Water Reclamation Division…407-254-9680

   c. Orange County Utilities Water Division…407-254-9850

   d. Orange County Utilities Engineering Division…407-254-9900

5. Advance Notification of Construction: The Orange County Utilities Construction Section (407-836-5550) shall be notified at least seven (7) days prior to any construction activity.

6. Operation of Orange County Valves: Water, wastewater, and reuse valves are to be operated only by Orange County Utilities Inspector (407-836-5550). All valves being installed are to remain closed during construction.

Q. Construction Sequence Plan

In addition to the Progress Schedule required by Section 01323, the Contractor shall submit a detailed construction sequence plan to the RPR for review and coordination with the plant's operations staff. The construction sequence plan must be accepted by the County before the work is started. The construction sequence plan shall comply with the time limits in Section 01040.

R. Construction Photographs

Prior to starting construction, the Contractor shall photograph the existing facilities from locations to adequately illustrate the condition of the facilities. Deliver three (3) mounted sets of prints to the County. Prints shall be 5″ x 7″ minimum, mounted in plastic sheets in loose leaf, three ring binders. Identify each print on back with the name of the project, description of view, and the time and date of exposure.

END OF SECTION

SECTION 01600 MATERIAL AND EQUIPMENT

A. Transportation and Handling

Deliver manufactured materials and products to the project site as needed for installation, undamaged, in original packages, containers, or bundles, as packaged by the manufacturer with manufacturer's name, brand, seals, and labels intact. Materials other than those designated within the Specifications shall not be delivered to the project site. No deliveries will be accepted by OCU personnel, Contractor shall be on site for all deliveries.

B. Storage and Protection

1. Protect and preserve all materials until final acceptance of the Project. Store all materials in a manner to facilitate inspection and to prevent damage, contamination, or intermixing.

2. Miscellaneous metal, reinforcement bars, welded wire fabric, and masonry reinforcement materials shall be stored to prevent contact with the ground and from being damaged by its own weight or by other loads. Reinforcement that has become muddy shall be cleaned before use.

3. Store cementitious materials in weathertight sheds on elevated floors away from damp surfaces. Prevent freezing.

4. Do not use and dispose of materials that have been stored for longer than their maximum recommended shelf life or beyond their recommended shelf date.

5. Store and protect all material and equipment in accordance with manufacturer's recommendations.

6. Store mechanical equipment with moving parts (pumps, valves, operators, etc.) in weathertight sheds on elevated floors.

7. Store electrical and electronic control equipment (motor control centers, panelboards, switch gear, wiring devices, etc.) in weathertight sheds on elevated floors and in an environment similar to the one in their final location (ventilated, air conditioned, etc.). Store all other electrical material in a manner to prevent contact with the ground and from being damaged by its own weight or by other loads.

C. Protection of Equipment

1. During construction, protect all equipment from moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps, coverings, or other suitable means. Apply protection immediately on receiving the products and maintain continually.

2. Keep products clean by elevating above ground or floor and by using suitable coverings. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

3. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore any finishes that become stained or damaged.

D. Equipment Selection and Serviceability

1. Locate and install all equipment so that it may be serviced. Demonstrate that there is room to remove all fan shafts, bearings, filters, pumps and motors, and similar equipment.

2. Equipment that is too large or poorly located to permit servicing shall be replaced or repositioned at no additional cost to the County.

3. Where piping, control diagrams or sequencing differ from the recommended piping arrangements of the equipment manufacturer, and will directly affect the equipment performance, the manufacturer's recommendations shall be submitted in writing to the Engineer for review prior to purchasing the equipment involved. Obtain such recommendations from the manufacturers in order to effect correct and perfect operation of the equipment at the capacities and temperatures indicated.

E. Spare Parts

1. Spare parts shall be packaged in sealed, rotationally moulded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Contractor shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

2. Pertaining to general inventory of all containers, the Contractor shall provide a general ascending alpha-numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

3. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum; Process description and Process number, equipment description, equipment tag, Manufacturer's information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

4. The Contractor shall provide an electronic log in MS Excel of all containers which include the following at a minimum; container alpha-numerical designation, content description, site storage location, O&M Manual volume subsection reference.

5. A copy of all inventory and manufactures product information data sheets shall be provided within a file pocket attached within the container.

6. Containers shall be positioned on site as designated by the Owner's Representative

7. CONTRACTOR shall maintain a maintenance log for all started equipment and materials. The OWNER and ENGINEER will have access to this log and be given copies as equipment is put into service. Include these logs in the warranty packages.

END OF SECTION

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SECTION 01664 SYSTEM START-UP AND TESTING

PART 1 - GENERAL

A. Description

1. This section includes system start-up and System Testing. Substantial completion for various portions of the work will be required prior to starting work on other portions of the project. Refer to Section 01040 for specific construction sequencing requirements.

2. The system startup and testing of the disk filters at the NWRF and EWRF facility shall take place following installation of the filters by the Owner's contractor under this contract. Contractor as described in Section 01664 shall refer to the Owner's Disk Filter installation contractor which will be retained under this contract. The term Manufacturer or Vendor within Section 01664 shall refer to the Disk Filter Manufacturer under separate contract. The Contractor shall coordinate with the Manufacturer for system startup and testing as described herein. The Contractor shall coordinate with the Disk Filter Manufacturer for integration of the disk filter control panels into the existing EWRF and NWRF control networks.

3. Prior to requesting issuance of the Certificate of Substantial Completion for any portion of work, complete system start-up and System Testing as specified herein, must be completed to the satisfaction of the Owner.

4. At least 90 days prior to initiation of the start-up for each process as described below, submit a detailed start-up plan and schedule of operational circumstances described below. It is the intent of this section that the entire system as described below be operated and tested under actual operating conditions prior to acceptance. The start-up plan must be accepted by Owner and Engineer prior to initiation of start-up.

5. For issuance of substantial completion for each major respective process, the Disk Filter Manufacturer is to perform system start-up and System Testing procedure for the following major facilities. Some of the major facilities are necessary to be tested prior to performing start-up and System Testing of other facilities. At a minimum the Disk Filter Manufacturer is required to perform an individual system start-up and System Testing procedure for the following major

facilities. The Contractor shall coordinate with the Disk Filter Manufacturer to ensure all necessary components are available for startup and system testing.

6. Tertiary Treatment

   (1) NWRF Disk Filters: Process 065 Disk Filters including but not limited to the following:
   - (a) Cloth Disk Filters and Filter Vessels
   - (b) Backwash/Waste System
   - (c) Electric Actuated Valves
   - (d) All electrical control panels, and starters, etc.
   - (e) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

   (2) EWRF Disk Filters: Process 570 Disk Filters including but not limited to the following:
   - (a) Cloth Disk Filters and Filter Vessels
   - (b) Backwash/Waste System
   - (c) Electric Actuated Valves
   - (d) All electrical control panels, and starters, etc.
   - (e) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

7. For those major facilities identified within Part 1.A.6 as designated for an independent facility System Start-up and System Testing procedure as required for issuance of substantial completion, it is intended that each major facility be placed in operation by accomplishing the following three general procedures:

   a. Preliminary Matters - field testing of individual components and equipment during the Contract Time, which may be accomplished one at a time and is to be performed as specified per the individual respective components' specification. The Manufacturer shall perform an inspection of the installed equipment during this period to confirm that the equipment is installed correctly and in accordance with their recommendations. I/O checkout and instrument calibration, as defined in Division 13 shall be performed during the Preliminary Matters period.

b. System Start-up - Starting the facility under operational conditions and showing it will work for a specified length of time, which shall be accomplished before System Testing. Unless otherwise noted, System Start-Up shall be conducted utilizing plant effluent, have a minimum duration of 48 consecutive hours, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures. At this time flow balance across all filters shall conducted at multiple flows including process rated flow. System Start-up shall be performed from the local equipment control panels. All equipment, control panels, actuated valves, and instrumentation shall be demonstrated operate satisfactorily for 48 consecutive hours as a system.

c. System Testing - proving that the entire Work will function properly as a system, each individual component will operate within the system and that the system will function to meet the specified standards over a stated period of time. Unless otherwise noted, shall be conducted utilizing the intended media to be processed, have a minimum duration of 7 consecutive days, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures. Verification that the disk filter control panels will communicate with the EWRF and NWRF control networks shall be performed. “System Testing” shall mean all process equipment, valves, piping, control panels, PLC/SCADA integration, HMI screens, and all other necessary equipment in order to operate the process in the automatic mode from SCADA

8. For those facilities not identified within Part 1.A.6 as designated for an independent facility System Start-up and System Testing procedure, the Disk Filter Manufacturer is perform System Start-Up and System Testing following the procedure outlined herein. The Contractor shall coordinate with the Disk Filter Manufacturer to ensure all necessary components are available for startup and system testing.

B. Submittals

1. At least 90 days prior to each facility's system start-up, submit a system start-up and System Testing program to the Engineer for review.

   a. The plan shall be a single comprehensive report for both NWRF and EWRF that includes detailed activities and coordination required to implement the requirements of this specification. The report shall include at a minimum preliminary matters, system start-up and System Testing for both the wastewater process equipment and the electrical equipment.

   b. The report shall include a detailed schedule for the sequence of all operations that the Disk Filter Manufacturer and Contractor will perform for the System Testing specified herein. Include outline of the manufacturer's training to be provided to Owner's staff.

   c. Identify the Owner's activities required for the system start-up and System Testing. Schedule a meeting with Owner and Engineer to review draft start-up plan at least 60 days prior to initiating start-up activities. Revise draft plan to incorporate comments from Owner and Engineer and re-issue start-up plan at least 30 days prior to initiating start-up activities.

2. All Manufacturers' certificates of proper installation shall be submitted during the Preliminary Matter startup period and shall be submitted and approved prior to moving on to the System Start-up phase.

3. All I/O and loop checkout documentation, as defined in Division 13, shall be submitted and approved prior to moving on to the System Start-up phase.

PART 2 - PRODUCTS

A. Water, Fuel, Chemicals and Electricity

The Contractor is responsible to supply all fuel, chemicals and electricity as necessary to perform all the system start-up and System Testing. At no cost to the Contractor, the Owner will provide the supply for all potable water, reclaimed water, or effluent or non-potable water. The Contractor is responsible to meter the volume of reclaimed

water to be utilized. The Contractor is responsible to provide the temporary pumping and conveyance facilities for the reclaimed water. The Contractor shall coordinate with the Disk Filter Manufacturer to ensure all necessary components are available for startup and system testing.

B. Laboratory System Testing Services

The Vendor is responsible to supply all services related to sample collection and laboratory System Testing services. The Vendor shall utilize a laboratory certified in the State of Florida. The certified laboratory is responsible to perform all the laboratory System Testing and produce the laboratory System Testing reports as required herein.

C. Electrical Test Recorders

Contractor shall install 24-hour test recorders to each motor starter for the purpose of the tests only and remove them after completion of System Testing.

D. Temporary Pumping and Piping Facilities

1. The Contractor is responsible to supply a complete pumping and piping system to convey all fluids to the various facilities being tested should it be required. The Contractor shall coordinate with the Disk Filter Manufacturer to identify any necessary pumping and piping requirements.

2. The Contractor is responsible for temporary pumping systems as required to empty and refill the structures to be improved. The Contractor is responsible for temporary pumping systems as required to simulate the process performance criteria noted within the Contract Documents.

3. Additional temporary pumping may be required for other processes. The Contractor will be responsible for all temporary pumping and piping systems for completion of the work described within the Contract Documents.

E. Temporary Metering and Analyzed Devices

Contractor shall coordinate with vendor for locations to supply and install temporary TSS analyzers, as required, upstream and downstream of each filter unit to record real time data.

PART 3 - EXECUTION

A. Preliminary Matters

1. Conduct all field inspections as defined in the individual specification sections, installation checks, hydrostatic tests, performance tests, and necessary corrections required, to demonstrate that individual components of the Work have been properly erected and found to operate in accordance with the Contract Documents, so that they can be utilized for their intended purposes.

2. Remove all electrical jumpers, bypasses or other items connected to the equipment, which are not intended to remain in the facility and are not required by the specifications. Demonstrate that each component is operating under its own control as designated.

3. Confirm that all electrical circuits are energized in the automatic position, that valves and gates are set to their normal position and that the flow path through the Work is unobstructed.

B. Start-Up System Testing

1. Provide personnel and equipment except as stated in paragraph entitled "Interface Between Disk Filter Manufacturer, Contractor, and Owner" (01664-Part 3.D) during the start-up System Testing period to perform the start-up System Testing tasks.

2. Prior to commencing system start-up and by utilizing the CAR procedure a minimum of thirty (30) days in advance of the work, coordinate system start-up activities with the Owner's operating personnel and the Engineer.

3. Initiate component start-up in accordance with the manufacturer's operation and maintenance manual.

4. Coordinate with Owner for any adjustments desired or operational problems requiring debugging.

5. Make adjustments as necessary.

6. During this start-up System Testing period, a representative of the manufacturer of each major piece of equipment shall visit the site for at least one day to inspect the equipment and certify to the Engineer and Owner in writing that the equipment has been installed properly and is operating properly.

7. During the start-up System Testing period, operate the facilities in a manner to test alarms, controls, and interlocks. Repair or replace equipment that does not respond to the interlocks, alarms and controls designed. The work must operate successfully during this System Testing period in the manner intended. If the work does not operate successfully, correct the problem and start the test over.

8. Test all motors for vibration by measuring the vibration on the shaft adjacent to the bearings. If a vibration level is specified in the technical specifications for a particular piece of equipment, assure that the equipment complies with the specified level. Repair, realign or replace equipment until the measured vibration is less than the specified maximum vibration level. Submit vibration test reports to Engineer for review.

9. The system start-up will be deemed to be completed after:

   a. All structures have been filled with Secondary effluent.

   b. All adjustments and operational scenarios as desired by the Owner have been made and simulated, respectively. Operational Scenarios included shall be at minimum, but not limited to the following; overflow conditions, alarm conditions, flow balance over influent weir at various flow conditions (average and peak), non-compliant influent conditions such as high turbidity, reject scenarios.

   c. Secondary Effluent has flowed through the new and modified unit processes at the processes rated capacity for at least 48 consecutive hours without overflows, problems or stoppages to make corrective measures. The effluent may be obtained from the existing plant flow. Flow rate should be varied from minimum to peak hour flow during the course of 48 hours.

   d. Unless otherwise noted, System Testing shall be conducted utilizing plant secondary effluent, have a minimum duration of 48 hours, at that processes' rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures.

e. Demonstrate that the control and/or monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings. Demonstrate each filter control panel shall provide historical output.

C. System Testing

1. General System Testing requirements;

a. After completion of the start-up System Testing, perform the System Testing of the filter improvements in the presence of the Engineer and Owner. A successful system test must be completed before substantial completion may be issued. Provide all personnel and equipment except as stated in the paragraph entitled "Interface Between Disk Filter Manufacturer, Contractor, and Owner" (016664-Part 3.D) as necessary during the System Testing period to complete the tasks. The Owner will direct the Contractor relative to required unit operation and performance under the varying operating conditions.

b. During the system test period, operate the facilities in a manner to test alarms, controls, and interlocks. Repair or replace equipment that does not respond to the interlocks, alarms, and controls designed.

c. During the System Testing, test the pumps:

(3) Operate the backwash/waste pumps for a full backwash cycle of all filter disks, during which time no repairs or adjustments shall be required. Assure that pumps operate as designed and specified in response to filter level controls, cavitation, and damage to impellers and shafts. Repair, replace, or realign motors, shafts, and impellers and retest.

(4) Where field tests are required for pumps and no meters are in the associated piping, provide temporary meters and flow recorders.

d. During the System Testing, test all motors for vibration by measuring the vibration on the shaft adjacent to the bearings. If a vibration level is specified in the technical specifications for a

particular piece of equipment, assure that the equipment complies with the specified level. Repair, realign, or replace equipment until the measured vibration is less than the specified maximum vibration level.

e. During the System Testing period, operate the Work and cause various operational circumstances to occur, as instructed by designated plant operating personnel. At a minimum, these circumstances will include average and peak daily flows, random equipment failures and tank overflows, surcharges, and bypasses. Acceptability of the Work's performance will be based on the work performing as specified under these actual and simulated operating conditions and producing an effluent as defined in the contract documents. The intent of the start-up System Testing is for the Disk Filter Manufacturer and 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 acceptance.

f. The System Testing for each process flow stream and instrumentation system will be conducted utilizing the intended media to be processed (i.e. secondary effluent, etc). The Work must operate successfully in the manner intended using secondary effluent, etc. as the media. If the work does not operate successfully, correct the problem(s) and start the test over from day one.

    1. Test Procedures – Twenty Four discrete samples shall be taken each day of testing on both combined filter influent and effluent. All samples shall be stored in a refrigerated compartment at 4 degree C prior to analysis. Filter influent shall be drawn from mid-depth of the filter influent box. Effluent sample shall be withdrawn from sample pumps provided by this project. Sampling and quality control practices shall be per 40 CFR part 136

    2. Contractor to provide constant turbidity meters upstream of filter units in combined influent. Turbidity meters downstream of filter are provided per this project.

g. Unless otherwise noted, System Testing shall be conducted utilizing the intended media to be processed, have a minimum duration of 7 consecutive days, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures.

2. Specific Requirements for the Disk Filters (Process 065 & 570);

a. Secondary Effluent will be used during testing and routed to the new disk filters. Performance data including filter flow, filter influent, and filter effluent TSS. Performance data for each filter vessel shall be provided at average and maximum flows.

b. Each filter vessel shall perform a full backwash/waste cycle. Backwash/waste flow shall be measured for compliance with the manufacturer's required backwash flows. Backwash shall be initiated automatically via level control in the filter vessel. All pumps and actuated valves shall operate properly during backwash/waste testing.

D. Interface Between Disk Filter Manufacturer, Contractor, and Owner

It is the intent of this section that, during Preliminary Matters, and the System Start-Up and System Testing:

1. During System Testing, the Disk Filter Manufacturer and Contractor will assist the Owner by performing all work to test, operate and maintain the plant (turning on/off pumps, opening/closing valves, etc.), assuming a 24 hour working day, seven days a week, starting the date a system test is initiated on any respective process.

2. The Owner will furnish certified operators in compliance with FDEP rules.

3. The Contractor and/or Vendor shall submit a C.A.R. for correspondence with the Owner and will not perform any activities without first consulting with Owner.

E. Instrumentation and Controls System Testing

The Disk Filter Manufacturer and Contractor are to perform the Operational Readiness Test (ORT), Functional

Demonstration Test (FDT) and Performance Acceptance Test (PAT) in conjunction with the Preliminary Matters, System Start-Up and System Testing procedures, respectively.

END OF SECTION

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SECTION 01700 CONTRACT CLOSEOUT

A. Clean-Up Operations

See Section 01740.

B. Closeout Submittals

1. At least 2 weeks prior to start-up, the following items shall be submitted:

   a. Service manuals, installation instructions, and operation and maintenance manuals.

   b. Spare parts and special tools ordered as part of this Contract.

   c. All keys to all doors, gates, and equipment.

   d. Statements from the manufacturer's representatives as called for in the Contract Documents.

2. Upon completion of the project, or portions thereof, and prior to final payment, the Contractor shall transfer to the County all applicable items accumulated throughout construction. These include, but are not limited to, the following items:

   a. Manufacturers' guarantees, bonds, and letters of coverage extending them beyond the time limitations of the Contractors' guarantee.

   b. Salvaged materials or materials and equipment borrowed from the County.

   c. Record documents of completed facilities.

   d. Releases of lien. General release from Contractor plus copies of releases from subcontractors and material suppliers.

3. The closeout requirements of this section are in addition to the requirements of the Standard General Conditions and Supplementary Conditions.

END OF SECTION

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SECTION 01720 PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

A. Description

1. 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.

2. 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.

3. 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:

   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)

   d. Boundary Survey and Survey Map Report for pump stations and easements with constructed improvements.

B. 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.

1. As-Built Drawings: Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed Work in a full size hard copy and an electronic AutoCAD file (dwg) format.

2. Record Documents: All documents as required in subsections Part 1.D and Part 2.B in this specification section.

3. 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.

4. Surveyor: Contractor's Surveyor that is licensed by the State of Florida as a Professional Surveyor and Mapper pursuant to Chapter 472, F.S.

5. Survey Map Report: As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, pump station and easement boundary issues, locations of constructed improvements outside boundaries, and accuracies obtained.

6. Specifications and Addenda: Legibly mark each section to record.

   a. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed; and

   b. Changes made by Field Order or by Change Order

C. Quality Assurance

1. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor's staff as approved by the County.

2. 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.

3. Make entries within 24-hours after receipt of information has occurred.

D. Record Documents at Site

1. Maintain at the site and always available for County's use one (1) record copy of:

   a. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents

   b. Change Orders, Verbal Orders, and other modifications to Contract

   c. Written instructions by the County as well as correspondence related to Requests for Information (RFIs)

   d. Accepted Shop Drawings, Samples, product data, substitution and "or-equal" requests

   e. Field test records, inspection certificates, manufacturer certificates and construction photographs

   f. Progressive As-Built Drawings

   g. Current Surveyor's tables for the As-Built Assets Attribute Data, Pipe Deflection Data, and Gravity Main Data

2. 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.

3. 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.

4. Record information concurrently with construction progress. Do not conceal any Work until required information is recorded.

PART 2 - PRODUCTS

A. As-Built Drawings

1. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.

2. Date all entries. Enter RFI No., Change Order No., etc. when applicable.

3. Call attention to the entry by highlighting with a "cloud" drawn around the area affected.

4. In the event of overlapping changes, use different colors for entries of the overlapping changes.

5. 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.

6. Make entries in the pertinent other documents while coordinating with the County for validity.

7. 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:

   a. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.

   b. As-Built Asset Attribute Data Table shall be completed in the Drawings.

   c. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record true elevations and locations, dimensions between boxes.

   d. 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.

e. 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.

f. 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.

g. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to Contractor's records and Shop Drawings.

8. As-Built Drawings shall include certifications from the Surveyor and the Contractor.

9. As-Built Drawings shall show location of all underground and above ground water, wastewater and reclaimed water piping and related appurtenances, based upon Record Survey information. All changes to piping location including horizontal and vertical locations of utilities and appurtenances shall be clearly shown and referenced to permanent surface improvements and road rights-of-way. Drawings shall also show actual installed pipe material, class, etc.

10. As-Built Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown.

11. Dimensions between all manholes, slope of gravity mains, invert and top elevations shall be shown.

12. Each As-Built Drawing shall be signed, sealed and dated by the licensed Surveyor as being an As-Built Drawings.

B. Record Documents

1. 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. The following documents shall be signed and sealed by the Surveyor:

   a. As-Built Asset Attribute Data Table (see Specification Section 01050 "Surveying and Field Engineering," Table 01050-2 for an example)

   b. Boundary Survey of disk filter and Survey Map Report. Include coordinates of all piping, equipment, and electrical equipment.

   c. 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.

   d. Gravity Main Table (see Specification Section 01050 "Surveying and Field Engineering", Table 01050-4 for an example)

   e. 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.

3. Digital sets of the final Record Documents including but not limited to:

   a. Scanned digital copies of the final As-Built Drawings

   b. Electronic Survey documents electronically sealed by the Surveyor

c. Final Record Documents information

d. 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

4. Pump station site Boundary Survey and Map Report.

5. New Boundary Survey to re-establish easement corners, right-of-way monuments, or pump station site corners with monuments if destroyed by the Work.

6. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.

7. 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.

8. 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).

C. Digital Record Drawing Submittal

A Record Drawing of the affected construction area shall be submitted in an encompassing digital CAD file that includes the overall utility system layout and the

associated parcel features. Feature point, line and polygon information for new or altered structures in the work area and all accompanying geodetic control and survey data shall be included. The minimum requirements are as follows:

a. State Plane Coordinate System

(1) The drawing shall be submitted using state plane coordinate system with at least two points referenced to the County's geodetic control network with a horizontal accuracy of plus/minus three centimeters relative to the County's geodetic control network points used as reference. The points shall be certified by a surveyor registered in the state of Florida.

(2) Features in drawing files that are stored in drawing units will be translated to real world locations. The geodetic control chosen shall correspond to existing monuments in the County control network.

(3) The new structures and features shall be geographically registered to the geodetic control. State plane coordinates exist for most quarter section corners in Orange County. Control assistance can be obtained from the survey section of Public Works.

(4) If the geodetic control point is located within the project limits, it shall be symbolically indicated and annotated in the design file. If the nearest geodetic control is located well outside of the project area then it shall be tied to one of the other geodetic control points used, and a reference tie annotated and indicated in the design file. The two geodetic control points described above are the least survey grade geo-referencing information a developer can use to create the plan view drawing. Please refer to the subsection, "Conventional and GPS Survey Standards" to understand the type of structures and survey grade needed for the additional geodetic information contained in this drawing. This document describes which structures need to be surveyed and created

within the drawing according to its corresponding horizontal coordinates and vertical elevation.

(5) All drawings need to be geographically registered in the Florida State Plane Coordinate System. A licensed Surveyor shall set the vertical and horizontal control at the project site.

(a) Horizontal Datum: State Plane, Florida East Zone, Transverse Mercator Projection, National NGS Datum NAD of 1983, Re-adjustment of 1990 using the HARN (High Accuracy Reference Network) correction;

(b) Vertical Datum: Vertically corrected to the North American Vertical Datum of 1929.

b. The spatial accuracy of the feature data contained in the digital Record Drawing shall be equal to or better than the graphical data contained in the plan/profile sheets.

c. Pressure piping is to be entered as a single line between tees, wyes, and reducers. Pipe sections should be continuous through structures such as valves and other fittings. Pipes should be broken and joined by a suitable fitting when a line changes its diameter or material properties. For wastewater force mains, the line feature(s) shall be input using the same direction from point to point as the proposed or existing flow. Therefore, the starting point of force main line segments within these layers shall be the upstream point and the downstream point shall be the endpoint of that segment. This procedure is required to indicate the continuity of flow and connectivity within the wastewater layers.

d. Gravity lines shall be entered as a single line, digitized in the direction of the design flow, and broken at manholes. The beginning point of the line would the upstream end and the ending point would be the downstream end.

e. Text identifying piping shall be aligned with the piping. Point and linear feature attribute text shall be visible on the drawing in a standard font and the lower left-hand corner of the text shall be just clear of the linear or point feature to which it corresponds, unless legibility requires that the label be moved and accompanied by a leader arrow. The labels shall be placed onto a separate layer and not to be placed in the feature layer. For reading from the bottom or right side of the plan sheet, the rotation angle shall be between -90 degrees and 90 degrees.

f. Features shall be placed on their appropriate layers and assigned colors by layer for consistency. Features shown in the AutoCAD files shall be in model space and be contained in the AutoCAD files as opposed to being linked to externally referenced files. CAD systems which use a numbering system for layers instead of names shall also include a conversion chart explaining which layer number corresponds with which layer name.

g. The GIS plan view layer shall be reviewed for duplicate objects, short objects, crossing objects, undershoots, clustered nodes, pseudo nodes, dangling objects or overshoots, and zero-length objects. Lines shall be continuous from structure to structure. Topology is provided by the end points of pipelines snapped to the end points of connecting lines, with a structure node being snapped to the end point. A point feature will be used to represent a structure such as a manhole or valve. The point feature shall be a symbol block with its block insertion point at the point of intersection or end point of a line.

h. For preparation of the Record Drawings, the County will provide the Contractor the specific language to be utilized on each Drawing for the Record Drawing stamp. At a minimum the Record Drawing will contain the following language: **"This document is a compiled representation of the constructed project, as prepared by the General Contractor: _____. The source and basis of information used in the preparation of the document, upon which the Engineer reviewed, was the General Contractor: _____. The Engineer did not confirm the**

accuracy or completeness of the information provided by the General Contractor:_____. This document is believed to be representative of the constructed condition in the opinion of the Engineer, however the accuracy and completeness of the information cannot be guaranteed. The Engineer shall not be held responsible for the accuracy of the material represented or the reuse of the material by others. These statements are required by rule 61G15-30, FAC for record documents that include information provided by others." The County will provide the Contractor with the final specific wording to be contained within the Record Drawing stamp when project substantial completion is issued.

i. File format shall be AutoCAD (current edition utilized by the County) (dwg) or drawing interchange file (dxf). Dxf files can be created from all major CAD and GIS packages. Standard transfer media will be accepted. This media includes CD, DVD, and Iomega zip disks.

PART 3 - EXECUTION

A. Pre-Construction Meeting

Pre-construction Meeting: The Surveyor shall 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.

B. Construction Progress Meetings

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.

C. Final Record Documents Submittal

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.

D. Storage and Preservation

1. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.

   a. Provide files and racks for storage of documents

   b. Provide locked cabinet or secure space for storage of samples

2. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.

3. In the event of loss of recorded data, use means necessary to again secure the data to the County's approval.

   a. Such means shall include, if necessary in the opinion of the County, removal and replacement of concealing materials.

   b. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

END OF SECTION

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SECTION 01740 CLEANING DURING CONSTRUCTION AND FINAL CLEANING

PART 1 - GENERAL

A. General

1. This section includes cleaning during construction and final cleaning on completion of the work.

2. At all times maintain areas covered by the Contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.

3. Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws. Do not burn or bury rubbish or waste materials on project site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

4. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Cleaning During Construction

1. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish. Inspection of the site and cleaning will be performed daily.

2. The site will be inspected by the Contractor daily to identify areas that require cleaning. Any areas identified will be cleaned immediately.

3. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

4. Provide containers for collection and disposal of waste materials, debris, and rubbish.

5. Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public

access roads to the site of any material falling from the haul trucks.

C. Site Cleaning Prior to Landscaping

Remove concrete, concrete wash, stucco splatter, gunite overspray, and all other wastes and debris prior to final grading and landscaping.

D. Final Cleaning

1. At the completion of work and immediately prior to final inspection, clean the entire project site as follows.

2. Clean, sweep, wash, and polish all work and equipment including finishes.

3. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces.

4. Repair, patch, and touch up marred surfaces to match adjacent surfaces.

5. Broom clean paved surfaces; rake clean landscaped areas.

6. Remove from the site all temporary structures and all materials, equipment, and appurtenances not required as a part of, or appurtenant to, the completed work.

END OF SECTION

SECTION 02050 EQUIPMENT, PIPING, AND MATERIALS DEMOLITION

PART 1 - GENERAL

A. Description

This section describes demolition, removal, and replacement of existing mechanical and electrical equipment and piping.

PART 2 – MATERIALS

Refer to other sections of these specifications for material to be used in removing, replacing, and/or abandoning in place equipment.

PART 3 - EXECUTION

A. General

Perform removal, replacement, and demolition work specified and indicated in the drawings. Prepare remaining surfaces to receive new scheduled and specified materials and finishes or finish to match adjacent surfaces if no additional work is scheduled or indicated.

B. Removal

Remove equipment indicated in the drawings.

C. Replacement

Replace equipment indicated in the drawings or listed herein. Unload the removed equipment and store it in the location designated by the County. Install the new equipment in locations as indicated in the drawings and as summarized below:

D. Salvage

Equipment salvaged from the premises is the property of the County. Coordinate with Orange County Operations for proper cleaning and preparation of the equipment for storage as designated by the County RPR, including but not limited to flushing, draining of fluids, lubrication, etc… Carefully remove and handle the equipment. Place the equipment on

pallets or other means to enable future relocation by forklift. Wrap the equipment in shrink wrap or other means as designated by the County RPR to protect it. Tag, label or identify the equipment in a manner as designated by the County RPR. Major Equipment as identified below shall be hauled, unloaded, and installed at Orange County SWRF as designated by the County RPR. The Contractor shall develop a log in MS Excel of salvaged equipment using an alpha-numerical designation to document the location, identification tags, and other pertinent information as designated by the County RPR.

1. The following are major equipment elements that shall be salvaged as part of the disk filter. Not all the equipment to be salvaged within the project is identified herein. Reference the drawings for further elements to be salvaged.

Major Salvaged Equipment
1. EWRF Existing Aqua Disk Filter (Process 470)
2. EWRF Process 470 Control Panels
3. EWRF Process 470 Feed Pumps

E. Existing Piping and Electrical Utilities

Shut off or disconnect utilities affecting demolition work. Schedule shutdowns with the County by processing a C.A.R form; notify the County seven (7) working days in advance of any shutdown that is required to perform the work. The County will open/close valves on piping, and electrical disconnects required for the shutdowns.

F. Removal or Relocation of Electrical Materials and Equipment

1. Unless otherwise noted, remove existing electrical materials and equipment from areas indicated for demolition or where equipment is to be relocated. Disconnect circuits at their source. Remove materials no longer used, such as studs, straps, and conduits. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 3/4 inch below the final finished surface. Remove existing unused wires.

2. Electric cables for demolition shall be removed from pumps and filters to their source panels and properly disconnected.

3. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface.

G. Patching

1. Patching shall mean the restoration of a surface or item to a condition as near as practicable to match the existing adjoining surfaces unless otherwise noted, detailed, or specified.

2. When patching involves painting, special coating, vinyl fabric, or other applied finish, refinish the entire surface plane (i.e., wall or ceiling), unless complete refinishing of the entire space is scheduled or specified.

3. Patching includes cleaning of soiled surfaces.

H. Demolition

1. Structures, boxes, pipes, and other items are to be removed, altered, salvaged, and disposed of as specified herein or indicated in the drawings. Remove and dispose of all portions of these items that interfere with project construction.

2. Remove and dispose offsite facilities to be demolished in their entirety including belowground footings, foundations, and other associated appurtenances, as shown in the drawings or as specified herein. Backfill and compact all site areas disturbed by demolition work with earth backfill or gravel material in accordance with Section 02200.

3. Perform the work in a manner that will not damage parts of the structure not intended to be removed or to be salvaged for the County. If, in the opinion of the County's Representative, the method of demolition used may endanger or damage parts of the structure or affect the satisfactory operation of the facilities, promptly change the method when so notified by the County's Representative. No blasting will be permitted.

4. All equipment, material, and piping, except as specified to be salvaged for the County, or removed by others, within the limits of the demolition, excavations, and backfills, will become the property of the Contractor and shall be removed from the project site. The salvage value of this equipment, materials, and piping shall be reflected in the contract price of the demolition work.

5. Do not reuse material salvaged from demolition work on this project, except as specifically shown.

END OF SECTION

SECTION 02200 EARTHWORK

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of earthwork for excavations, fills, and embankments for roadways, structures, and sites.

B. Submittals

Submit six copies of a report from a testing laboratory verifying that the material contains less than 1% asbestos by weight or volume and conforms to the gradation specified.

C. Testing for Compaction

1. The Owner will test for compaction and relative density as described below.

2. Determine the density of soil in place by the sand cone method, ASTM D 1556. Compaction tests will be performed for each lift or layer.

3. Determine laboratory moisture-density relations of soils per ASTM D 698.

4. Determine the relative density of cohesionless soils per ASTM D 4253 and D 4254.

5. Sample backfill materials per ASTM D 75.

6. "Relative compaction" is the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.

D. Disposal of Excess Materials

Excess site excavated or wasted material shall be disposed of offsite by the Contractor at his expense. No prearranged disposal site or related permits have been determined or secured by the Owner.

E. Material Availability

Sufficient earthwork material to complete the work is not available at the site. Secure source of material and permits to complete the project requirements.

PART 2 - MATERIALS

A. Structural Fill & Backfill

1. Structural backfill shall consist of clean, fine to medium sand, contain less than 1% by weight asbestos or organic matter (peat, humus, leaves, and carbon compounds), and conform to the following gradation requirements:

Sieve Size	**Percent Passing by weight**
3/8 inch	100
No. 4	90 - 100
No. 200	<10
Organic Matter	<1%

2. Excavated native material may be used for structural backfill provided it conforms to the above specifications for structural backfill material.

B. Select Sand Fill, Including Imported Sand for Pipe Zone and Pipe Bedding in Pipe Trenches

1. The material used for the select sand fill shall consist of less than 1% by weight asbestos or organic matter (peat, humus, leaves, and carbon compounds), and conforming to the following gradations requirements:

Sieve Size	**Percent Passing by weight**
3/8 inch	100
No. 4	90 - 100
No. 200	<12
Organic Matter	<1%

2. Sand shall have a coefficient of permeability greater than 0.014 cm/s measured in accordance with ASTM D2434. Native material may be used in lieu of imported sand if it is shown by the Contractor that it is in compliance with the aforementioned requirements.

3. Excavated native material may be used for select sand fill provided it conforms to the above specifications for select sand fill.

C. Pipe

Sieve Size	Percent Passing by weight
1/2 inch	90 - 100
3/8 inch	80 - 100
No. 4	60 - 100
No. 200	<30
Organic Matter	0 – 5%

Backfill

1. The material used for pipe backfill of the trench zone shall consist of less than 1% by weight asbestos or organic matter (peat, humus, leaves, and carbon compounds), and conform to the following gradation requirements:

2. Excavated native material may be used for pipe backfill provided it conforms to the above specifications for pipe backfill.

D. Common Fill:

1. The material used for common fill shall consist of less than 1% by weight asbestos and conform to the following gradation requirements:

2. Excavated native material may be used for common fill provided it conforms to the above specifications for common fill.

E. Unsuitable Material:

1. The following gradation is for the classification of unsuitable material encountered during the Work:

Sieve Size	Percent Passing by weight
1/2 inch	<10
No. 200	>30
Organic soils	>20

2. Material encountered that meets any one (1) of the three (3) criteria noted in the gradation table above shall be determined to be unsuitable material.

3. When unsuitable material is encountered, it is to be excavated to a satisfactory limit until suitable material is reached for the purpose of the Work being performed at hand.

4. Unsuitable material is to be excavated, hauled and disposed of in accordance to Specification Section 01025.

F. Sand-Cement Slurry Backfill

Sand-cement slurry backfill shall consist of one sack (94 pounds of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

G. Water for Compaction

Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l. Provide all water needed for earthwork. Provide temporary piping and valves to convey water from the source to the point of use. Provide any meters if the water is taken from a County pipeline.

H. Gravel and Crushed Rock for Structures

Reference Specification Section 02276.

I. Drain Material

Drain rock, or crushed rock, shall consist of hard, durable particles of stone, crushed to the required gradation below per AASHTO T-27 or ASTM C136, and shall be free from vegetable matter, lumps of clay, and other deleterious matter size:

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	90 – 100
1/2 inch	30 – 60
3/8 inch	0 – 20
No. 4	0 - 5

J. Filter Fabric

1. Filter fabric shall be manufactured from polyester, nylon, or polypropylene material; shall be of woven construction; and shall meet the following requirements:

   a. Grab tensile strength (ASTM D1682): 100 lbs minimum for a 1-inch grip.

   b. Equivalent open sizes (UFGS-02373)

2. Filter fabric shall be MIRAFI, manufactured by Mirafi Inc., Charlotte, North Carolina; or equal

K. Drainpipe

Underdrain or back of wall drainpipe shall be ABS or PVC.

L. Membrane Liner

1. Lexsuco's "Membrane Waterproofing," Rubber and Plastics Compound Company's "Nervastral Seal-Pruf H-D," or equal, PVC plastic membrane sheeting, 30 mils thick.

2. Sheets shall be as wide as practicable for application that will result in the least number of laps.

M. Adhesive for Membrane Liner

Lexsuco M-W, Type A cement, "Nerva-Plast" cement, or equal, synthetic rubber base cement especially manufactured for use with PVC membrane material for cold application. Do not use asphaltic base adhesives.

PART 3 - EXECUTION

A. Dewatering

Provide and operate equipment adequate to keep excavations and trenches free of water. Dewater subgrade to a minimum of 2 feet below bottom of excavation. Remove water during period when concrete is being deposited, when pipe is being laid, and during the placing of backfill. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation. Obtain (if necessary) and comply with discharge permit from St. John's River Water Management District.

B. Excavation

1. Provide monitoring wells for verification of groundwater levels.

2. Excavation is unclassified. Perform excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 3 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

3. Excavations shall have sloping, sheeting, shoring, and bracing conforming with current State &/or Federal OSHA requirements and the General Conditions.

4. After the required excavation has been completed, the Owner will observe the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the structure where unacceptable subgrade materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the structure or within a zone outside and below the structure defined by a line sloping at 1-horizontal to 1-vertical from 1 foot outside the edge of the footing. Refill the overexcavated areas with structural backfill material.

5. The Contractor will not receive any additional payment for refill material used for his convenience.

C. Limits of Foundation Excavation

Excavate to the depths and widths needed to accomplish the construction. Allow for forms, working space, structural backfill, and site grading. Do not excavate for footings, slabs, or conduits below elevations indicated. Unless unacceptable material is encountered and overexcavation is authorized by the Owner, backfill overexcavations with compacted structural backfill material. Correct cuts below grade by trimming adjoining areas and creating a smooth transition. The Contractor shall bear all costs for correcting unauthorized overexcavated areas.

D. Preparation of Foundation Subgrade

1. The existing location shall be cleared, stripped and grubbed as specified within Section 02110.

2. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross section indication, shall be smooth and free from irregularities, and shall be at the specified relative compaction. The subgrade shall extend over the full width and area extending a minimum of 5-feet beyond the edges of the foundations.

3. Scarify the final subgrade surface and compact the top 24 inches of the subgrade to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557) to a depth of 24-inches below the bottom elevation of the foundation.

4. Remove soft material encountered and replace with structural backfill. Fill holes and depressions to the required line, grade, and cross sections with structural backfill.

5. If rock is encountered at final grade, overexcavate to a depth of 6 inches and place structural backfill to establish final grade.

E. Preparation for Placing Structural Fill and Backfill

1. After excavation of existing material or removal of unacceptable material at the exposed subgrade, scarify the final subgrade surface to a depth of 12 inches and compact to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

2. Remove foreign materials and trash from the excavation before placing any fill material. Obtain the specified compressive strength and finish of concrete work per Sections 03300 before backfilling.

F. Placing and Compacting Fill and Structural Fill

1. Excavated material may be used for fill providing all deleterious materials have been removed from the stockpiled material.

2. Place backfill in maximum 8-inch lifts and compact each lift to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

3. Where fill is to be constructed on slopes steeper than 3:1, bench the fill into competent undisturbed materials as the fill progresses up the slope. Benches shall be sloped at least 2% into the slope and shall be of a width at least equal to the height of fill lift.

G. Placing and Compacting Structural Backfill

1. Place structural backfill material around piping, structures, channels, and other areas, including authorized overexcavation areas, to the lines and grades shown or specified. Do not exceed loose lifts of 8 inches in depth.

2. Limits of Structural Backfill: Limits of structural backfill shall be a minimum of 5.0 feet from edge of foundation and shall extend at a 1:1 slope to the finish grade.

3. Compact each lift to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557). Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be replaced.

4. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides. Comply with backfill preparation around concrete structures as specified in Section 03300.

5. Do not backfill the walls of structures that are laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

6. Do not operate earthmoving equipment within 7 feet of walls of concrete structures. Place and compact fill or backfill adjacent to concrete walls with hand-operated tampers or other equipment that will not damage the structure.

7. Backfill adjacent to water-holding basins and channels only after leakage tests have been conducted as specified in Section 03800.

8. Monitor concrete structures during all backfill operations and stop work if there is damage to or a resultant reaction observed within structure.

H. Moisture Control of Backfills and Embankments

During the compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the backfill material. Maintain uniform moisture content throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the backfill material. At the time of compaction, the water content of the material shall be at optimum water content or within 2 percentage points above optimum. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.

I. Site Grading

Perform earthwork to the lines and grades shown in the drawings. Shape, trim, and finish slopes of channels to conform with the lines, grades, and cross sections as shown. Remove exposed roots and loose rocks exceeding 3 inches in diameter. Round tops of banks to circular curves of not less than a 3-foot radius. Neatly and smoothly trim rounded surfaces. Do not overexcavate and backfill to achieve the proper grade.

J. Vapor Barrier Installation

1. Place vapor barrier with adjacent sheets bonded per manufacturer's requirements.

2. Lay vapor barrier sheets directly over the compacted subgrade just before sand cushion is placed and concrete is poured. Carefully install to avoid puncture or tear. Patch punctures and tears occurring during subsequent operations. Lap edges at least 4 inches and lap end joints at least 6 inches, with laps continuously sealed with tape. Carry barrier over any pipes laid on the fill and seal in waterproof manner to any pipes or conduits which penetrate the fill. Turn up membrane a minimum of 2 inches at the edges and secure to exterior wall foundations or footings with adhesive. Apply vapor barrier to walls with the same adhesive. Do not place stakes through vapor barrier membranes for screeding of concrete slabs.

END OF SECTION

SECTION 02222 PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

A. Description

This section includes materials and procedures for protecting existing underground utilities.

PART 2 - MATERIALS

A. Replacement in Kind

Except as indicated below or as specifically authorized by the County's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 - EXECUTION

A. General

1. Replace in kind street improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.

2. Where utilities are parallel to or cross the construction but do not conflict with the permanent work to be constructed, follow the procedures given below. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. For utility crossings not shown in the drawings, refer to the General Conditions and the instructions of the Owner's Representative for guidance.

3. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in work.

B. Procedures

1. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified in the drawings or in the specifications.

2. Cut and Plug Ends: Cut abandoned utility lines and plug the ends. Plug storm drains and sewers with an 8-inch wall of brick and mortar. Cap waterlines with a cast-iron cap or install a 3-foot-long concrete plug. Dispose of the cut pipe as unsuitable material.

3. Remove and Reconstruct: Where so indicated in the drawings or as required by the County's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

C. Compaction

1. Utilities Protected in Place: Backfill and compact under and around the utility so that no voids are left.

2. Utilities Reconstructed: Prior to replacement of the utility, backfill the trench and compact to an elevation 1 foot above the top of the ends of the utility. Excavate a cross trench of the proper width for the utility and lay, backfill, and compact.

3. Alternative Construction--Sand Slurry: Sand slurry consisting of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability may be substituted for other backfill materials to aid in reducing compaction difficulties. Submit specific methods and procedures for the review of the County's Representative prior to construction.

D. Special Construction

1. Reinforced Concrete Beam: Where indicated in the drawings or as determined by the County's Representative, support utilities by a reinforced concrete beam. The primary purpose of the beam is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction and shall incorporate the beam as part of the protection.

2. Concrete Support Wall: Where indicated in the drawings or as determined by the County's Representative, support the utilities by a concrete support wall as shown on the utility support details in the drawings. The purpose of the concrete support wall is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction.

E. Thrust Blocks on Waterlines

1. The Contractor's attention is called to thrust blocks for pipelines throughout the project whose thrust is in the direction of the new excavation and, therefore, may be affected by the construction. These pipelines are owned and operated by the County. Protect thrust blocks in place or shore to resist the thrust by a means accepted by the County's Representative and reconstruct. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the County's Representative, reconstruct them to bear against firm unexcavated or backfill material or restrain pipe mechanically.

2. Provide firm support by backfilling that portion of the trench for a distance of 2 feet on each side of the thrust block to be reconstructed from the pipe bedding to the pavement subgrade, with either:

   a. Sand-cement slurry (94 pounds of cement per cubic yard).

   b. The native material compacted to a relative compaction of 95%.

3. Then excavate the backfill material for construction of the thrust block.

4. Test compaction of the backfill material before pouring any concrete thrust block. Use Class A concrete per Section 03300 for reconstruction.

END OF SECTION

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SECTION 02223 TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation for pipeline trench excavation, backfilling, and compacting.

B. Submittals

1. Submit six copies of a report from a testing laboratory verifying that material conforms to the specified gradations or characteristics for pea gravel, granular material, imported sand, rock refill for foundation stabilization, and water.

2. Submit method of compaction in pipe zone including removal sequence of shoring where used.

C. Testing for Compaction

The County will test for compaction as described in Section 02200.

D. Pavement Zone

The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

E. Street Zone

The street zone is the top 30 inches of the trench immediately below the pavement zone in paved areas.

F. Trench Zone

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.

G. Pipe Zone

The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as specified below. Where

multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

Pipe Diameter	Thickness of Pipe Zone Above Top of Pipe
6 inches or smaller	6 inches
8 inches and larger	10 inches

H. Pipe Base or Bedding

The pipe base or bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

Pipe Diameter	Thickness of Pipe Base
16 inches or smaller	4 inches
18 inches and larger	6 inches

PART 2 - MATERIALS

A. Pea Gravel

Pea gravel shall be rounded gravel, graded with less than 10% passing a No. 200 sieve, less than 50% passing a No. 4 sieve, and having a maximum particle size as follows:

Type of Pipe	Maximum Particle Size (inches)
Ductile iron	¾

B. Common Fill

1. See Section 02200.

C. Select Sand Fill-Pipe Zone and Pipe Base

See Section 02200.

D. Pipe Backfill—Trench Zone

See Section 02200.

E. Gravel and Crushed Rock

Gravel or crushed rock material shall conform to the Florida DOT Section 901, "Coarse Aggregate," Grade 357.

F. Permeable Material for Underdrains

1. Permeable material shall consist of hard, durable, clean sand, gravel, or crushed stone and shall be free of organic material, clay balls or other deleterious substances. Gradation shall be:

Sieve Size	Percent Passing By Weight
3/4 inch	100
1/2 inch	95 - 100
3/8 inch	70 - 100
No. 4	0 - 55
No. 8	0 - 10
No. 200	0 - 3

2. Durability Index shall be at least 40 per ASTM D 3744.

G. Sand-Cement Slurry

Sand-cement slurry backfill shall consist of one sack (94 pounds) of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

H. Rock Refill for Foundation Stabilization

Rock refill shall be crushed or natural rock containing less than 1% asbestos by weight or volume, having the following gradation:

Sieve Size	Percent Passing By Weight
3 inches	100
1-1/2 inches	70 - 100
3/4 inch	60 - 100
No. 4	25 - 55
No. 30	10 - 30
No. 200	0 - 10

I. Water for Compaction

See Section 02200. Water shall be free of organic materials injurious to the pipe coatings.

J. Underground Plastic Warning Tape for Metal Pipe

See Section 15075.

K. Underground Detectable Metallic Pipe Warning Tape

See Section 15075.

PART 3 - EXECUTION

A. Compaction Requirements

Unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Pipe Zone: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

2. Backfill in Trench Zone Not Beneath Paving: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

3. Backfill in Trench Zone to Street Zone in Paved Areas: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

4. Backfill in Street Zone in Paved Areas: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

5. Refill for Overexcavation: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

B. Sidewalk, Pavement, and Curb Removal

Cut bituminous and concrete pavements regardless of the thickness and curbs and sidewalks prior to excavation of the trenches with a pavement saw or pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface. Haul pavement and concrete materials from the site. Do not use for trench backfill.

C. Material Replacement

Remove and replace any trenching and backfilling material which does not meet the specifications, at the Contractor's expense.

D. Trench Widths

Trench widths in the pipe zone shall be as shown in the drawings. If no details are shown, maximum width shall be 18 inches greater than the pipe outside diameter. Comply with 29CFR Part 1926 Subpart P--Excavations. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing.

E. Trench Excavation

Excavate the trench to the lines and grades shown in the drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade at no additional cost to the County with imported sand. Place the refilling material over the full width of trench in compacted layers not exceeding 8 inches deep to the established grade with allowance for the pipe base or special bedding.

F. Location of Excavated Material

1. During trench excavation, place the excavated material only within the working area or within the areas shown in the drawings. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

2. Remove and store excavated topsoil separately. Replace topsoil in the top 24 inches of the trench zone.

3. Locate trench spoil piles at least 15 feet from the tops of the slopes of trenches. Do not operate cranes and other equipment on the same side of the trench as the spoil piles.

G. Trench Excavation in Backfill and Embankment Areas

1. Construct and compact the embankment to an elevation of 1 foot minimum over the top of the largest pipe or conduit to be installed.

2. Excavate trench in the compacted backfill or embankment. Place pipe base material, install pipe or conduit, and backfill with pipe zone material. Compact backfill above the pipe zone to the same relative compaction as the adjacent embankment as specified in Section 02200.

H. Foundation Stabilization

1. After the required excavation has been completed, the County will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a width 24 inches greater than the pipe outside diameter and to the depth required.

2. Backfill the trench to subgrade of pipe base with rock refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 8 inches deep to the required grade. Foundation stabilization

work shall be executed in accordance with a change order.

3. Rock refill used by the Contractor for his convenience will not receive any additional payment.

I. Installing Buried Piping

1. All buried piping shall be mechanically restrained. All existing piping requiring a new connection is to be mechanically restrained.

2. No pipe deflection of buried piping is allowed unless approved by the County's Representative. Approval will be on a case by case basis.

3. Backfill per the detailed piping specification for the particular type of pipe and per the following.

4. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

5. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

6. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipelaying to provide firm, continuous, uniform support along the full length of pipe, and compact to the relative compaction specified herein. Before laying each section of the pipe, check the grade and correct any irregularities.

7. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill the area excavated for the joints with the bedding material specified or indicated in the drawings for use in the

pipe zone. If no bedding material is specified or indicated, use imported sand.

8. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side. If no pipe zone material is specified or indicated, use imported sand. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

9. Compact each lift to the relative compaction specified herein.

10. Push the backfill material carefully onto the backfill previously placed in the pipe zone. If no backfill material is specified or indicated, use native earth backfill. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.

J. Backfill Compaction

1. Compact per the detailed piping specification for the particular type of pipe and per the following.

2. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

3. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

4. Do not use any axle-driven or tractor-drawn compaction equipment within 3 feet of building walls, foundations, and other structures.

END OF SECTION

SECTION 02231 SOIL-CEMENT BASE COURSE

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing to construct a compacted base course composed of a combination of soil, Portland Cement and water.

PART 2 - PRODUCTS

A. Portland Cement

1. Except where a particular type of cement might be specifically called for on the plans, the cement used in the work may be of any one of the following AASHTO designated Types:

   Type I, II, or III (AASHTO M 85) or Type IS (AASHTO M 240).

   For all types specified the cement shall be subject to either the compressive or the tensile strength test. The air content test will be made at the option of the Engineer.

2. The cement used shall conform to the requirements of the AASHTO Designations shown therefore, with additional requirements as shown below.

3. Different brands of cement, cement of the same brand from different mills, or different types of cement, shall not be mixed during any continuous pour. Different brands or types of cement shall be stored separately.

4. Only portland cements containing less than 0.6 percent alkali, calculated as Na_2O (percent Na_2O plus 0.658 percent K_2O), shall be used in combination with coarse or fine aggregates from the Montgomery, Alabama, area, the Tuscaloosa formation or any other alkali reactive aggregate.

5. The cement may be delivered in bags or in bulk. The storage building, bin or silo shall be weatherproof and shall be located convenient to the work to be performed. On small jobs, storage in the open may be permitted by the Engineer, in which case a raised platform and adequate waterproof covering shall be provided.

If conditions warrant, a competent storekeeper may be required who shall have charge of the cement storehouse and shall keep suitable records of the delivery and use of all cement. Copies of such records shall be delivered to the Engineer at the close of each day's work or eight-hour run, showing in such details as he may reasonably require, the quantity used during the day or run, at each part of the work.

6. Cement varying more than five percent from designated weights (94 pounds per sack) shall be rejected (1) in carload lots if the average of 50 sacks taken at random is less than the designated weights, and (2) in individual sacks, if tests disclose that sacks vary more than five percent from designated weights and still the average of 50 sacks is greater than the designated weight. In the second instance, the cement may be used provided the proper adjustment per sack is made; such adjustment to be made by weight only.

   Cement which has been damaged, which is partially set, or which is lumpy or caked, shall not be used, and the entire contents of the sack of cement or the container of bulk cement, which contains damaged, partially set, or lumps of caked cement, will be rejected for use. Cement salvaged from discarded or used sacks shall not be used.

7. When, under the provisions of these specifications, it becomes necessary to transport loose cement, it shall be kept in a weatherproof compartment, separate from other aggregates.

B. Water

1. Water for use with cement shall be clean and practically free of oil, acid, alkali, chlorides, organic matter, and other deleterious substances.

   Water supplies which are approved by a public health department may be accepted without being tested. Water from all other sources shall be tested and approved by a public health department before use and shall not contain impurities in excess of the following limits:

Acidity or alkalinity calculated in Terms of calcium carbonate	0.05%
Total organic solids	0.05%
Total inorganic solids	0.08%
Total chlorides as sodium chloride	0.05%

C. Material

Use local or hauled-in clean sand or sand and clay.

D. Concrete

All concrete for base repair will be Class 1 concrete, minimum 28-day compressive strength of 2,500 psi as specified in Section 03300.

E. Curing Material

1. Rapid-curing, cut-back asphalt shall conform to the requirements of AASHTO M 81 except that the penetration range shall be from 60-120 instead of 80-120.

2. Cut-Back Asphalt, Grade RC-70 shall not be more than 15 units deficient in viscosity requirements. (The designation, "deficient," shall be considered as any variation, either under or over, from the minimum and maximum limitations for the viscosity, in the number of units by which the viscosity is measured.)

PART 3 - EXECUTION

A. Composition and Proportioning

1. Submit the name of an independent testing laboratory for review by the Engineer. Submit a design mix prepared by the testing laboratory for review by the Engineer.

2. Do not process the base until all tests of the soil to be used have been completed and the exact proportion of cement required for the particular soil has been determined according to "Expanded Short-Cut Test Methods for Determining Cement Factors for Sandy Soils", Highway Research Bulletin 61, 1952, and/or, when applicable, methods of "Wetting and Drying Test of Compacted Soil-Cement Mixtures", ASTM D559 (AASHTO T-135).

3. The quantity of water required will be the amount necessary for optimum moisture content in the compacted mixture. This quantity will vary with the nature of the soil and shall have been determined according to "Methods of Test for Moisture-Density Relation of Soil-Cement Mixtures", ASTM D558 (AASHTO T-134).

B. Preparation of Soil Aggregate

Remove unsuitable material and add suitable material as necessary prior to the application of cement. Pulverize the

soil to be treated for sufficient width and depth to give the compacted cross section shown on the plans. Pulverizing shall continue until 80 percent of the soil, by dry weight, exclusive of gravel, shell or stone larger than 3/4 inch, will pass a No. 4 sieve. Manipulate the pulverized soil until the moisture in the soil does not exceed the percentage of the optimum moisture specified for the soil-cement mixture.

C. Application of Cement

Shape the soil to the approximate cross section shown on the plans, and spread the designated quantity of cement uniformly over the surface in one operation.

D. Mixed-In-Place Method

Immediately after the cement has been distributed, mix it with the loose soil with a machine that will produce the proper homogeneous mixture. Shape the mixture to the approximate lines and grades shown on the plans.

E. Central Plant Mixed Method (Optional)

1. Mix the soil, cement and water in a pugmill either of the batch of continuous flow type. Equip the plant with feeding and metering devices which will add the soil, cement and water into the mixer in the specified quantities. Mix soil and cement sufficiently to prevent cement balls from forming when water is added, and continue until a uniform and intimate mixture of soil, cement and water is obtained.

2. Haul the mixture to the roadway in trucks equipped with protective covers. Place the mixture on the moistened subgrade in a uniform layer by an approved spreader and in such quantity that the completed base will conform to the required grade and cross section. Do not permit dumping of the mixture in piles or windrows upon the subgrade.

F. Compacting and Finishing

1. Compact the base to a density of 95 percent of the maximum density as determined by AASHTO T-180 to the line, grade and thickness shown in the plans.

2. After the mixture is compacted, reshape the surface of the base to the required lines, grades and cross section, and then lightly scarify to loosen imprints left by the compacting or shaping equipment until a

uniform, even surface mulch of approximately 1 inch in thickness is obtained. Then thoroughly roll and compact the surface.

3. Complete all of the above mixing, compacting and finishing within six (6) hours.

G. Construction Joints

1. At the end of each day's construction, form a straight transverse joint by cutting back into the completed work to form a true vertical face. This joint shall be located such as to exclude all that part of the base at the end of the run which does not have full depth, is not thoroughly compacted, not properly proportioned, or not properly mixed.

2. Build soil-cement for large, wide areas in a series of parallel lanes of convenient length and width meeting the approval of the Engineer. Form straight longitudinal joints at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

H. Weather Limitations

During seasons of probability of freezing temperature, do not apply cement unless the temperature is at least $40^{O}F$ in the shade and rising.

I. Surface Requirements (Scalping or Hardplaning)

After compacting and finishing have been completed, and not later than the beginning of the next calendar day after the construction of any section of base, test the surface with a template cut to the required crown and/or with a 10-foot straight-edge laid parallel to the centerline. Correct all irregularities greater than 1/4 inch. Additional wetting before, during and after this final shaping operation shall be required to keep the base continuously moist until the cure coat is applied.

J. Protecting and Curing

Within not more than three daylight hours after the hardplaning operations have been completed, the base shall be covered and protected against rapid drying by curing.

K. Opening to Traffic

Completed sections may be opened to all traffic after seven days.

L. Maintenance

Maintain the base to a true and satisfactory surface until the wearing surface is constructed. Should any repairs or patching be necessary, they shall extend to the full depth of the base and shall be made in a manner that will assure restoration of a uniform base course conforming to the requirements of these specifications. In lieu of repairing with soil-cement, Class 1 concrete may be used.

M. Testing

1. Monitor the construction procedure with the same independent testing laboratory that prepared the reviewed design mix and perform the following tests during placement:

   a. Determine cement content, moisture content, "inplace" density and thickness (maximum spacing of test holes 300 feet). Notify the Engineer immediately of any deviation from the design mix.

   b. Perform a laboratory density test and prepare two 4 inch-diameter by 4.6-inch-high compression test cylinders for each 300 feet of roadway. Moist cure by 7 days and test for compressive strength. Minimum acceptance standards are as follows:

      Thickness: Average in 1,000 ft.-1/4 inch variation
      Maximum variation in one hole-1/2 inch

      Compressive Strength: 300 psi in 7 days
      (molded laboratory specimens)
      350 psi in 14 days
      430 psi in 28 days

2. Send two copies of all field and laboratory test results to the Engineer within 10 days of completion of said tests. Include the cost of mix design and testing in the unit price bid for the soil-cement base.

END OF SECTION

SECTION 02232 LIMEROCK BASE COURSE

PART 1 - GENERAL

A. Description

The work specified in this section consists of the construction of a base course composed of limerock constructed on the prepared subbase in accordance with these specifications and in conformity with the lines, grades, notes, and typical cross sections shown on the plans.

B. Submittals

Submit copies of a certification from a testing laboratory that the material used for the base meets the specified criteria and contains less than 1% by weight asbestos.

PART 2 - PRODUCTS

A. Materials

1. Use limerock having a minimum percentage of carbonates of calcium and magnesium of 70, a maximum percentage of water-sensitive clay mineral of 3, and a liquid limit not exceeding 35. The material shall be non-plastic and contain less than 1% by weight asbestos.

2. Limerock material shall not contain cherty or other extremely hard pieces, or lumps, balls or pockets of sand or clay size material in sufficient quantity as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

3. At least 97 percent (by weight) of the material shall pass a 3-1/2 inch sieve and the material shall be graded uniformly down to dust. The fine material shall consist entirely of dust of fracture. All crushing or breaking-up which might be necessary in order to meet such size requirements shall be done before the material is placed on the road.

4. Limerock material used in construction of limerock base shall have an average LBR value of not less than 100.

PART 3 - EXECUTION

A. Transporting Limerock

Transport limerock to the point where it is to be used, over rock previously placed and dumped on the end of the preceding spread. In no case shall rock be dumped directly on the subbase.

B. Spreading Limerock

1. Spread limerock uniformly. Remove and replace all segregated areas of fine or coarse rock with well-graded rock. Place limerock 12” minimum outside of asphalt width.

2. Construct base in courses between 4 inches and 6 inches in thickness.

3. For double-course base, spread rock in two courses. Thickness of the first course shall be approximately one-half the total thickness of the finished base, or enough additional to bear the weight of the construction equipment without disturbing the subgrade.

C. Compacting and Finishing Grade

1. For double-course base, blade the first course if necessary to secure a uniform base and compact to the density specified below immediately prior to spreading the second course. No other finishing of this course is required.

2. After spreading is completed, scarify the entire surface and shape to produce the specified grade and cross section after compaction. For double-course bases, scarifying shall penetrate by at least 1/2-inch the surface of the first course.

3. As soon as proper moisture conditions are attained, compact the material to an average density of 98 percent of the maximum density obtainable under AASHTO Method T-180 (modified). Take density readings after grading and cross sectioning have been completed.

4. "Hard-plane" the surface with a blade immediately prior to the application of prime coat to remove thin-glazed or cemented surface, leaving a granular or porous condition that will allow free penetration of prime material. Remove materials planed from the base area.

5. If at any time, the subbase material becomes mixed with the base course material, excavate and remove the mixture, reshape and compact the subbase, and replace the materials removed with clean base material, shaped and compacted as specified above.

D. Testing Surface

1. Check the finished surface of the base course with a templet cut to the required cross section and with a 15-foot straight edge laid parallel to the center line of the road or other approved testing devices. Correct all irregularities greater than ±1/4 inch by scarifying and removing or adding rock, as may be required, after which the entire areas shall be compacted as specified herein.

2. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, complete the compacting operations for such areas prior to making the density tests on the finished grade.

E. Thickness Testing

After the base is completed, test holes or cores shall be taken by an independent testing laboratory at intervals of not more than 300 feet in roadways or 2,400 sq. ft. in area paving. The average thickness of three consecutive holes must be equal to at least the specified thickness. Where the base is more than 1/2 inch deficient in thickness, or does not meet the average thickness requirement, rework the area covered by this deficient base by scarifying to a depth of at least 3 inches and adding more base material, so that after proper compacting the thickness and shape will conform to the plans.

F. Density Testing

1. After the base is completed, the density shall be checked at intervals of not more than 300 feet of roadway or 2,400 sq. ft. of area paving. If any field density tests are below the specified density, rework and recompact the area until the minimum density is achieved.

2. MAKE AT LEAST THREE DENSITY DETERMINATIONS ON EACH DAY'S FINAL COMPACTION OPERATIONS ON EACH COURSE. The density determinations shall be made at more frequent intervals if deemed necessary by the Engineer.

END OF SECTION

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SECTION 02270 EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

A. Description

The work specified in this Section consists of measures required to control erosion on the project, right-of-way, and in areas outside the project area where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects of public or private property adjacent to the project area and damage to work on the project. These measures will consist of construction and maintenance of temporary erosion control features or, where practical, the construction and maintenance of permanent erosion control features.

Effective May 1, 2003 construction sites that will result in a disturbance of one acre or more are required to seek coverage from FDEP under the Generic Permit for Stormwater Discharge from Large and Small Construction Activities - DEP document 62-621.300(4)(a). Accordingly, the Contractor shall be required to submit a Notice of Intent (NOI) along with the application fee to the FDEP Stormwater Notices Center to use the Generic Construction NPDES permit. This will also require the Contractor to develop and implement a Stormwater Pollution Prevention Plan (SWPPP) for this project; the requirements of which shall be followed by the Contractor for the duration of the project.

B. Control of Contractor's Operations Which May Result in Water Pollution

1. In addition to the erosion control measures specified herein, the Contractor shall comply with all requirements of the final approved Stormwater Pollution Prevention Plan (SWPPP) for the project.

2. Take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments, with fuels, oils, bitumens, calcium chloride, or other harmful materials. Conduct and schedule operations so as to avoid or otherwise minimize pollution or siltation of such streams, etc. Do not dump the residue from dust collectors or washers into any water body.

3. Construction operations in stormwater ponds and other impoundments shall be restricted to those areas where it is necessary to perform filling or excavation to

accomplish the work shown in the Contract Documents and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear impoundments of all obstructions placed therein or caused by construction operations.

4. Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or runoff.

C. Start of Work

Do not start work until erosion control measures are in place.

PART 2 - PRODUCTS

A. General

1. No testing of materials used in construction of temporary erosion control features will be required.

2. Materials used for the construction of the temporary erosion and sedimentation control measures not to be incorporated into the completed project may be new or used.

3. Coordinate with the conditions of the FDEP NOI permit.

PART 3 - EXECUTION

A. General

1. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, artificial coverings, berms, baled hay or straw, floating silt barriers, staked silt barriers and staked silt fences. Design details for some of these items may be found in the Water Quality Section of the applicable edition of the FDOT Roadway and Traffic Design Standards.

2. Incorporate permanent erosion control features into the project at the earliest practical time. Correct conditions, using temporary measures, that develop during construction to control erosion prior to the time it is practical to construct permanent control features.

3. Construct temporary and permanent erosion and sediment control measures to prevent the pollution of adjacent water ways in conformance with the laws, rules and regulations of Federal, State and local agencies.

B. Installation

1. Temporary Sod: This work shall consist of furnishing and placing sod in accordance with the Contract Documents.

2. Temporary Mulching: This work shall consist of furnishing and applying a two-inch to four-inch thick blanket of straw or hay mulch and then mixing or forcing the mulch into the top two inches of the soil in order to temporarily control erosion. Only undecayed straw or hay, which can readily be cut into the soil, shall be used. Other measures for temporary erosion control such as hydromulching, chemical adhesive soil stabilizers, etc., may be substituted for mulching with straw or hay. When permanent grassing operations begin, temporary mulch materials shall be plowed under in conjunction with preparation of the ground.

3. Sandbagging: This work shall consist of furnishing and placing sandbags in configurations, so as to control erosion and siltation.

4. Slope Drains: This work shall consist of constructing slope drains, utilizing pipe, fiber mats, rubble, cement concrete, asphaltic concrete plastic sheeting, or other acceptable materials, in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as may be approved as suitable to adequately perform the intended function.

5. Sediment Basins: Sediment basins shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as suitable to adequately perform the intended function. Sediment basins shall be cleaned out as necessary.

6. Artificial Coverings: This work shall consist of furnishing and applying fiber mats, netting, plastic sheeting, or other approved covering to the earth surfaces.

7. Berms: This work shall consist of construction of temporary earth berms to divert the flow of water from an erodible surface.

8. Baled Hay or Straw:

   a. This work shall consist of construction of baled hay or straw dams to protect against downstream accumulations of silt. The baled hay or straw dams shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards.

   b. The dam shall be placed so as to effectively control silt dispersion under conditions present on this project. Alternate solutions and usage of materials may be used if approved.

9. Temporary Silt Fences and Staked Silt Barriers: This work shall consist of furnishing, installing, maintaining and removing staked turbidity barriers in accordance with the manufacturer's directions, these specifications and the details as shown in FDOT's Roadway and Traffic Design Standards.

C. Removal of Temporary Erosion Control Features

In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in such a manner that there will be no detrimental effect.

D. Maintenance of Erosion Control Features

General: Provide routine maintenance of permanent and temporary erosion control features until the project is completed and accepted.

E. Protection During Suspension of Contract Time

In the event that it is necessary that the construction operations be suspended for any appreciable length of time, shape the top of the earthwork in such a manner as to permit runoff of rainwater and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes, and impoundments. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation.

END OF SECTION

SECTION 02551 PRIME AND TACK COATS

PART 1 - GENERAL

A. Description

This section includes materials, testing and application of bituminous material on a previously prepared base and on an existing pavement surface.

B. Submittals

Submit shop drawings in accordance with the General Conditions and Section 01300 showing the materials to be used and manufacturer's certificates showing compliance with the specifications.

PART 2 - PRODUCTS

A. Prime Coat

The material used for prime coat shall be:

1. Cut-back Asphalt Grade RC-70 or RC-250 meeting the requirements of AASHTO M81 except that the penetration range shall be from 60-120 instead of 80-120.

   For Grade RC-3000, in addition to the requirements shown in Table I of AASHTO M81 the following values shall be added to the requirements for Distillation Test:

Distillate, percentage by volume of total distillate to 680 deg. F.	Grade RC-3000 Max.
to 320 deg. F	0
to 374 deg. F	10
to 437 deg. F	40

   All other requirements for the distillation test (and for other properties included in the table) shall be as shown in Table I of AASHTO M81.

2. Emulsified Asphalt Grades SS-1 or CCS-1, SS-1H or CCS-1H diluted in equal proportion with water; asphalt emulsified asphalt grade AE-60, AE-90, AE-150 or AE-200 diluted at the ratio of 6 parts emulsified asphalt to 4 parts water; special MS-Emulsion diluted at the ratio of

6 parts emulsified asphalt to 4 parts water; Asphalt Emulsion Prime (AEP) meeting the following:

a. Anionic Emulsified Asphalt shall meet the requirements of AASHTO M140 with the exception that the cement mix test will be waived when the asphalt is used in non-mix application, such as tack coats and primes.

b. Cationic Emulsified Asphalt shall meet the requirements of AASHTO M208.

c. Emulsified Asphalt Grades AE-60, AE-90, AE-150 and AE-200 shall meet the following requirements:

HIGH FLOAT EMULSIONS

	Asphalt Emulsion Grade			
	AE-60		AE-90	
	Min	Max	Min	Max
Tests on Emulsion:				
Saybolt Furol Viscosity at 122°F, sec.	75	400	75	400
Settlement 5 days, %		5		5
Storage Stability 24 Hr., %		1		1
Sieve Test, %		0.10		0.10
Demulsibility, 50 ml CaC12 0.10N, %	75		75	
Residue by Distillation, %	65		65	
Oil Portion, % by Volume (500°F Dist)		1		2
Tests on Residue:				
Penetration 77°F 100 g 5 sec	40		70	
Absolute Viscosity, poise 140°F	3200		1600	
Ductility 77°F 5 cm/min, cm	40		40	
Float Test 140°F, sec	1200		1200	
Solubility in Trichloroethylene, %	97.5		97.5	

	AE-150		AE-200	
	Min	Max	Min	Max
Tests on Emulsion:				
Saybolt Furol Viscosity at 122°F, sec.	75	400	75	
Settlement 5 days, %		5		5
Storage Stability 24 Hr., %		1		1
Sieve Test, %		0.10		0.10
Demulsibility, 50 ml CaC12 0.10N, %	75			
Residue by Distillation, %	65		62	
Oil Portion, % by Volume (500°F Dist)		3		8
Tests on Residue:				
Penetration 77°F 100 g 5 sec	125		150	
Absolute Viscosity, poise 140°F	800		400	
Ductility 77°F 5 cm/min, cm	40			
Float Test 140°F, sec	1200		1200	
Solubility in Trichloroethylene, %	97.5		97.5	

d. Special MS-Emulsion shall meet the following requirements with a minimum application temperature of 170°F:

SPECIAL MS-EMULSION

	Min	Max
Tests on Emulsion:		
Saybolt Furol Viscosity at 77°F, sec.	45	--
Storage Stability 24 Hr., %	--	1
Sieve Test, %	--	0.10
Demulsibility, 50 ml CaC12 0.10N, %	65	--
Residue by Distillation, %	62	--
Oil Portion, % by Volume (500°F Dist)	--	8
Tests on Residue:		
Penetration 77°F 100 g 5 sec	60	--
Ductility 77°F 5 cm/min, cm	40	--
Absolute Viscosity, poise 140°F	800	--
Solubility in Trichloroethylene, %	97.5	

e. Emulsified Asphalt Grade CRS-2H shall meet the following requirements:

EMULSIFIED ASPHALT GRADE CRS-2H

	Min	Max
Tests on Emulsion:		
Saybolt Furol Viscosity at 122°F, sec.	100	400
Settlement 5 days, %	--	5
Storage Stability 24 Hr., %	--	1
Demulsibility, 35 ml 0.8% Sodium dioctyl Sulfosaccinate, %	40	
Particle Charge	Positive	
Sieve Test, %	--	0.1
Residue, %	65	--
Tests on Residue:		
Penetration 77°F 100 g 5 sec	80	140
Ductility 77°F 5 cm/min, cm	40	--
Solubility in Trichloroethylene, %	97.5	--

f. Asphalt Emulsion Prime shall meet the following requirements:

ASPHALT EMULSION PRIME (AEP)

	Min	Max
Tests on Emulsion:		
Saybolt Furol Viscosity at 77°F, sec.	20	150
Settlement 5 days, %	--	5
Storage Stability 24 Hr., %	--	1
Sieve Test, %	--	0.1
Demulsibility, 50 ml CaC12 0.10N, %	65	--
Residue, %	55	--
Oil Portion, % by Volume (500°F Dist)	--	12
Tests on Residue:		
Penetration 77°F 100 g 5 sec	40	200
Ductility 77°F 5 cm/min, cm	40	--
Solubility in Trichloroethylene, %	97.5	--

Where Emulsified Asphalt is deficient from the minimum percentage of residue required in the applicable specifications, payment for such material will be made at reduced rates as shown in the following table:

Deficiency from Minimum Percent Residue	Percentage of Original Contract Price
1 - 3	95
4 - 6	85
7 - 9	75
*More than 9	50

*At the discretion of the Engineer, the asphaltic mixture, the base material, the surface treatment, or the mineral seal coat containing this material may be left in place with 50 percent payment made therefore, or be removed to the extent required by the Engineer and acceptably replaced.

The viscosity requirements for all Grades of Emulsified Asphalt used as tack coat or prime coat may be waived by the Engineer if satisfactory results are being obtained.

B. Cover Material for Prime Coat

1. If an emulsified asphalt is used for prime coat, the cover material shall be hot-asphalt coated (mix to contain from two to four percent asphalt-cement) to achieve a prime coat which will remain reasonably intact until the surface course is placed.

2. If material other than emulsified asphalt is used for the prime coat, the cover material shall be either sand (bare or hot-asphalt coated) or screenings. The sand shall be nonplastic and free from any appreciable amount of silt, clay balls and root particles, and from any noticeable sticks, trash, vegetation or other organic matter. Screenings shall be Miami Oolitic rock screenings as specified in FDOT Specification Section 902-5.2.3.

C. Tack Coat

1. Unless a specific type or grade of material is called for in the plans or specifications, the material used for tack coat may be any of the following: Emulsified Asphalt, Grades RS-1, RS-2, CRS-2, SS-1, CSS-1, SS-1H, CSS-1H, AE-60, AE-90, AE-150, or CRS-2H, Special MS Emulsion, or Asphalt Emulsion Prime (AEP). The materials specified above shall not be diluted prior to use.

2. Emulsified asphalt (RS Type) shall meet the following requirements:

	Min.	Max.
Tests on Emulsion:		
Saybolt furol viscosity at 77°F, sec.	75	--
Storage stability 24 Hr., %	--	1.0
Sieve test, %	--	0.1
Naptha content, % by volume	5	15
Residue, %	55	--
Tests on Residue:*		
Penetration at 77°F, 100g, 5 sec.	50	--
Viscosity at 140°F (poises)	800	--
Solubility in trichloroethylene, %	97.5	--

* Residue by distillation shall be in accordance with AASHTO T-59 except that the maximum temperature shall be 329° + 10°F (165° + 5°C) and the sample shall be maintained at this temperature for 20 minutes.

PART 3 - EXECUTION

A. Equipment

Pressure Distributor: The pressure distributor shall be equipped with pneumatic tires having a sufficient width of rubber in contact with the road surface to avoid breaking the bond or forming a rut in the surface. The distance between the centers of openings of the outside nozzles of the spray bar shall be equal to the width of the application required, within an allowable variation of two inches. The outside nozzle at each end of the spray bar shall have an area of opening not less than 25 percent nor more than 75 percent, in excess of the other nozzles. All other nozzles shall have uniform openings. When the application covers less than the full width, the normal opening of the end nozzle at the junction line may remain the same as those of the interior nozzles.

B. Cleaning Base and Protection of Adjacent Work

1. Before any bituminous material is applied, all loose material, dust, dirt, caked clay and other foreign materials which might prevent proper bond with the existing surface shall be removed for the full width of the application. Particular care shall be taken in cleaning the outer edges of the strip to be treated, to insure that the prime or tack coat will adhere.

2. When the prime or tack coat is applied adjacent to curb and gutter, valley gutter or any other concrete surfaces, such concrete surfaces (except where they are to be covered with a bituminous wearing course) shall be covered with heavy paper, or otherwise protected while the prime or tack coat is being applied. Any bituminous material deposited on such concrete surfaces shall be removed.

C. Weather Limitations

Prime and tack coats shall be applied when the air temperature, in the shade, is above 40°F, and when all other weather conditions and the condition of the surface are suitable.

D. Application of Prime Coat

1. General: The surface to be primed shall be clean and the moisture content of the base shall not exceed 90 percent of the optimum moisture. The temperature of the prime material shall be between 100°F and 180°F. The actual

temperature shall be that which will insure uniform distribution. The material shall be applied by means of a pressure distributor. The amount to be applied will be dependent on the character of the surface and shall be sufficient to coat the surface thoroughly and uniformly, with no excess. A prime coat is required on newly constructed limerock, shell, and sand clay bases.

2. Rate of Application

   a. Limerock, Limerock Stabilized, and Local Rock Bases: For these bases, the rate of application shall be not less than 0.10 gallon per square yard.

   b. Sandy-Clay, Shell and Shell Stabilized Bases: The rate of application for these bases shall be not less than 0.15 gallon per square yard.

3. Partial Width of Application: If warranted by traffic conditions, the application may be made on only one-half of the width of the base at one time, in which case positive means shall be used to secure the correct amount of bituminous material at the joint.

4. Sanding

   a. If emulsified asphalt is used to prime coat, the primed base shall be uniformly covered by an application of sand-bituminous hot mix or screenings at an approximate rate of ten pounds per square yard. The entire surface of the sand-bituminous hot mix or screenings cover material shall be rolled with a traffic roller as required to produce a reasonable dense mat.

   b. If material other than emulsified asphalt is used for prime coat, the primed base shall be covered by a light uniform application of cover material. If considered necessary for proper distribution of spread, the cover material shall be lightly dragged with a drag broom, after which it shall be rolled with a traffic roller, for at least ten passes over the entire area.

E. Application of Tack Coat

1. General: Where a bituminous surface is to be laid and a tack coat is required, the tack coat shall be applied as specified herein below.

2. Use a tack coat on existing pavement to be resurfaced, primed bases in areas which have become excessively dirty and cannot be cleaned, or in areas where the prime has cured and lost its bonding effect.

3. Method of Application: The tack coat shall be applied with a pressure distributor except that, on small jobs if approved by the Engineer, application may be by other mechanical devices or by hand methods. The bituminous material shall be heated to a suitable temperature and shall be applied in a thin, uniform layer.

4. Rate of Application: The rate of application shall be between 0.02 and 0.08 gallon per square yard. For tack coat applied on concrete pavement which is to be surfaced, the rate of application may exceed the upper limit.

5. Curing and Time of Application: The tack coat shall be applied sufficiently in advance of the laying of the bituminous mix to permit drying but shall not be applied so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material.

6. Protection: The tack coat surface shall be kept free from traffic until the subsequent layer of bituminous hot mix has been laid.

END OF SECTION

SECTION 02576 ASPHALT PAVEMENT

PART 1 - GENERAL

A. Description

This section specifies requirements for material, testing and installation of plant mix asphalt pavement.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following:

2. A design mix for the asphalt including gradation of all materials, content of mix, Marshall stability, and laboratory density.

3. Certifications showing that the materials comply with the specifications and contain less than 1% by weight asbestos.

PART 2 - PRODUCTS

A. Asphaltic Concrete

1. Composition, design mix and physical properties shall meet the requirements of the following:

Bituminous Concrete Mixtures
(Gradation Design Range)

Percent by Weight Total Aggregate Passing Sieves

Type	3/4	1/2	3/8	No. 4	No. 10	No. 40	No. 80	No. 200
S-I	100	88-100	75-93	47-75	31-53	19-35	7-21	2-6
S-III		100	88-100	60-90	40-70	20-45	10-30	2-6

(1) 100% passing 1-1/4-inch sieve and 94-100% passing 1-inch sieve.

Marshall Design Properties for
Bituminous Concrete Mixes

Mix Type	Minimum Marshall Stability (lbs)	Flow[1] (0.01 in.)	Minimum VMA (%)	Air Voids (%)	Minimum Effective Asphalt Content (%)
S-I	1500	8-14	14	3-5	5.0
S-III	1500	8-14	15	3-7	5.5

(1) The maximum flow for the mix design shall be one point less than shown. The maximum flow values shown apply only during production.

B. Asphaltic Concrete Type S-I and S-III

1. Type S-I and S-III shall meet the above requirements and the requirements in the following paragraphs.

2. The Asphalt Cement, Viscosity Grade AC-20 or AC-30, shall meet the following except that no spot test is required:

Test	AC-20 Min.	AC-20 Max.	AC-30 Min.	AC-30 Max.
Viscosity, 140°F (60°C), poises	(2000 ± 400)		(3000 ± 600)	
Viscosity, 275°F (135°C), Cs	300	--	350	--
Penetration, 77°F (25°C), 100 gm, 5 Sec.	60	--	50	--
Flash Point, COC, °F (°C)	450	--	(232)	--
Solubility in Trichloroethylene, percent	99.0	--	99.0	--
Tests on Residue from Thin Film Oven Test:				
Viscosity Ratio= $\frac{\text{Visc. 140°F after TFOT}}{\text{Visc. 140°F before TFOT}}$	--	4	--	4
Ductility 77°F (25°C) 5 cm per min, cm.	80	--	50	--
Loss on Heating, %	--0.5	--	0.5	

3. Mineral filler shall consist of limerock dust, portland cement, slag dust or hydrated lime. It shall be thoroughly dry and free from lumps, consisting of aggregations of fine particles. The filler shall meet the following gradation requirements:

Sieve Number	Total % Passing
30	100
80	95 (min)
200	65 (min)

Mineral filler may be provided from process screenings from stone or slag provided that the loss in processing under the Los Angeles Abrasion Test does not exceed 45%. The gradation of this filler shall be such that all of it shall pass the No. 10 sieve, and not more than 35% shall pass the No. 200 sieve. The material passing the No. 200 sieve shall be free of organic impurities and clay minerals shall not exceed 4.0%. The plasticity index of the material passing the No. 200 sieve shall not exceed 4.

4. Coarse Aggregate:

   a. Coarse Aggregate shall consist of gravel, rock or slag and contain less than 1% by weight asbestos. All coarse aggregate shall be washed and shall be free from disintegrated pieces, clay lumps, soft and friable particles, salt, alkali, organic matter and adherent coatings. The weight of deleterious substances shall not exceed the following percentages:

Coal and lignite	1.00
Clay lumps	2.00
Soft and friable particles	2.00
Cinders and clinkers	0.50
Free Shell	1.00
Organic matter (wet)	0.03
Material passing the No. 200 Sieve	1.75
Chert	3.00

      In addition, the sum of the percentages of all substances listed above shall not exceed ten.

   b. Coarse aggregate shall have a maximum loss of 45% when subjected to the Los Angeles Abrasion Test, a maximum loss of 12% when subjected to the Soundness (Sodium Sulfate) Test and contain a maximum of 10% flat or elongated pieces.

   c. Natural Stones: Coarse aggregate may be processed from gravels, granites, limestones, dolomites, sandstones, or other naturally occurring hard, sound, durable materials meeting the requirements of this paragraph.

      (1) Gravel shall be composed of naturally occurring quartz. The loss when the material is subjected to the Los Angeles Abrasion Test (AASHTO T96), shall be no more than 45%. The dry-rodded weight per cubic foot of the gravel, tested according to AASHTO T19, shall

be not less than 95 pounds. Crushed gravel shall consist of 85%, by weight, of the material retained on the No. 4 sieve, having three crushed faces.

(2) Granites: Coarse aggregate produced from the crushing of granites shall be sound and durable. For granites to be used in bituminous mixtures and surface treatments, the Los Angeles Abrasion requirement is modified to permit a maximum loss up to 50 (Manual of Florida Sampling and Testing Methods FM 1-T 096). Maximum amount of mica schist permitted is 5% (AASHTO T-189).

(3) Limestones, Dolomites and Sandstone: Coarse aggregates may be produced from limestone, dolomites, sandstones, and other naturally occurring hard, durable materials meeting the requirements of this paragraph.

(4) Pre-Cenozoic limestones and dolomites shall not be used as crushed-stone aggregates, either coarse or fine, for wearing courses of asphaltic concrete surface courses. This specifically includes materials from the Ketona Dolomite (Cambrian), Newala Limestone (Lower Ordovician), Bangor Limestone (Mississippian), and other formations of similar composition and origin occurring in central and northern Alabama and Georgia.

d. Slag shall be clean, tough and durable. It may be either air-cooled blast-furnace slag or phosphate slag. It shall be reasonably uniform in density and quality, and free from deleterious substances. It shall contain not more than 1.5% of sulphur. The dry-rodded weight shall be not less than 70 pounds per cubic foot. The loss, when the slag is subjected to the Los Angeles Abrasion Test, shall not exceed 45%. It shall contain not more than 10% glassy particles.

e. Unless written permission from the Owner is obtained, coarse aggregates of different types shall not be mixed, nor be used alternately in sections of less than one mile.

f. Grading shall be in accordance with FDOT Specification Section 901-1.4 Table 1.

g. Lightweight expanded aggregate shall be clean and durable material produced by firing shale, clay, or slate in a rotary kiln. It shall be reasonably uniform in quality and density and free from deleterious substances, except that the term cinders and clinkers shall only apply to those particles clearly foreign to the expanded aggregate in question and the maximum percentage of material passing the No. 200 sieve shall be 3.00. The dry-loose unit weight of the material, determined in accordance with AASHTO T19, shall not be less than 33 or more than 55 pounds per cubic foot. The burning process shall be carefully controlled. As an indication of the control of burning, the producer shall obtain and test samples of material at frequent intervals. Control shall be considered adequate if the dry-loose unit weight of such samples does not differ by more than ±6% from the average weight established from the producer's quality control testing records. When subjected to the Los Angeles Abrasion Test, the loss shall not exceed 35%.

5. Fine Aggregate:

a. Fine aggregate shall consist of natural silica sand, screenings, or a combination thereof, composed of clean, tough, angular grains, free from clay, soft or flaky particles, salt, alkali, organic matter, loam and other foreign matter. As delivered to the mixer it shall be free from clayey lumps of loosely bonded aggregations and the individual particles shall be free from adhering dust. Stone of slag screenings shall be produced from material complying with the abrasion requirements specified for coarse aggregate. The weight of deleterious substances (shale, coal and lignite, cinders and clinkers, clay lumps) shall not exceed 1.0, 1.0, 0.5 and 1.0% respectively.

b. The following additional limitation shall apply for stone used as aggregate in all asphaltic concrete used as a wearing coarse. Pre-Cenozoic limestones and dolomites shall not be used as crushed-stone aggregates, either coarse or fine, for wearing courses of asphaltic concrete surface coarses. This specifically includes materials from the Ketona Dolomite (Cambrian), Newala Limestone (Lower Ordovician), Bangor Limestone (Mississippian), and

other formations of similar composition and origin in central and northern Alabama and Georgia.

c. Any screenings used in the combination of aggregate shall contain not more than 15% of material passing the No. 200 sieve and, if necessary to meet this requirement, they shall be washed.

d. Any natural sand portion of the fine aggregate other than screenings shall be siliceous and shall contain not more than 10% of material passing the No. 200 sieve.

e. Silica sand, when tested by means of laboratory sieves, shall meet the following requirements:

Passing Sieve	Percent by Weight
No. 4	95-100
No. 8	85-100
No. 16	65- 97
No. 30	25- 70
No. 50	5- 35
No. 100	0- 7
No. 200	Max. 4

f. Screenings: Screenings shall be composed of hard, durable particles, either naturally occurring, such as gravel screenings, or resulting from the crushing or processing of the parent rock, to include natural rock, slags, expanded clays or shales (lightweight aggregates), or other approved inert materials with similar characteristics.

Aggregates classified as screenings shall conform to the following gradation requirements:

Sieve Size	Passing Percent
3/8"	100
No. 4	85 to 100
No. 200	Maximum 15

PART 3 - EXECUTION

A. Hot Bituminous Mixtures

1. Plant operations shall not begin unless all weather conditions are suitable for the laying operations.

2. The mixture shall be spread only when the surface upon which it is to be laid has been previously prepared, is intact, firm and properly cured, and is dry. No mixture shall be spread that cannot be finished and compacted during daylight hours. The mixture shall be spread only when the air temperature (the temperature in the shade away from artificial heat) is above 40°F for layers greater than one inch (100 lbs per square yard) in thickness and 45°F and above for layers one inch (100 lbs per square yard) or less in thickness (this includes leveling courses). No mixture shall be placed when there is evidence of a frozen base. The mixture shall not be spread 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.

3. Mixing at the asphalt plant shall be sufficient to produce a thoroughly and uniformly coated mixture. The ingredients of the mix shall be heated and combined in such a manner as to produce a mixture, which shall be at a temperature, when discharged from the pugmill or surge bin, within the range of 230°F to 310°F and within the tolerance shown in the following table:

Temperature Tolerance From
Job Mix Formula

Any Single Measurement	±25°F
Average of Any Five Consecutive Measurements . .	±15°F

However, the temperature of the mixture, in all cases, shall be such that will yield an asphalt Kinematic viscosity within the range of 280 and 150 centistokes. The mix temperature will be taken at the plant on the first five loads each day and on an average of once every five loads thereafter. Take corrective action if the temperature fails to fall within the specified tolerance.

4. The maximum time that any mix may be kept in a hot storage or surge bin is 72 hours. Produce a homogeneous mixture, free from moisture and with no segregated materials, that meets all requirements of the specifications for the mixture, including compliance with the design limits. These requirements shall apply also 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.

5. The mixture shall be transported in tight vehicles previously cleaned of all foreign material and each load shall be covered. The inside surface of the truck bodies shall be thinly coated with soapy water or an emulsion containing not over 5% of oil. Kerosene, gasoline or similar products shall not be used. After the truck bodies are coated and before any mixture is placed therein, they shall be raised so that all excess liquids will be drained out.

6. Prior to the laying of the mixture, the surface of the base or pavements to be covered shall be cleaned of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.

7. All asphaltic concrete mixtures (including leveling courses), other than adjacent to curb and gutter or other true edges, shall be laid by the string-line method, to assure the obtaining of an accurate, uniform alignment of the pavement edge. The temperature of the mix at the time of spreading shall be within $\pm$25°F of the actual mix temperature. The minimum frequency for taking mix temperatures on the road will be an average of one per five trucks. Take corrective action if the temperature range fails to fall within the specified tolerance range. Any mixture caught in transit by a sudden rain may be laid at risk. Should such mixture prove unsatisfactory, it shall be removed and replaced with satisfactory mixture at no additional expense to the Owner. In no case shall the mixture be laid while rain is falling or when there is water on the surface to be covered. The forward speed of the spreader shall be as established by the manufacturer of the equipment and sufficient for an even application. For each paving machine being operated, a separate crew will be required; each crew operating as a full unit. The depth of each layer shall be checked at frequent intervals of approximately 25 feet. Any deviation below the design thickness as shown on the drawings shall be immediately

corrected. In limited areas where the use of the spreader is impossible or impracticable, the mixture may be spread and finished by hand. Straight-edging and back-patching shall be done after initial compaction has been obtained and while the material is still hot.

8. For courses other than leveling, upon arrival, the mixture shall be dumped into a mechanical spreader and immediately spread and struck-off 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, or the specified thickness, will be secured. An excess amount of mixture shall be carried ahead of the screed at all times. Hand raking shall be done behind the machine as required. If necessary due to the traffic requirements, the mixture shall be laid in trips in such manner as to provide for the passage of traffic. Where the road is closed to traffic, the mixture may be laid to the full width, by machines traveling in echelon. Before any rolling is started the surface shall be checked, any irregularities adjusted, and all drippings, fat sandy accumulations from the screed, and fat spots from any source shall be removed and replaced with satisfactory material. No skin patching shall be done. When a depression is to be corrected while the mixture is hot, the surface shall be well scarified before the addition of fresh mixture.

9. For leveling courses, all depressions in the existing surface more than one inch deep shall be filled by spot patching with leveling course mixture and then thoroughly compacted prior to spreading any leveling course. All leveling courses shall be placed by the use of two motor graders (one of which is equipped with a spreader box) unless otherwise shown in the plans. When the total asphalt mix provided for leveling exceeds 50 pounds per square yard, the mix shall be placed in two or more layers, with the average spread of any layer not to exceed 50 pounds per square yard. When Type S-III Asphaltic Concrete is used for leveling, the average spread of a layer shall not be less than 50 lbs per square yard not more than 75 pounds per square yard. The quantity of mix for leveling shown in the plans represents the average for the entire project; however, the rate of application may vary throughout the project. When leveling in connection with base widening, all the leveling mix must be placed prior to the widening operation. When a leveling course is specified to be placed over cracked concrete pavement (including existing concrete pavement covered with an asphaltic

surface), the first layer of leveling shall be placed as soon as possible but no later than 48 hours after cracking the concrete. The remainder of the leveling course shall be placed in the normal sequence of operations. Where a leveling course is to be placed over existing concrete pavement or bridge decks, the excess joint filler in the cracks and joints shall be trimmed flush with the surface prior to placing the first layer of the leveling course.

10. For each paving or leveling train in operation, furnish a separate set of rollers, with their operators. The following equipment, sequence and coverage are only suggested for use based on past successful performance. Utilizing whatever equipment selected, the sequence and coverage of rolling shall meet the minimum density requirements specified:

    a. Seal rolling by using tandem steel rollers weighing 5 to 12 tons, following as close behind the spreaders as is possible without pick-up, undue displacement or blistering of the material.

    b. Rolling with self-propelled pneumatic-tired rollers, following as close behind the seal rolling as the mix will permit. The roller shall cover every portion of the surface with at least five passes.

    c. Final rolling with the 8- to 12-ton tandem steel rollers, to be done after the seal rolling and pneumatic-tired rolling have been completed, but before the internal pavement temperature has dropped below 175°F.

11. The initial rolling shall be longitudinal. Where the lane being placed is adjacent to a previously placed lane, the center joint shall be pinched or rolled, prior to the rolling of the rest of the lane. After the rolling or pinching of the center joint, the rolling shall continue across the mat by overlapping each previous roller path by at least one-half the width of the roller wheel. The motion of the roller shall be slow enough to avoid displacement of the mixture, and any displacement shall be corrected at once by the use of rakes, and the addition of fresh mixture if required. Final rolling shall be continued until all roller marks are eliminated. Rolling with the self-propelled, pneumatic-tired rollers shall proceed at a speed of 6 to 10 miles per hour, and the area covered by each roller shall not be more than 4,000 square yards per hour,

except that for Type S Asphaltic Concrete, this maximum rate of coverage shall be 3,000 square yards per hour.

a. A sufficient number of self-propelled pneumatic-tired rollers shall be used such that the rolling of the surface for the required number of passes will not delay any other phase of the laying operation nor result in excessive cooling of the mixture before the rolling is complete. In the event that the rolling falls behind, the laying operation shall be discontinued until the rolling operations are sufficiently caught up.

b. Areas which are inaccessible to a roller (such as areas adjacent to curbs, headers, gutters, bridges, manholes, etc.) shall be compacted by the use of hand tamps or other satisfactory means.

c. Self-propelled pneumatic-tired rollers shall be used for the rolling of all patching and leveling courses. Where the initial leveling course is placed over broken concrete pavement, the pneumatic-tired roller shall weigh at least 15 tons. For Type S-III Asphaltic Concrete leveling courses, the use of a steel-wheel roller, to supplement the traffic rollers, will be required. On other leveling courses, the use of a steel-wheeled roller will be required on all passes after the first.

d. The rollers shall not be allowed to deposit gasoline, oil or grease onto the pavement, and any areas damaged by such deposits shall be removed and replaced. While rolling is in progress, the surface shall be tested continuously and all discrepancies corrected to comply with the surface requirements. All drippings, fat or lean areas and defective construction of any description shall be removed and replaced. Depressions which develop before the completion of the rolling shall be remedied by loosening the mixture and adding new mixture to bring the depressions to a true surface. Should any depression remain after the final compaction has been obtained, the full depth of the mixture shall be removed and replaced with sufficient new mixture to form a true and even surface. All high spots, high joints and honeycomb shall be corrected. Any mixture remaining unbonded after rolling shall be removed and replaced. Any mixture which becomes loose or broken, mixed or coated with dirt or in any way defective, prior to laying the wearing course

shall be removed and replaced with fresh mixture which shall be immediately be compacted to conform with the surrounding area. Areas of defective surface may be repaired by the use of indirect heat. No method of repair involving open-flame heaters shall be used.

12. Shoulder pavements wider than 5-1/2 feet shall be compacted by the use of equipment of the type required for other asphaltic concrete pavements. Compaction of asphaltic concrete 5-1/2 feet or less in width, shall be done by the use of tandem steel rollers not exceeding 12 tons in weight. Other compaction in such restricted widths shall be by the use of rubber-tired equipment.

13. The density of a completed course shall be at least 94% of the laboratory density.

14. Placing of the mixture shall be as continuous as possible and the roller shall not pass over the unprotected end of the freshly laid mixture except when the laying operation is to be discontinued long enough to permit the mixture to become chilled. When the laying operation is thus interrupted, a transverse joint shall be constructed by cutting back on the previous run to expose the full depth of the mat.

15. Where only a portion of the width of pavement is to be laid and opened to traffic, longitudinal joints shall be formed by rolling the exposed edge of the strip first laid. When the adjacent strip is constructed, the Engineer may require the edge of the mixture in place to be trimmed back to expose an unsealed or granular vertical surface. Where the strip first laid is closed to traffic, the edge shall not be sealed but shall be left vertical and the adjacent strip placed against it without trimming.

16. When fresh mixture is laid against the exposed edges of joints (trimmed or formed as provided above), it shall be placed in close contact with the exposed edge so that an even, well-compacted joint will be produced after rolling.

17. The finished surface shall be of uniform texture and compaction and shall be smooth. The surface shall have no pulled, torn, or loosened portions and shall be free of segregation, sand streaks, sand spots, or ripples. Any area of the surface which does not meet the foregoing requirements shall be corrected.

18. All pavements (both intermediate and final courses), intersections, acceleration lanes, deceleration lanes, tapers, crossovers, transitions at beginning and end of project, and similar areas shall be tested with a straightedge for surface tolerance. Any individual surface irregularity in these areas in excess of 3/16-inch as determined by a 15-foot straightedge shall be corrected and retested. Provide a 15-foot manual straightedge at the job site at all times during the paving operation for checking joints and surface irregularities.

19. If the Owner elects to waive corrections, the appropriate pay quantity for Asphaltic Concrete shall be reduced by the equivalent quantity of materials which would have been removed and replaced if the correction had been made.

    a. Where the pay quantity is in square yards, the reduction is based on the area which would have been removed multiplied by the ratio of the layer thickness to the total thickness of the type of mix specified.

    b. Where the pay quantity is in tons, the reduction is based on the volume which would have been removed (length x lane width x layer thickness) multiplied by the laboratory density for the mix.

    c. Where the project is a lump sum pay quantity based on amount completed, the appropriate reduction in percent complete shall be calculated based on the total amount of paving.

20. Select one of the following correction methods unless overlaying is prohibited.

    a. Removing and Replacing: If correction is made by removing and replacing the pavement, the removal must be for 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.

    b. Overlaying: If correction is made by overlaying, the overlaying shall 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. The overlay shall extend full width of the roadway. Care shall be taken to maintain the specified cross and lengthwise slopes.

21. All corrective work, either by removing and replacing or by overlaying, including the bituminous material, shall be provided at no additional cost to the Owner.

22. Sections of newly compacted asphaltic concrete which are to be covered by additional courses shall be kept clean until the successive course is laid.

23. Blade graders operating adjacent to the pavement during shoulder construction shall have a 2-inch by 8-inch (or larger) board (or other attachment providing essentially the same results) attached to their blades in such manner that it extends below the blade edge, in order to protect the pavement surface from damage by the grader blade.

24. Vehicular traffic shall not be permitted on any pavement which has not hardened sufficiently to prevent rutting or other distortion.

25. The specified thickness and density is the minimum to be supplied and any deficiency(s) shall be corrected either by replacing the full thickness for a length extending at least 50 feet from each end of the deficient area, or (when permitted by the Owner) by overlaying with a minimum thickness of 75% of the specified thickness..

B. Saw-Cutting

Where existing pavement is to be removed, except brick, saw-cut the surface leaving a uniform and straight edge with minimum disturbance to the remaining adjacent surface.

C. Settlement of Pavement

All settlement of pavement repairs occurring within a period of one year after final acceptance of the project by the Owner shall be repaired or replaced as required by and at no cost to the Owner.

D. Testing

1. Unless otherwise stipulated on the plans, the following tests will be made by an independent testing laboratory.

   a. Extraction of the asphaltic concrete and sieve analysis of the aggregate.

   b. Determination of bitumen content of the asphaltic concrete.

c. Core borings (approximately every 200 feet) to determine thickness and density.

d. Marshall stability.

E. Repairs

Repair holes made to test the finished asphalt.

END OF SECTION

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SECTION 02610 STABILIZED SUB-BASE

PART 1 - GENERAL

A. Description

This section includes materials, testing, and construction of a firm and unyielding stabilized sub-base.

B. Submittals

Submit copies of a certification from a testing laboratory that the material used for the base meets the specified criteria.

PART 2 - PRODUCTS

A. Materials

Use local or hauled-in clean sand or sand and clay.

B. Stabilizers

Use high-bearing-value soil, sand-clay, or rock screenings. Do not use muck, trash, hardpan, material having a plasticity index of more than 10 or a liquid limit greater than 40.

PART 3 - EXECUTION

A. Construction Methods

Test local material for compliance with the required Florida Bearing Value. If the natural in-place soils do not meet the required stability, uniformly mix to depth shown in plans sufficient borrow material for stabilization with the in-place soils to produce the required bearing value. Compact the stabilized sub-base in both cuts and fills to a density of 98 percent of the maximum density as required by AASHTO T-180 (modified). Shape the sub-base to within 1/4 inch of the cross section grade shown in the plans prior to making the density tests. MAKE THE DENSITY TESTS BEFORE OTHER WORK PROCEEDS. Maintain the required density and cross section until the base or pavement has been laid or until the aggregate materials for the base or pavement course have been spread in place.

B. Required Bearing Value

Unless otherwise specified or shown in the plans, stabilized sub-base shall have a minimum Florida Bearing Value of 50.

C. Tests

Density and bearing value tests shall be made by an independent testing laboratory at intervals not more than 300 feet in roadways or 2,400 sq. ft. in area paving. If any test results are unsatisfactory, re-excavate and re-compact the sub-base until the desired compaction is obtained. Make additional tests on each side of an unsatisfactory test to determine the extent of re-excavation, re-mixing and re-compaction necessary.

END OF SECTION

SECTION 02615 REINFORCED CONCRETE CULVERT PIPE

PART 1 - GENERAL

A. General

This section includes material, testing and installation of round and elliptical concrete pipe, corrugated steel or aluminum pipe and pipe arch, fittings and other appurtenances.

B. Submittals

Submit shop drawings in accordance with the General Conditions showing the materials to be used and manufacturer's certificates (for pipe, curing compound, gaskets, bituminous coating, fasteners) showing compliance with the specifications.

PART 2 - PRODUCTS

A. Round Concrete Pipe

1. Round Concrete Pipe shall meet the design requirements of Class III (of ASTM C 76) unless otherwise designated.

   a. For all classes, use any of the alternate wall designations shown and the provisions for Alternate Design, as specified in Section 10 of ASTM C76, shall apply.

   b. The process of manufacture and the details of the pipe design, including strength of the concrete may be inspected or checked by the County.

   c. Furnish pipe without lifting holes.

2. The following provisions of ASTM C 76 shall be revised as shown:

   a. The text of Section 7 is deleted and the following is substituted therefor: Aggregates for concrete shall conform to the following requirements:

      1) Coarse Aggregate

         a) Coarse Aggregate shall consist of gravel, rock or slag and contain less than 1% by weight asbestos. All coarse aggregate shall be washed and shall be free from disintegrated pieces, clay lumps, soft and friable particles, salt, alkali, organic matter and adherent coatings. The weight of

deleterious substances shall not exceed the following percentages:

Coal and lignite	1.00
Clay lumps	2.00
Soft and friable particles	10.00
Cinders and clinkers	0.50
Free Shell	1.00
Organic matter (wet)	0.03
Material passing the No. 200 Sieve	1.75
Chert	3.00

In addition, the sum of the percentages of all substances listed above shall not exceed ten.

b) Coarse aggregate shall have a maximum loss of 45 percent when subjected to the Los Angeles Abrasion Test, a maximum loss of 12 percent when subjected to the Soundness (Sodium Sulfate) Test and contain a maximum of 10 percent flat or elongated pieces.

c) Natural Stones: Coarse aggregate may be processed from gravels, granites, limestones, dolomites, sandstones, or other naturally occurring hard, sound, durable materials meeting the requirements of this paragraph.

1) Gravel shall be composed of naturally occurring quartz. The loss when the material is subjected to the Los Angeles Abrasion Test (AASHTO T96) shall be no more than 50 percent. The dry-rodded weight per cubic foot of the gravel, tested according to AASHTO T19, shall be not less than 95 pounds. Crushed gravel shall consist of 85 percent, by weight, of the material retained on the No. 4 sieve, having three crushed faces.

2) Granites: Coarse aggregate produced from the crushing of granites shall be sound and durable.

3) Limestones, Dolomites and Sandstone: Coarse aggregates may be produced from limestone, dolomites, sandstones, and other naturally occurring hard, durable materials meeting the requirements of this paragraph.

d) Slag shall be clean, tough and durable. It may be either air-cooled blast-furnace slag or phosphate slag. It shall be reasonably uniform in density and quality, and free from deleterious substances. It shall contain not more than 1.5 percent of sulphur. The dry-rodded weight shall be not less than 70 pounds per cubic foot. The loss, when the slag is subjected to the Los Angeles Abrasion Test, shall not exceed 45 percent. It shall contain not more than ten percent glassy particles.

e) Unless written permission from the County is obtained, coarse aggregates of different types shall not be mixed.

f) Grading shall be in accordance with FDOT Spec Section 901-1.4 Table 1.

g) Lightweight expanded aggregate shall be clean and durable material produced by firing shale, clay, or slate in a rotary kiln. It shall be reasonably uniform in quality and density and free from deleterious substances, except that the term cinders and clinkers shall only apply to those particles clearly foreign to the expanded aggregate in question and the maximum percentage of material passing the No. 200 sieve shall be 3.00. The dry-loose unit weight of the material, determined in accordance with AASHTO T19, shall not be less than 35 or more than 55 pounds per cubic foot. The burning process shall be carefully controlled. As an indication of the control of burning, the producer shall obtain and test samples of material at frequent intervals. Control shall be considered adequate if the dry-loose unit weight of such samples does not differ by more than $\pm$6 percent from the average weight established from the producer's quality control testing records. When subjected to the Los Angeles Abrasion Test, the loss shall not exceed 35%.

2) Fine Aggregate

a) Fine aggregate shall consist of natural silica sand, screenings, or a combination thereof, composed of clean, tough, angular grains, free from clay, soft or flaky particles, salt, alkali, organic matter, loam and other foreign matter. As delivered to the mixer it shall be free from clayey lumps

of loosely bonded aggregations and the individual particles shall be free from adhering dust. Stone or slag screenings shall be produced from material complying with the abrasion requirements specified for coarse aggregate. The weight of deleterious substances (shale, coal and lignite, cinders and clinkers, phosphate, clay lumps) shall not exceed 1.0, 1.0, 0.5, 1.0 and 1.0 percent respectively.

b) Any screenings used in the combination of aggregate shall contain not more than 15 percent material passing the No. 200 sieve and, if necessary to meet this requirement, they shall be washed.

c) Any natural sand portion of the fine aggregate other than screenings shall be siliceous and shall contain not more than ten percent material passing the No. 200 sieve.

d) Silica sand, when tested by means of laboratory sieves, shall meet the following requirements:

Passing Sieve	Percent by Weight
No. 4	95-100
No. 8	85-100
No. 16	65- 97
No. 30	25- 70
No. 50	5- 35
No. 100	0- 7
No. 200	Max. 4

e) Screenings: Screenings shall be composed of hard, durable particles, either naturally occurring, such as gravel screenings, or resulting from the crushing or processing of the parent rock, to include natural rock, slags, expanded clays or shales (lightweight aggregates), or other approved inert materials with similar characteristics.

Aggregates classified as screenings shall conform to the following gradation requirements:

Sieve Size	Passing Percent
3/8"	100
No. 4	85 to 100
No. 200	Maximum 15

b. Paragraph (d) of Section 16 (for curing by membrane compound) shall not apply. For membrane curing the compound used shall meet the requirements set forth in this section. The coating shall be applied immediately after the pipe has been removed from the mold and shall be applied by spraying in a single-coat, continuous operation at a uniform coverage of at least one gallon to each 200 square feet of pipe surface. Any cracks, checks, or other defects in the coating shall be recoated within 30 minutes. The coating shall remain undisturbed for a period of 72 hours.

c. Paragraph (c) of Section 19 is deleted.

d. The provisions of Section 22, pertaining to facilities for testing pipe, shall be superseded by the following:

Each manufacturer of the pipe shall provide a suitable apparatus for testing his products. Upon the request of the County and under his supervision the manufacturer shall perform such tests and in such manner as the County may deem necessary in order to establish the quality of the product as required by these specifications. No payment or allowance will be made to the manufacturer for such equipment, for expenses in testing, or for the pipe broken. The manufacturer shall furnish facilities for inspection during the manufacture.

e. Paragraph (d) of Section 23 shall be revised as follows: "Variations in laying lengths of two opposite sides of pipe shall not be more than 1/8 inch (3.2 mm) per foot of diameter, with a maximum of 1/2 inch (1.27 cm) in any length of pipe, except where beveled-end pipe for laying on curves is specified by the purchaser."

f. In Section 25, the line headed "(a)" shall be revised to read "(a) The pipe class, and type of wall."

g. The provisions of Article 28 of ASTM C 76 (for repairs) shall not apply.

3. The following are special requirements for pipe joints when round rubber gaskets are used.

a. When round rubber gaskets are to be installed in the pipe joint the gasket shall be the sole element relied on to maintain a tight joint.

b. The joint shall be of the bell-and-spigot type or the double spigot and sleeve type. The joint shall be so proportioned that the spigot, or spigots, shall readily enter the bell or sleeve of the pipe.

c. The joint ring forms for forming the joint surface shall be of heavy steel, cast iron, or aluminum, and shall be accurately machined to the dimensions of the joint. They shall be a true circular form within a tolerance of 1/32 of an inch. Dimensional checks of joint ring form shall indicate for each size pipe a length of spigot, or tongue, not more than 1/8 inch shorter than the bell, or groove, depth. The pipe shall be so manufactured that joint surfaces are concentric with the inside of the pipe within a tolerance of 3/32 inch. The shape and dimensions of the joint shall be such as to provide compliance with the following requirements:

    1) The joint shall be so dimensioned that when the gasket to be used is placed on the spigot it will not be stretched more than 20 percent of its original length.

    2) The space provided for the gasket shall be a groove in the spigot end of the pipe and such space, when the joint is made, shall not be more than 110 percent of the volume of the gasket.

    3) The joint shall be so designed that when the outer surface of the spigot and the inner surface of the bell come into contact at some point on the periphery, the diametric deformation in the gasket at the point of contact shall not be greater than 50 percent of the normal gasket diameter, and the diametric deformation in the gasket at a point opposite the contact point shall not be less than 20 percent of the normal gasket diameter.

    4) When the pipes are joined there shall be parallel surfaces on both the bell and the spigot, extending from the edge of the gasket toward the bell face for a distance of not less than 3/4 inch. These parallel surfaces shall in no case be farther apart than 1/8 inch when the spigot is centered in the bell. The tapers on these surfaces shall not exceed three degrees.

5) The inside surface of the bell at the end of the bell shall be flared to facilitate joining the pipe sections without damaging or displacing the gasket.

d. The entire surfaces of near-contact of the jointed pipes shall be free from air holes, chipped or spalled concrete laitance, and other such defects.

e. Pipes showing minor manufacturing imperfections or handling injuries to the bell or spigot may be acceptable if such defects can be, and are, acceptably repaired as prescribed below.

f. Individual air holes (trapped air), or spalled areas with a length of up to one-half the pipe radius, or 12 inches whichever is smaller, may be repaired by careful use of a hand-placed, stiff, pre-shrunk, one-to-one mortar of cement and fine sand, and with no additional preparation other than a thorough washing with water of the defect. Curing shall be done either by moisture curing under wet burlap or by application of an approved membrane curing compound. Such repaired pipe which is sound, properly finished and cured, and which otherwise conforms to specification requirements will be considered acceptable.

4. Membrane curing compound shall conform to the requirements of AASHTO M 148 (Type 1 for clear compound and Type 2 for white-pigmented compound), and the following additional requirements.

a. The membrane curing compound shall be of a consistency suitable for spraying at temperatures prevalent at the time of construction operations, and which forms a continuous, uniform film. It shall be free from precipitated matter caused by conditions of storage or temperature. The compound shall be relatively nontoxic.

b. The curing compound shall be delivered to the job in the manufacturer's original container, labeled with the manufacturer's name, plant location, grade designation of compound, lot number and quantity, and no material will be acceptable unless all such requirements are complied with.

B. Elliptical Concrete Pipe

1. Elliptical concrete pipe shall conform with the requirements of ASTM C 507, except that the exceptions and modifications to ASTM C 76, as specified for round concrete pipe, shall apply also to elliptical pipe. Standard elliptical pipe shall meet the requirements of

Table I for Class HE-III and special elliptical pipe shall meet the requirements of Table I for Class HE-IV.

2. Furnish pipe without lifting holes.

3. Use preformed flexible joint sealer conforming to Federal Specification SS-5-00210 (GSA-FSS).

C. Pipe Gaskets

1. Except where O-ring type gaskets are specified for special cases and for special type pipe, round rubber gaskets for use in concrete pipe joints shall meet the requirements of Article 5.9 of ASTM C 361, with the additional requirements that the gasket used shall be of such cross sectional area and perimeter as to properly fit the space provided in the pipe joint in which it is to be used.

2. Prior to use, the gasket shall be stored, in as cool a place as practicable.

3. For sealing elliptical concrete pipe joints, cold adhesive preformed plastic gaskets may be used.

   a. Cold adhesive preformed plastic gaskets shall be of a material, shape and size so as to effect a permanent water tight seal in joints of elliptical concrete pipe. A minimum of two pieces of gasket material shall be used in each joint.

   b. The gasket material shall be protected by a two-piece removable wrapper. To facilitate application, the two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half.

   c. The size of the gasket shall be in accordance with the manufacturer's recommendation for the particular joint in which it is to be used. However, the minimum size for each of the gaskets used in a joint shall be in accordance with the following:

Pipe Size (Inches)	Nominal Gasket Size (Inches)	Minimum Cross Section (Sq. Inches)
Up to 19 x 30	1 1/2	1.75
19 x 30 to 53 x 83	1 3/4	2.50
Over 53 x 83	2	3.25

   The above minimum size requirements are based on a joint designed with a maximum taper of 10 degrees and an in-place annular space of approximately 1/4 inch.

4. The gasket sealing the joints shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler. The material shall contain no solvents and shall not produce irritating fumes or obnoxious odors. The gasket shall not depend on oxidizing, evaporation or chemical action for its adhesive or cohesive strength.

5. The chemical composition of the gasket material shall meet the following requirements:

	Max.	Min.
Bitumen (petroleum plastic content (% by weight)	50	70
Ash-Inert Mineral Matter (% by weight)	30	50
Volatile Matter (@ 325°F) (% by weight)	2.0 Max.	

6. The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5% solution of caustic potash, a mixture of 5% hydrochloric acid, a 5% solution of sulfuric acid, and a saturated hydrogen sulfide solution shall show no visible deterioration.

7. The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

	Min.	Max.
Specific Gravity @ 77°F	1.20	1.35
Ductility @ 77°F (cm)	5.0	
Softening Point @ 77°F	320°F Min.	
Penetration 77°F (150 gms) 5 sec.	50	120

The manufacturer of the gasket material shall furnish the County certified test results covering the shipment of material to the project.

D. Inspection Independent of Tests

1. The following imperfections in a pipe or special fitting will be considered injurious and cause for rejection without consideration of the test results hereinabove specified:

   a. Cracked Pipe: A single crack in the barrel of the pipe, extending through the entire thickness, regardless of the length of such crack; a single crack which extends through one-fifth of the barrel thickness and is over 3 inches long; any surface fire

crack which is more than 1/32-inch wide at its widest point.

b. Surface Imperfections: Surface imperfections such as lumps, blisters, pits, or flakes on the interior surface of a the pipe or fitting.

c. Socket-Out-of-Round: When the bore or socket of the pipe varies from a true circle more then 3 percent of its nominal diameter.

d. Broken Pipe: A joint of pipe with a piece broken from either the socket or spigot end.

e. Foreign Matter Fused to the Pipe: Pipe joints that have tramp clays, grog, or other foreign matter fused permanently to the exterior surface of the pipe or fitting.

PART 3 - EXECUTION

A. Laying Storm Sewers

1. Keep trenches free of water during the laying operation. Lay all pipe without break, upgrade from structure to structure, with the bell ends of the pipe upgrade, to the line and grade given and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Clean the interior of the sewer pipe of all dirt and superfluous materials of all description as the work progresses. Do not flush the new line into the downstream system.

2. Storm sewers shall be watertight.

B. Lamping

1. After the pipe has been installed and the compacted back-fill placed, "lamp" the installed drainage pipe between manholes, inlets or other structures in order to ascertain that they are clear and to correct alignment. The diameter of lamp image shall have no vertical reduction from that of the pipe inside vertical diameter and not more than 20 percent horizontal reduction. The County or County representative may observe the lamping.

2. Provide assistance to the County or his representative as necessary to lamp the pipes. If lamping indicates any faulty installation of the pipe, or dirt or debris in the pipe or structures, clean, repair or replace the pipe at no additional cost to the County.

END OF SECTION

SECTION 02778 CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 - GENERAL

A. Description

This section includes materials and installation of concrete curbs, gutters, and sidewalks.

B. Submittals

Submit six copies of a report from a testing laboratory verifying that crushed rock and aggregate material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

C. Testing for Compaction

The Owner will test for compaction as described in Section 02200.

D. Standard Specifications

Wherever reference is made in this section to the State Specifications, such reference shall be understood to mean the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

PART 2 - MATERIALS

A. Forms

1. Forms shall conform to the requirements of Section 03100. Provide stakes and bracing materials to hold forms securely in place.

2. Materials for sidewalk forms shall be 2-inch dressed lumber straight and free from defects, or standard metal forms. Where short-radius forms are required, 1-inch dressed lumber or plywood may be used. Provide stakes and bracing materials to hold forms securely in place.

B. Crushed Rock Base

Clean 3/4-inch and smaller crushed rock or crushed gravel, free from foreign material and containing less than 1% asbestos by weight or volume, and conforming to Class 12 per Section 901 of the Florida State Specifications.

C. Expansion Joint Filler

Expansion joint filler shall be 1/2 inch thick for curbs and 1/4 inch thick for sidewalks and shall conform to premolded joint filler in Section 03250.

D. Concrete

Concrete shall be Class I per Section 345 in the Florida State Specifications.

E. Reinforcing Steel

Conform to Section 415 and 931 in the Florida State Specifications.

F. Curing Compound

Curing compound shall be as specified in Section 03345.

G. Excavation and Backfill

Conform to Section 02200.

PART 3 - EXECUTION

A. Preparation of Subgrade

Excavate and shape subgrade to line, grade, and cross-section. Compact subgrade until the top 12 inches are compacted to 90% relative compaction. Remove all soft material disclosed by compacting and replace with crushed rock base. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross-section shown and shall be smooth and free from irregularities at the specified relative compaction. The subgrade shall be considered to extend over the full width of the base course.

B. Placing Crushed Rock Base

After the subgrade for curbs, sidewalks, and roadway slabs is compacted and at the proper grade, spread crushed rock base material. Sprinkle with water and compact. Top of the compacted gravel shall be at the proper level to receive the concrete. Compact crushed rock base 4 inches or more of compacted crushed rock base material.

C. Setting Forms

1. Conform to Section 03100.

2. Forms on the face of the curb shall not have any horizontal joints within 7 inches of the top of the curb. Brace forms to prevent change of shape of movement in any direction resulting from the weight of the concrete during placement. Construct short-radius curved forms to exact radius. Tops of forms shall not depart from gradeline more than 1/8 inch when checked with a 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.

D. Sidewalk Construction

Sidewalk construction shall be in accordance with Section 522 of the FDOT Standard Specifications for Road and Bridge Construction.

END OF SECTION

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SECTION 02810 SODDING

PART 1 - GENERAL

A. Description

Provide all materials, water, equipment, transportation, tools, and labor, to establish grass plus all items called for or that can be reasonably inferred from the drawings, including sodding, grading, fertilizing, watering, mowing, replacing and maintaining the area for a complete job. Sod all areas disturbed. Seed and mulch not allowed.

B. Applicable Publications

Portions of the publications listed below form a part of this specification only to the extent referenced.

1. Florida Department of Transportation, "Standard Specifications for Road and Bridge Construction" (Fla. DOT SPEC).

2. Turfgrass Producers Association of Florida, "Standards of Sod Quality."

C. Records

Submit written weekly records to the County of all grassed areas for use in determining the beginning and ending of the maintenance period for each area. The records shall indicate the date of grassing, fertilizing and mowing, the type (sod), quantity (sq. ft., sq. yds, or acres) and location of grassing.

D. Submittals

1. Submit Shop Drawings in accordance with the General Conditions, Section 01300 and the following. Submit certificates stating that the materials conform to the requirements of this specification as follows:

   a. Certificate from sod producer stating that sod meets the requirements for "Florida Standard Grade" as defined by the Turfgrass Producers Association of Florida, and set forth in paragraph "SOD" of this specification.

   b. Fertilizer manufacturer's certificate of analysis including Nitrogen, Phosphorus Potash and complete

micro-nutrients in accordance with paragraph "Fertilizer" of this specification.

2. Submit a copy of the certificate(s) with each delivery.

PART 2 - PRODUCTS

A. Sod

1. Argentine Bahia with well matted roots. The sod shall be taken up in commercial-size rectangles, preferably 12-inch by 24-inch or larger, except where 6-inch strip sodding is called for.

2. The sod shall have no visible broadleaf weeds when viewed from a standing position and the turf shall be visibly consistent with no obvious patches of foreign grasses. In no case may the total amount of foreign grasses or weeds exceed 2% of the total canopy. Florida Standard Grade sod shall be neatly mowed and mature enough that when grasped at one end it can be picked up and handled without damage. The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling.

B. Fertilizer

Commercial grade, controlled release, granular fertilizer consisting of blend of coated prilled urea with iron included in a slowly soluble form, free flowing and uniform in composition conforming to Florida DOT Specification 982-1, and bearing the manufacturer's guaranteed statement of analysis by weight of 12 parts nitrogen, 8 parts phosphoric acid and 8 parts potash, plus complete micronutrient including magnesium, sulfur, zinc, manganese, copper and boron.

C. Source Requirements for Sod and Mulch

Comply with all current restrictions for transporting sod and mulch material from or through quarantine areas for the white fringed beetle, witchweed, and West Indian sugar cane borer weevil, as issued by the Division of Plant Industry, Florida Department of Agriculture and the Animal and Plant Health Inspection Service, U.S. Department of Agriculture.

D. Water for Grassing

Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 8.5. Provide all water needed for grassing. Provide permanent or temporary piping and valves, and temporary trucks to convey water from the source to the point of use. Provide any meters required and pay for water used if the water is taken from a public water system. Water shall be free of petroleum products, pesticides and any other deleterious constituents. Plant reclaimed water is available for watering. Contractor is responsible for pumping of reclaimed water source. Coordinate with Owner's representative for pumping access.

PART 3 - EXECUTION

A. Coordination of Work

Coordinate all work activities to provide for establishment of grass cover at the earliest possible time in the construction schedule to minimize erosion of topsoil.

B. Construction Methods - General

1. Provide and establish grass in all areas designated on the drawings or that are disturbed during construction (except areas to be paved, landscaped or covered with structures).

2. Do not fertilize when wind velocities exceed 15 miles per hour. Sod only when the soil is in proper condition to induce growth.

3. When a length of roadway slopes or adjacent areas have been graded and made ready, commence grassing in accordance with these specifications. Incorporate grass covering into the project at the earliest practical time in the life of the contract to reduce potential erosion.

4. Store fertilizer in dry locations away from contaminants. Sprinkle sod with water and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that heating will not develop.

C. Construction Methods for Grassing

1. The location of grassing will be as called for in the drawings. If the type is not designated, match the type of grass in adjacent areas.

2. Sequence of Operations: The several operations involved in the work shall proceed in the following sequence:

   a. Preparation of the ground.

   b. Sodding.

   c. Watering and maintaining

D. Preparation of Area to be Grassed

1. Prepare the areas to be grassed by disc-harrowing and thoroughly pulverizing them to a depth of at least 6 inches.

2. Bring all areas to be grassed to finished grades, remove weeds, surplus dirt and rock debris over 1 inch in diameter, and rough grade the area.

3. Test the soil for pH. If the soil is below a pH level of 5.5, spread lime to raise the pH level to at least 5.5.

4. Uniformly apply fertilizer at the rate of 400 to 500 pounds per acre. Immediately after the fertilizer and/or lime are spread over the area, mix them into the soil to a depth of approximately 4 inches.

5. Float the area to a smooth uniform grade. Slope all areas to drain. Establish flow lines as shown on the drawings. Finish areas to be grassed approximately 1 inch below top of adjoining curb or pathway.

E. Sodding

1. Incorporate sodding into the project at the earliest practical time in the life of the contract. Do not use sod which has been cut for more than 3 days. Stack any sod which is not planted within 24 hours after cutting and maintain properly moistened.

2. Place the sod on a prepared surface, with abutting joints. Fill any gaps or cracks between sod blocks with sod. Roll with a minimum one-ton roller to obtain an even surface. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas and project limits.

3. Where sodding is used in drainage ditches, stagger the setting of the pieces to avoid a continuous seam along the line of flow.

4. On areas where the sod may slide due to height and slope, peg the sod with pegs driven through the sod blocks into firm earth at suitable intervals. Replace any pieces of sod which, after placing, show an appearance of extreme dryness.

F. Mowing

1. Mow first when the grass reaches a height of 3 to 4 inches. Mow a second time when the grass reaches a height of 6 inches and before a seedhead occurs. Subsequent mowings should establish a uniform grass surface of 2-1/2 inches and be made before seedhead occurs. All mowings should be made with a cut height as low as possible to stop shading of the Bahia grass.

2. Mow sod to establish a uniform grass surface of 2-1/2 inches.

3. Provide equipment for mowing that does not rut the soil surface. Fill any ruts that are in excess of two (2) inches deep with native soil free from twigs and rocks larger than 1 inch in diameter. Temporarily suspend mowing operations when the soil is too wet to provide adequate support and traction for equipment.

G. Watering

1. Maintain a balanced watering program until the acceptance of work.

2. Apply water in sufficient quantities and as often as seasonal conditions require keeping the grassed areas moist.

3. Provide supplemental water and irrigate seed areas when the rainfall is not adequate to maintain soil moisture necessary for germination and growth of the grass. It is Contractor's responsibility to determine the quantities of water required and when to irrigate. This obligation shall remain in full force and effect until final acceptance of the work by County and shall be provided at no additional cost to County.

4. County, at his discretion, may relieve Contractor of this obligation at such time as County is able to provide irrigation. This action, however, does not relieve Contractor of the provisions and guarantees set forth in the Contract Documents.

H. Maintenance

1. Maintain all grassed areas for a period of 90 days after the date of substantial completion and guarantee against all defects and faults of material and workmanship.

2. Maintain grass areas by watering, fertilizing, and mowing to establish an even and uniform grass surface of 2-1/2 inches, as specified above.

3. In the event that the grass exhibits iron chlorosis symptoms during the establishment period, apply liquid iron at manufacturer's recommended rates.

I. Guarantee

1. Guarantee all grasses areas to be alive and in satisfactory growth at the end of the maintenance period (90 days).

2. Replace any grass that is dead or not in satisfactory growth, as determined by the County or County's representative. Guarantee new sod or seed for an additional 90 days.

3. The term "Satisfactory Growth" as used in this section is defined as even plant growth in healthy conditions without bare spots larger than one square foot in seeded areas and without bare spots in sodded areas. Bare spots larger than one square foot in seeded areas shall be re-seeded and bare spots in sodded areas resodded. All grassed and sodded areas shall be maintained until satisfactory growth has been demonstrated. In the event that the subsequent stand of grass is found to be contaminated with weeds or other obnoxious or undesirable growth, effectively eliminate such undesirable growth, at the Contractor's expense.

4. Replace sod with the same variety as initially specified.

J. Inspection

1. Request inspection from the County and his representative at least 72 hours in advance of the time inspection is required.

2. Provide an authorized representative to be on-site during inspection.

END OF SECTION

SECTION 03100 CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and design, install and remove formwork for cast-in-place concrete as shown on the Drawings and as specified herein.

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.

E. Form Ties

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a wood or metal cone at least 1/2-in diameter and 1-1/2-in long. Form ties in concrete exposed to view shall be the cone-washer type.

2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.

3. Flat bar ties for panel forms, if used, shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.

4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.

5. Common wire shall not be used for form ties.

6. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non-shrink cement grout. 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, prevent segregation and 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 blockouts, 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 24 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 this Section, 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. Concrete Joint 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. 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.

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 01340, 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

2. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

1.06 DELIVERY, HANDLING AND STORAGE

A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.

B. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.

C. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials shall be new, of domestic manufacture and shall comply with the following material specifications.

B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706.

D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.

E. Welded Deformed Steel Wire Fabric: ASTM A497.

F. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.

G. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.

H. The following alternate materials are allowed:

1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:

a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3000 psi.

b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.

c. The carbon equivalency (CE) of bars shall be

0.55 or less.

I. Reinforcing Steel Accessories

1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.

2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.

3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.

4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.

J. Tie Wire

1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire or stranded wire.

K. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to manufacturer's recommended value.

1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the rebar.

2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.

L. Fiber Reinforcement

1. Synthetic reinforcing fiber for concrete shall be 100 percent polypropylene collated, fibrillated fibers as manufactured by Propex Concrete Systems

Chattanooga, TN - Propex or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

2.02 FABRICATION

A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice.

B. Bars shall be cold bent. Bars shall not be straightened or rebent.

C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.

D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded, shall have the applicable end(s) saw-cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

PART 3 EXECUTION

3.01 INSTALLATION

A. Surface condition, bending, spacing and tolerances of placement of reinforcement shall comply with the CRSI Manual of Standard Practice. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.

B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:

1. Concrete cast against and permanently exposed to earth: 3-in

2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2-in (including bottom cover of slabs over water or sewage)

3. Concrete not exposed to soil, water, sewage, sludge and/or weather:

a. Slabs (top and bottom cover), walls, joists,

shells and folded plate members - 1-in

b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1-1/2-in

C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.

D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.

E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference, shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.

F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.

G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or

penetration.

3.03 SPLICING OF REINFORCEMENT

A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters, but not less than 12-in. The lap splice length for column vertical bars shall be based on the bar size in the column above.

B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.

C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.

D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than 12-in. The spliced fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.

E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

3.04 ACCESSORIES

A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the

reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.

C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified herein.

D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and 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.

F. Miscellaneous Metals are included in Section 05500.

G. Sealants and Caulking are included in Section 07920.

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 are compatible with each other.

2. Certification that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

2. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

3. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

4. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types).

5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. U.S. Army Corps of Engineers (CRD).

1. CRD C572 - Specification for Polyvinylchloride Waterstops.

C. Federal Specifications

1. FS SS-S-210A - Sealing Compound for Expansion Joints.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.

C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

2.02 MATERIALS

A. Standard Waterstops

1. PVC Waterstops - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. The waterstop shall be Greenstreak Group, Inc. model No. 732 or approved equal for construction 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. Premolded Joint Filler

1. Premolded joint filler - structures. Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4-in unless shown otherwise on the Drawings.

2. Premolded joint filler - sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt-impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4-in unless otherwise shown on the Drawings.

D. Bond Breaker

1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.

2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

E. Expansion Joint Dowels

1. Dowels shall be smooth steel conforming to ASTM A675, Grade 70. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-in on the diameter of the dowel and extends no more than 0.04-in from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end. Caps shall allow for at least 1-1/2-in of expansion.

F. Bonding Agent

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, N.J.; Concresive Liquid (LPL) by Master Builders of Cleveland, OH or equal. Acrylic may be used if approved by the Engineer.

G. Compressible Joint Filler

1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evasote 380 E.S.P, by E-Poxy Industries, Inc., Ravena, NY , Sikaflex 1a by Sika or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Standard Waterstops

1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.

2. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).

3. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.

4. Waterstops shall be terminated 3-in below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1-in deep, at point of termination.

B. Special Waterstops

1. Install special waterstops at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided.

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 waterblasting or sandblasting and prepare for bonding.

6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.

7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

D. Expansion Joints

1. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.

2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal 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 DESCRIPTION

A. Provide cast-in-place concrete as indicated and in compliance with Contract Documents.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 117: Specifications for Tolerances for Concrete Construction and Materials and Commentary.

2. 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

3. 214R: Recommended Practice for Evaluation of Strength Test Results of Concrete

4. 301: Standard Specifications for Structural Concrete

5. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete

6. 304.2R: Placing Concrete by Pumping Methods

7. 305R: Hot Weather Concreting

8. 306R: Cold Weather Concreting

9. 308: Standard Practice for Curing Concrete

10. 309R: Guide for Consolidation of Concrete

11. 311.4R: Guide for Concrete Inspection

12. 318: Building Code Requirements for Structural Concrete

13. 350: Code Requirements For Environmental Engineering Concrete Structures

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

1. A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

4. C33: Standard Specification for Concrete Aggregates

5. C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

6. C40: Standard Test Method for Organic Impurities in Fine Aggregates for Concrete

7. C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

8. C87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

9. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

10. C94: Standard Specification for Ready-Mixed Concrete

11. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or Cube Specimens)

12. C123: Standard Test Method for Lightweight Particles in Aggregate

13. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

14. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

15. C143: Standard Test Method for Slump of Hydraulic Cement Concrete

16. C150: Standard Specification for Portland Cement

17. C157: Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete

18. C171: Standard Specification for Sheet Materials for Curing Concrete

19. C172: Standard Practice for Sampling Freshly Mixed Concrete

20. C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

21. C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

22. C260: Standard Specification for Air-Entraining Admixtures for Concrete

23. C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)

24. C295: Standard Guide for Petrographic Examination of Aggregates for Concrete

25. C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

26. C311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete

27. C494: Standard Specification for Chemical Admixtures for Concrete

28. C595: Standard Specification for Blended Hydraulic Cements

29. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

30. C881: Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete

31. C882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear

32. C989: Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

33. C1017: Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

34. C1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

35. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

36. C1116: Standard Specification for Fiber Reinforced Concrete

37. C1240: Standard Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout

38. D75: Standard Practice for Sampling Aggregates

39. E154: Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

40. E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

41. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

1.03 TOLERANCES

A. Conform to ACI 117.

B. Concrete slabs for buildings shall be within 3/16 inch of 10 ft straightedge in each direction except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 in.

C. Pitch floor to floor drains minimum of 1/8 inch/ft or as shown on Drawings. Minimum thickness of slabs and depth of beams shall be as dimensioned on Drawings. Pitch bottom of slab or beam to match top slope of slab or beam to maintain thickness or depth noted. As an alternate, bottom of slab or beam may be poured level provided that minimum thickness or depth is maintained.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data:

1. Manufacturer's specifications and instructions including Material safety Data Sheets (MSDS) for admixtures and curing materials. Manufacturer’s certification of compatibility of all admixtures.

C. Proposed mix designs including complete details of product additives and certification that all additives are compatible with all other additives. In addition, submit drawing which indicates the portions of each structure which is to receive the concrete waterproofing additive.

D. Submit prequalification test results to the Engineer for each Ready Mix Concrete Mix proposed, showing adequate performance for:

1. Compressive strength

2. The standard deviation for the concrete compressive strength tests shall be in conformance with ACI 214.3R 88(97) “Recommended Practice for Evaluation of Compression Test Results of Concrete.”

3. Air entrainment

E. Shop Drawings:

1. Provide certificate that cement used complies with ASTM C150 and these specifications.

2. Provide certificates that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.

3. Provide certificate of compliance with these specifications from the manufacturer of the concrete admixtures.

4. For each formulation of concrete proposed, provide concrete mix designs and laboratory 7-day and 28-day compressive tests, or submit test results of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects in the past twelve months.

5. Proposed special procedures for protection of concrete under wet weather placement conditions.

6. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

F. Manufacturers' Instructions

1. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's data sheets as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.

G. Field Quality Control Submittals

1. Provide delivery tickets for ready-mix concrete or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant

shall account for moisture in both coarse and fine aggregate.

1.05 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) or Florida Department of Transportation (FDOT) certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. Testing of Ready Mix Concrete

1. Testing will be performed by an independent testing agency arranged by the Owner.

2. Testing of Ready Mix Concrete trucks on delivery will include:

a. Slump

b. Air content

c. Wet density

d. Concrete temperature

3. Samples will be cast for laboratory testing for:

a. Compressive strength

4. Samples may be taken for other testing as determined by the Engineer.

5. Copies of the results of all concrete testing carried out by the independent testing agency will be made available to the Engineer upon request.

6. The provision of the test results from the independent testing agency does not relieve the Contractor of the responsibility to furnish materials and construction in compliance with the performance requirements of the contract documents and to carry out their own testing program.

7. The Contractor shall take samples and carry out testing as part of their quality control procedures to verify that the concrete satisfies the performance requirements set out in these specifications. Where possible, these tests shall be carried out on the same batches as tested by the independent testing agency.

8. Copies of the test results for all tests carried out by the Contractor must be made available to the Engineer for review and records.

C. Unless otherwise indicated, materials, workmanship, and practices shall conform to the following standards:

1. Local building codes.

2. ACI 301, "Structural Concrete for Buildings."

3. ACI 318, "Building Code Requirements for Reinforced Concrete."

4. ACI 350, "Code Requirements For Environmental Engineering Concrete Structures."

D. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions govern.

E. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

F. Perform concrete work in conformance with ACI 301 unless otherwise specified.

G. Do not use admixtures, including calcium chloride, which will cause accelerated setting of cement in concrete.

H. Do not place concrete until design mix and material test results are accepted by the Engineer.

I. Employ an independent testing laboratory, acceptable to the Engineer, to develop concrete mix designs and

testing. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent.

J. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C172

2. Specimen Preparation: ASTM C31

3. Compressive Strength: ASTM C39

4. Air Content: ASTM C231

5. Slump: ASTM C143

6. Temperature: ASTM C1064

7. Unit Weight: ASTM C138

8. Obtaining Drilled Cores: ASTM C42

K. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.

L. Hot weather concrete to conform to ACI 305R and as specified herein.

M. Cold weather concrete to conform to ACI 306R and as specified herein.

N. Reject concrete delivered to job site that exceeds the time limit or temperature limitations specified.

O. Do not place concrete in water or on frozen or uncompacted ground.

P. Workability

1. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.

2. Adjust the proportions to secure a plastic, cohesive mixture, and one that is within the specified slump range.

3. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

B. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

1.07 SITE CONDITIONS:

A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C 31 and as specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement:

1. Portland Cement, ASTM C150, Type I/II or Type II.

2. Shall be one brand form one source. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

3. Maximum tricalcium aluminate shall not exceed 8 percent. The maximum percent alkalies shall not exceed 0.6 percent.

B. Fly Ash:

1. Provide fly ash conforming to the following requirements:

a. Class F fly ash conforming to ASTM C 618 for chemical and physical properties.

b. Supplemental requirements in percent:

(1) Maximum carbon content: 3 percent

(2) Maximum sulfur trioxide (SO3) content: 4 percent

(3) Maximum loss on ignition: 3 percent

(4) Maximum water requirement (as a percent of control): 100 percent

(5) Fineness, maximum retained on No. 325 sieve: 25 percent

C. Fine Aggregates:

1. Clean, sharp, natural sand conforming to requirements of ASTM C33.

D. Coarse Aggregate:

1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.

E. Water and Ice:

1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C94.

2. Water shall not contain more than 500 mg/L of chlorides nor more than 500 mg/L of sulfate.

3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305R and ACI 306R.

F. Color Additive for Exterior Electrical Duct Encasement:

1. For exterior electrical duct concrete encasements, use a color additive for identification purposes.

G. Concrete Admixtures:

1. Maintain compressive strength and maximum water-cement ratios specified in Table 03300-1 when using admixtures. Include admixtures in solution form in the water-cement ratio calculations.

2. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

3. Use admixtures in compliance with the manufacturer’s printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix.

4. Do not use admixtures in greater dosages than recommended by manufacturer.

5. Water Reducing:

a. Water-reducing admixture shall conform to ASTM C494, Type A. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

(1) BASF Corporation; Polyheed Series

(2) Sika Corporation, Plastocrete 161

(3) WR Grace & Co.;Darex II-AEA

(4) Euclid Chemical Company; Eucon NW

6. Water Reducing and Retarding:

a. Water-reducing and retarding admixture shall conform to ASTM C494, Type D. The amount of admixture added to the concrete shall be in

accordance with the manufacturer's recommendations.

b. Products:

(1) BASF Corporation; Pozzolith Series

(2) Sika Corporation; Plastiment

(3) Euclid Chemical company; Eucon WR-91

7. High-Range Water-Reducing Admixture (Superplasticizer):

a. High-Range water-reducing admixture shall conform to ASTM C494, Type F or ASTM C1017, Type I.

b. Products:

(1) BASF Corporation; Glenium Series

(2) WR Grace & Co.; Daracem 100

(3) Euclid Chemical company; Eucon SPC

H. Fiber Reinforcement:

1. Concrete noted as fiber reinforced concrete on Drawings shall be fiber reinforced in accordance with the following:

a. Fiber reinforcing shall conform to ASTM C 1116, Type III.

b. Fibers shall be macro fibers. Micro fibers are prohibited.

c. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement.

d. Volume of fibers shall be a minimum of 1-1/2 pounds per cubic yard.

e. Fiber length: 1/2-inch to 3/4-inch.

I. Epoxy Bonding Agent:

1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives. The class of epoxy bonding agent shall be suitable for ambient and substrate temperatures.

2. Products:

a. Sika Corp.; Sikadur 32

b. Euclid Chemical Company; Duralcrete

c. BASF Corporation, Concresive Liquid LPL

J. Vapor Barrier: 10 mil polyethylene sheet conforming to ASTM E1745.

K. Curing Compound:

1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C309.

2. Products:

a. BASF Construction Chemicals: Kure-N-Seal

b. Euclid Chemical Company: Rez-Seal

L. Burlap Mats:

1. Conform to AASHTO M182.

M. Sisal-Kraft Paper and Polyethylene Sheets for Curing:

1. Conform to ASTM C171.

2.02 MIXES

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231: 2 +/- 1 percent 1.

C. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03300-1.

Table 03300-1

Class	Type of Work	28-Day Minimum Compressive Strength (psi)	Minimum Cementitous Content (lbs per C.Y.)	Maximum Water/ Cement Ratio
A	Concrete for all structures and concrete not otherwise specified.	4,000	560	0.44
B	Pavement, concrete topping, pipe encasement	3,000	500	0.54
C	Miscellaneous unreinforced concrete, mud slab	2,000	376	0.60
E	Precast concrete	5,000	630	0.40

D. Measure slump in accordance with ASTM C143:

1. Proportion and produce the concrete to have a maximum slump of 4±1 inches.

2. Mixes containing water reducers shall have a maximum slump of 6 inches after the addition of a mid-range water reducer and maximum slump of 8 inches after the addition of a high range water reducer.

E. Pozzolan Content:

1. Water to cementitious ratio shall not exceed water to cement ratio given on table.

2. Fly Ash: Use of is optional. Combine fly ash with cement at rate of 1.0 lb fly ash/lb reduction of cement. Fly ash shall not be less than 15 percent nor more than 20 percent of the total cementitous content given in table.

F. Aggregate Size:

1. Aggregate size shall be 3/4-inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1-1/2 inches maximum for all thicker slabs and sections. Aggregate size for floor topping shall be maximum 3/8-inch.

2. Combined aggregate grading shall be as shown in the following table:

Table 03300-2				
Maximum Aggregate Size	1-1/2 inch	1 inch	3/4-inch	3/8-inch
Aggregate Grade per ASTM C33	467	57	67	8

PART 3 EXECUTION

3.01 SUBGRADE INSPECTION:

A. Examine the subgrade and the conditions under which work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected to comply with specified subgrade conditions in a manner acceptable to the Engineer.

3.02 MIXING AND TRANSPORTING CONCRETE:

A. General: Conform to concreting procedures set forth in ASTM C94, ACI 304R and as specified herein.

B. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

C. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.

D. Do not add water at the jobsite.

E. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery slips certifying the contents of the pour.

3.03 CONCRETE ACCEPTANCE

A. Accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. Sign delivery batch tickets to indicate concrete acceptance.

B. Reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Engineer.

C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified. Slump and air content of pumped concrete will be tested at pipe discharge.

D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Unless otherwise permitted, time for completion of discharge shall comply with ASTM C94. When discharge is permitted after more than 90 minutes have elapsed since batching or after the drum has revolved 300 revolutions, verify that air content of air-entrained concrete, slump, and temperature of concrete are as specified.

E. Reject concrete not conforming to specification before discharging into the forms.

3.04 PREPARATION AND COORDINATION

A. Contractor shall notify the Engineer of readiness to place concrete in any portion of the work a minimum of 5 working days prior to concrete placement. Failure to provide this notification could be cause for delay in placing concrete.

B. Reinforcement, positioning of embedded items, and condition of formwork will be observed by the Engineer prior to concrete placement.

C. Coordinate the sequence of placement such that construction joints will occur only as designed.

D. Schedule sufficient equipment for continuous concrete placing. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide backup concrete vibrators at the project site. Test concrete vibrators the day before placing concrete.

E. Compact the subgrade and/or bedding. Saturate the subgrade approximately eight hours before placement and sprinkle ahead of the placement of concrete in areas where vapor retarder is not used. Remove standing water, mud, and foreign matter before concrete is deposited.

F. Where shown on contract drawings, intentionally roughen surfaces of set concrete in a manner to expose bonded aggregate uniformly at joints.

G. When shown on contract drawings, install a granular base beneath slabs on ground. Place granular material on a compacted subgrade and compact granular base.

H. Place vapor retarder under slabs on grade and where shown on contract drawings. Install material with 6 inch lap at joints and seal joints with tape as recommended by the vapor retarder manufacturer. Tape material cut for slab penetrations to the pipe, conduit or other items passing through the slab. Use tape recommended by the vapor retarder manufacturer.

I. Install vapor retarder without punctures or tears and protect against punctures and breaks.

J. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

3.05 CONCRETE PLACEMENT

A. Placement shall conform to ACI 304R as modified by these specifications.

B. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls until seven days after placement of first placed concrete.

C. Do not place concrete until free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.

D. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.

E. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.

F. Deposit concrete continuously and in level layers. Place in lifts not exceeding 24 inches. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.

G. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove partially hardened concrete from site at no additional compensation.

H. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from

mortar). Limit maximum free fall of concrete to 4 feet. Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.

I. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams or slabs supported thereon. Place beams monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.

J. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.

K. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.

L. Conduct vibration in a systematic manner with regularly maintained vibrators. Furnish sufficient backup units at job site. Use vibrators having minimum frequency of 8,000 vibrations per minute and of sufficient amplitude to consolidate concrete.

M. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.

N. Use additional vibration with pencil vibrators on vertical surfaces and on exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete:

1. Reduce distance between internal vibration insertions and increase time for each insertion.

2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.

3. Use spading as a supplement to vibration where particularly difficult conditions exist.

O. Pumping Concrete:

1. Conform to the recommendations of ACI 304.2R except as modified herein.

2. Base pump size on rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.

3. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 2 inches.

4. Do not use aluminum pipes for delivery of concrete to the forms.

3.06 CURING AND PROTECTION

A. General:

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.

2. Comply with curing procedures set forth in ACI 301, ACI 308 and as specified herein.

3. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.

4. Perform cold weather concreting in conformance with ACI 306R.

5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration:

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared

from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.

2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10 days.

3. Avoid rapid drying at the end of the final curing period.

C. Curing Requirements:

1. Unformed Surfaces: Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.

2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm water spray or warm water saturated fabric immediately following form removal.

3. Below grade structures: Moist cure by the application of water to maintain the surface in a continually wet condition.

4. Other concrete: Moist cure by moisture-retaining cover curing, or by the use of curing compound.

D. Curing Methods:

1. Water Curing: Use water curing for unformed surfaces including grout topping. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods:

a. Keeping the surface of the concrete continuously wet by ponding or immersion.

b. Continuous water-fog spray or sprinkling.

c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4 inch lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface.

2. Sealing Materials:

a. Use common sealing materials such as plastic film or waterproofing (kraft) paper.

b. Lap adjacent sheets a minimum of 12 inches. Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.

c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.

d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.

3. Membrane Curing Compound:

a. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment.

b. Do not use curing compounds on construction joints or on surfaces to receive dustproofer/sealer, concrete paint, concrete fills and toppings or other applications requiring positive bond.

c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.

E. Protection from environmental conditions: Maintain the concrete temperature above 50 degrees F continuously throughout the curing period. Make arrangements before concrete placing for heating, covering, insulation or housing to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.

2. Protect the concrete continuously for the entire curing period.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.

4. Avoid temperature changes in concrete that exceed 5 degrees F in any one hour and 50 degrees F in any 24-hour period.

F. Protection from physical injury: Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.

3.07 FIELD QUALITY CONTROL:

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305R and the following.

2. When the weather is such that the temperature of the concrete as placed would exceed 95 degrees F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 95 degrees F .

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306R and the following.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F. Materials shall be free from ice and frozen lumps before entering the mixer.

4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F for the first five days after placing, and above 35 degrees F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Backfill Against Walls

1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

D. Concrete Testing

1. Concrete quality testing shall be performed on the concrete by independent testing agency retained by the Owner.

2. The testing agency will use concrete samples provided by the Contractor to perform slump (per ASTM C143), air content (per ASTM C231), and temperature tests (per ASTM C1064) and for field control test specimens.

3. The testing agency will submit test reports of concrete field measurements specified above to the Contractor, concrete supplier, and to the Engineer.

4. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

5. Concrete Quality Test Specimen:

a. Perform sampling and curing of test specimen in accordance with ASTM C31.

b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.

c. The testing agency will cast a minimum of one set of 8 test specimens, each 4 inch diameter by 8 inch long cylinders, for each 50 cubic yard of each mix design of concrete but not less than once a day.

d. Test cylinders in accordance with ASTM C39. Test two cylinder at 7 days for information; test three cylinders at 28 days for acceptance; and hold three reserve cylinders for verification. Strength acceptance will be based on the average of the strengths of the three cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use a reserve cylinder for the test result.

6. The Contractor may take field control test specimens for small quantities of concrete.

7. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.

8. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.

9. Concrete Coring:

a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Engineer detects deficiencies in the concrete, the Contractor will take concrete cores at least 2 inches in diameter from the structure in conformance with ASTM C 42 at locations determined by the Engineer.

b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.

c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.

d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C39 and submit test strength test results of cores specified above to the Contractor and to the Engineer.

e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Owner.

3.08 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03350 CONCRETE FINISHES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Cast-In-Place Concrete is included in Section 03300.

C. Grout is included in Section 03600.

D. Moisture Protection is included in Division 7.

E. Painting, toppings and special surfaces are included in Division 9.

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.

B. Services of Manufacturer's Representative

1. 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 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.

3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)

4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can

be wiped off clean with the burlap.

5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.

6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

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. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.

D. Concrete Sealer

1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:

a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Paragraph 3.05 below.

b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking workmen.

c. Newly-Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.

d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.

e. Methods: Apply sealer so as to form a continuous, uniform film by spray, soft-bristle

pushbroom, long-nap roller or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.

f. Applications: For curing only, apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.

g. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full-strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.03 CONCRETE RECEIVING CHEMICAL HARDENER

A. After 28 days, minimum, concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 sq ft per gallon and in accordance with manufacturer's recommendations as reviewed.

3.04 APPROVAL OF FINISHES

A. All concrete surfaces, when finished, will be inspected by the Engineer.

B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.

C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

3.05 SCHEDULE OF FINISHES

A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.

B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:

1. Concrete to Receive Dampproofing: Rough-form finish. See Paragraph 3.01D above.

2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough-form finish. See Paragraph 3.01D above.

3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.

4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.

5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough-form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.

6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.

7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.

8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A above.

9. Concrete for Exterior Walks, Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.

10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C above.

11. Concrete to Receive Hardener: See Paragraph 3.02D above.

12. Concrete to Receive Floor Sealer: See Paragraph 3.02E 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 03250.

D. Cast-in-Place Concrete is included in Section 03300.

E. Miscellaneous Metals are included in Section 05500.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

1. Commercially manufactured nonshrink cementitous grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.

2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.

3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.

4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03200. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.

B. Laboratory Test Reports

1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.

C. Certifications

1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.

D. Qualifications

1. Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. U.S. Army Corps of Engineers Standard (CRD)

1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

B. Pre-installation Conference

1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing

1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc, for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.

2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name,

product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.

C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.

D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.

E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a

pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.

a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp. or equal.

b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp. or equal.

B. Nonshrink Epoxy Grout

1. Nonshrink epoxy-based grout shall be a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30×10^{-6} when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout-Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co. or equal.

C. Cement Grout

1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Concrete Grout

1. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 2900 psi at 28 days, or 2500 psi nominal strength. Coarse aggregate size shall be 1/2-in maximum. Slump should not exceed 5-in and should be as low as practical yet still retain sufficient workability.

2. Synthetic reinforcing fibers as specified in Section 03200 shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may effect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to 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. Provide the surface with a broomed finish, aligned to drain. Protect and keep the surface clean until placement of concrete grout.

B. Remove the debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing of debris into tank drain lines will not be permitted.

C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Saturation may be maintained by ponding, by the use or soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste. (A bonding grout composed of 1 part portland cement, 1.5 parts fine sand, an approved bonding admixture and water, mixed to achieve the consistency of thick paint, may be substituted for the cement slurry.)

D. Place concrete grout to final grade to ensure high and low spots are eliminated.

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:

1. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.

2. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.

3. 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.

4. Cement grout: Cement grout may be used for grouting of incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting of primary structural steel members such as columns and girders.

5. Concrete grout: Use at locations indicated on the Drawings.

END OF SECTION

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SECTION 03740 MODIFICATIONS AND REPAIR TO CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide concrete repair as indicated and in compliance with Contract Documents.

B. Complete repair work in accordance with this specification and the product manufacturer's instructions regarding surface preparation and application.

C. The areas of concrete repair shall be determined by the Contractor and the Engineer and shall include any location where concrete deterioration has reached a depth of 1/2-inch or deeper and at any air voids, bugholes or poorly consolidated concrete areas where the specified filler/surfacer materials cannot be used for filling or surfacing of the concrete.

D. If repair work is required for an area indicated to receive protective lining or coating, provide such repair in accordance with the requirements of this specification and the related product manufacturer's written instructions.

E. The repair work specified herein is intended to cover the requirements for repair of concrete only, to a maximum depth of approximately 1-1/2-inch. If after blasting and cleaning, an area is discovered that requires a repair greater than 1-1/2-inch deep, or an area is discovered that requires repair or replacement of reinforcing steel notify the Engineer so that details may be provided to the Contractor to complete the repair.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 503.4: Standard Specification for Repairing Concrete with Epoxy Mortars

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

1. C33: Standard Specifications for Concrete Aggregates

2. C150: Standard Specification for Portland Cement

3. C321: Standard Test Method for Bond Strength of Chemical-Resistant Mortars

4. C882: Test Method for Bond Strength of Epoxy Resin Systems

5. D570: Test Method for Water Absorption of Plastics

6. D638: Test Method for Tensile Properties of Plastics

7. D695: Test Method for Compressive Properties of Rigid Plastics

8. D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

9. D4262: L.R. Standard Test Method for pH of Chemically Cleaned or Acid Etched Concrete Surfaces

10. E337: L.R. Standard Practice Test Method for Measuring Humidity with a Psychrometer.

C. National Association of Corrosion Engineers (NACE):

1. 6D-173: “A Manual for Painter Safety”

2. 6F-163: “Surface Preparation of Steel or Concrete Tank Interiors”

3. TPC2: “Coatings and Linings for Immersion Service”

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300.

1. Procedures proposed for the accomplishment of repair work. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations to be coordinated with other works in progress.

2. Manufacturer’s recommendations and product data sheets for all repair materials including performance criteria, surface preparation, ambient condition requirements and applications, curing

requirements, volatile organic compound (VOC) data, and safety requirements.

3. Material Safety Data Sheets (MSDS) for any materials brought on-site including all repair system materials, solvents and abrasive blast media.

4. Qualifications of foreman and epoxy gun operators and demonstration of meeting the minimum requirements specified.

5. Design Mixes: Provide concrete and cement mortar in conformance with Section 03300 and as specified herein.

1.04 QUALITY ASSURANCE

A. Furnish the names of all subcontractors proposed for use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.

B. Include in accepted applicator qualifications:

1. A minimum of five years experience in applying epoxy polyurethane and polymer-modified and cement-based compounds similar to those specified in this Section.

2. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

C. Adhere strictly to the manufacturer’s recommendations regarding temperature at time of application for all work. Do not use epoxy materials when either the temperature of the concrete to be repaired or the ambient temperature is below 50 degrees F . 24 hours before, during, or for a period of 48 hours after the completion of the repair. Temporary heat may be used to meet the specified requirements.

D. Use new repair materials and use within the shelf life limitations set forth by the manufacturer.

E. The Contractor is ultimately responsible for the concrete repair work. Inspections by the Engineer or others do not limit the Contractor’s responsibility.

F. Make all parts of the work accessible for inspections by the Engineer. Correct any conditions not in conformance with the specifications at no additional cost to the Owner.

G. Submit any changes in the specified repair work methods to the Engineer for review.

H. Provide technical field support or training services required by the accepted material manufacturers at no additional cost to the Owner.

I. Provide materials from a single manufacturer for all components of a single repair.

1.05 SERVICES OF MANUFACTURERS REPRESENTATIVES

A. Provide the services of a qualified manufacturer's technical representative to instruct the Contractor's personnel in the mixing, proper use and application of the epoxy, polyurethane polymer-modified and cement-based compounds.

B. Provide written certification from the manufacturers' representative that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

C. Provide on-site time required for the manufacturer's representative to achieve a successful installation at no additional cost to the Owner.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide shelter to store materials in area or areas designated by the Owner solely for this purpose. Confine mixing, thinning, clean-up and associated operations and storage of repair mortar materials debris before authorized disposal, to these areas.

B. Mix all specified materials in the sheltered mixing operation and materials from direct sunlight and inclement weather. Protect facilities from staining and damage.

C. Do not dispose of waste materials on-site.

D. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in Contractor's area longer than 24 hours.

E. Deliver all materials to the job site in new, unopened containers. Each container shall bear the manufacturer's name and label. Labels on all material containers shall contain the following information:

1. Name of product.

2. Federal Specification Number if applicable.

3. Manufacturer's batch number.

4. Manufacturer's name.

5. Generic type of material.

6. Hazardous material identification label.

7. Shelf life date.

F. Clearly mark all containers indicating any safety hazards associated with the use of or exposure to the materials.

G. Handle and store materials to prevent damage or loss of label. Protection of materials is the Contractor's responsibility.

1.07 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Comply with the repair material manufacturer's recommendations as to environmental conditions under which materials can be applied and cured.

2. Do not apply materials when dust is being generated.

B. Protection:

1. Cover or otherwise protect finish work or other surfaces not being repaired.

C. Ventilation:

1. Provide ventilation to meet product requirements prior to, during, and after application.

PART 2 PRODUCTS

2.01 WATER

A. The water used for mixing concrete repair products shall be clear, potable and free of deleterious substances.

2.02 AGGREGATE

A. All aggregates shall conform to ASTM C33 and Section 03300.

2.03 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.

B. Products:

1. Sika Corp.; Sikdur 32

2. Euclid Chemical Company; Duralcrete

2.04 ANTI-CORROSION COATING

A. Anti-corrosion coating shall be a three-component, epoxy-modified cementitious material.

B. Products:

1. Sika Corp.; Sika Armatec 110

2. Sto Concrete Restoration Division; CR 246

3. Euclid Chemical Company; Duralprep

2.05 EPOXY CRACK REPAIR BINDER

A. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive suitable for crack grouting by injection.

B. Products:

1. Sika Corp.; Sikadur 52

2. Euclid Chemical Company; Duralcrete LV

3. BASF Chemical Company; SBC Concresive 1380

2.06 FLEXIBLE POLYURETHANE CRACK REPAIR MATERIAL

A. Flexible polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water.

B. Products:

1. Prime Resins; Prime Flex 900 XLV

2. Avanti International; Scotch Seal 5600 Chemical Grout

2.07 EPOXY REPAIR MORTAR

A. Epoxy Repair Mortar shall be two-component, 100 percent solids, 100 percent reactive epoxy resin system.

B. Spall repair mortar for use in horizontal applications.

1. Products:

a. BASF Building Systems; Concresive Paste LPL

b. Sika Chemical Corp.; Sikadur 22 Lo-Mod

C. Spall repair mortar for use in vertical and overhead applications.

1. Products:

a. Sika Chemical Corp.; Sikadur 23 Lo-Mod Gel

2.08 SPALL REPAIRS USING NON-SHRINK CEMENTITOUS MORTAR

A. Products:

1. BASF Building Systems; EMACO S88 CI

2. BASF Building Systems; Thorite

3. Sauereisen, Inc.; Underlayment F-120

2.09 SPALL REPAIRS USING POLYMER MODIFIED CEMENTITOUS MORTAR

A. Repair spalls repair not requiring formwork using a two-component, polymer-modified cementitious mortar having a minimum 28-day compressive strength of 7,000 psi.

B. Spall repair mortar for use in horizontal applications.

1. Products:

a. Sika Corp.; Sikatop 122 Plus

b. Euclid Chemical Company; Duraltop Fast Set

C. Spall repair mortar for use in vertical applications.

1. Products:

a. Sika Corp; Sikatop 123 Plus

b. Euclid Chemical Company; Duraltop Gel

2.10 SPALL REPAIRS REQUIRING FORMWORK

A. Repair spalls repair requiring formwork using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 6,000 psi. Mix each unit of mortar with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.

B. Products:

1. Sika Corp.; Sikatop 111 Plus

2. Euclid Chemical Company; Duraltop Flowable Mortar

2.11 SEALANT

A. Sealant shall be a two-component polyurethane sealant as specified in Section 03250. Primers and bond breakers shall conform to the sealant manufacturer's recommendations.

2.12 EXPANSION JOINT FILLER

A. Expansion joint filler shall be as specified in Section 03250.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform exterior work during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. Protect unfinished work during inclement weather with tarpaulins or heavy gage polyethylene sheeting.

B. Perform work in spaces within structures at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.

C. Coordinate concrete rehabilitation work with other work being performed.

D. Remove scaling, broken, loose and disintegrating materials by use of hand tools or power driven saws, down to solid unyielding material.

E. Clean surfaces thoroughly of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

3.02 EPOXY BONDING AGENT

A. Use epoxy bonding agent to adhere fresh mortar to existing concrete. Roughen existing concrete surfaces prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Place repair material while bonding agent is still tacky or per the written instructions of the manufacturer. Reapply bonding agent if bonding agent cures prior to placement of repair material.

B. Conform to all the requirements of ACI 503.4, and as specified herein.

3.03 ANTI-CORROSION COATING

A. Sandblast clean and coat reinforcing steel that is cut or exposed during alteration and/or repair operations with an anti-corrosive coating.

B. Cover all exposed parts of the steel with the coating and apply according to manufacturer's recommendations.

3.04 EPOXY CRACK REPAIR

A. Cracks on horizontal surfaces: When permitted by the Engineer, repair existing structural cracks by gravity feeding an epoxy crack repair binder into the prepared crack.

1. Rout concrete surface at the crack to form a minimum 1/4-inch wide by 1/4-inch deep V-notch and clean to remove all loose and foreign particles. Fill crack with clean, dry sand and pour epoxy crack repair binder into V-notch, completely filling crack.

2. As binder penetrates into crack, apply additional binder to the V-notch.

B. Cracks on vertical or horizontal surfaces: Repair existing structural cracks by pressure injecting an epoxy crack repair binder into the prepared crack. Seal cracked surfaces and install injection ports per manufacturer's recommendations.

1. Do not cut reinforcement steel when drilling holes injection ports. If rebar is encountered during drilling, abandon the hole and relocate. Patch the abandoned hole immediately with epoxy mortar flush with the surface of the existing concrete.

2. Once the surface sealing material has cured, inject crack with epoxy crack repair binder as directed by the manufacturer.

3. Remove injection ports upon satisfactory completion of crack injection and patch with epoxy mortar.

3.05 RIGID AND FLEXIBLE POLYURETHANE CRACK REPAIR

A. Repair leaking cracks by pressure injecting with a waterproof hydrophilic or hydrophobic injection grout

seal crack surfaces and install injection ports per manufacturer's recommendations.

B. Do not cut rebar when drilling holes for injection ports. If rebar is encountered during drilling, abandon the hole and patch immediately with epoxy mortar flush with the surface of the existing concrete.

C. Once the surface sealing material has cured, inject crack with waterproof hydrophilic or hydrophobic injection grout as directed by the manufacturer.

3.06 SPALL REPAIR

A. Saw cut the perimeter of the repair area to a minimum depth of 1/2-inch below the surface of the concrete.

B. Chip all loose concrete in the repair area to remove loose and degraded concrete to a minimum of 1/2-inch or until a sound substrate is reached.

C. Clean the area and repair to the original dimensions with spall repair patching material according to the manufacturer's recommendations.

D. Make final finished surface of patches flat, level and even with the existing concrete surface. Do not feather repair mortar to meet existing concrete surface.

E. Finish final patches on horizontal surfaces consistent with the finish on the existing structure.

3.07 JOINT REPAIR

A. Remove sealant, bond breaker and joint filler.

B. Remove unsound concrete on the joint faces.

C. Remove laitance and provide a clean dry surface.

D. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregate following the manufacturer's instructions.

E. Restore surface to original dimensions by trowelling epoxy mortar onto the existing substrate in a manner to ensure bonding following the manufacturer's instructions.

F. Cure repair in accordance with the manufacturer's instructions.

G. Install new joint filler, bond breaker and sealant.

3.08 CURING

A. Cure repair materials in accordance with manufacturer recommendations.

3.09 CLEANING

A. Mechanically remove excess material from walls, floors, etc. after material has cured.

B. Clean excess materials caused by work under this Section from existing surfaces by the use of power sanders. Vacuum surfaces to receive final cleaning and finishing specified under other sections of the specifications. Sand cracks flush to adjacent surfaces.

C. Remove misplaced sealants using methods and materials recommended by the manufacturers. Leave finished work and work area in a neat and clean condition.

3.10 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 05500 MISCELLANEOUS METAL

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes metal fabrications not specifically included in other Sections and required for completion of work as shown on Contract Drawings and in accordance with Contract Documents.

B. Furnish labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. B18.5: Round Head Bolts.

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

1. A6: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.

2. A36: Standard Specification for Carbon Structural Steel.

3. A48: Standard Specification for Gray Iron Castings.

4. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

5. A108: Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.

6. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

7. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

8. A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

9. A240: Standard Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels.

10. A276: Standard Specification for Stainless Steel Bars and Shapes.

11. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

12. A325: Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.

13. A366: Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

14. A489: Standard Specification for Carbon Steel Lifting Eyes.

15. A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

16. A501: Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

17. A502: Steel Structural Rivets.

18. A536: Standard Specification for Ductile Iron Castings.

19. A569: Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.

20. A570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

21. A572: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

22. A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.

23. A675: Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

24. A786: Rolled Steel Floor Plates.

25. A992: Standard Specification for Structural Shapes.

26. B26: Specification for Aluminum-Alloy Sand Castings.

27. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.

28. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

29. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

30. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

31. B308: Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

32. B 429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

33. D1056: Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

34. F436: Standard Specification for Hardened Steel Washers.

35. F541: Standard Specification for Alloy Steel Eyebolts.

36. F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

37. F594: Standard Specification for Stainless Steel Nuts.

38. F844: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

39. F1554: Standard Specification of Anchor Bolts, steel, 36, 55 and 105-ksi Yield Strength.

40. F2329: Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

C. American Institute of Steel Construction (AISC):

1. ANSI/AISC 360-5: Specification for Structural Steel Buildings

2. AISC Manual of Steel Construction, Thirteenth Edition

D. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. D1.1: Structural Welding Code.

3. D1.2: Structural Welding Code - Aluminum.

E. Aluminum Association:

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

a. AA M31C22A41

(1) M31: Mechanical Finish, Fine Satin

(2) C22: Finish, Medium Matte

(3) A41: Clear Anodic Coating, Class I

F. International Code Council – Evaluation Services (ICC-ES):

1. ICC-ES Acceptance Criteria 01: Mechanical Anchors in Masonry Elements

2. ICC-ES Acceptance Criteria 58: Adhesive Anchors in Masonry Elements

3. ICC-ES Acceptance Criteria 193: Mechanical Anchors in Concrete Elements

4. ICC-ES Acceptance Criteria 308: Post-installed Adhesive Anchors in Concrete Elements

1.03 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Submit shop drawings and product data showing materials of construction and details of installation for all items furnished under this Section. Shop drawings shall show sizes of members, method of assembly, anchorage and connection to other members.

2. Product Data:

a. Manufacturer’s catalog sheets on pre-manufactured items.

3. Miscellaneous Submittals:

a. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for concrete anchors.

4. Stamped by Professional Engineer registered in State where the project is located.

1.04 QUALITY ASSURANCE

A. Test and inspect structural assemblies in accordance with Section 01065.

B. Design connections not detailed on the Drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State where the Project is located.

C. Steel:

1. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale that will withstand vigorous wire brushing may remain. Perform no welding when base metal is lower than 0 degrees F.

2. Qualify welding operators in accordance with AWS D1.1. Qualification tests shall be run by a recognized testing laboratory acceptable to the Engineer at Contractor's expense.

D. Aluminum:

1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with AWS.

E. Adhesive Anchors:

1. Adhesive Anchor Installers shall be trained and certified by manufacturer.

F. Galvanized Coating:

1. Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY STORAGE AND HANDLING

A. Insofar as practical, factory assemble items specified herein. Package, ship and tag unassembled materials in a manner that will protect materials from damage and will facilitate identification and field assembly.

B. Package stainless steel items in a manner to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling. Use padded slings and straps.

D. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

E. Store fabricated items in a dry area, not in direct contact with ground.

1.06 FIELD MEASUREMENTS

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 PRODUCTS

2.01 MISCELLANEOUS METAL SHAPES, CASTINGS, BOLTS AND ACCESSORIES

A. Structural Steel Shapes:

1. W Shapes: ASTM A992, 50 ksi

2. M Shapes: ASTM A36

3. S, C and MC Shapes: ASTM A36

4. L Shapes: ASTM A36

5. HSS Rectangular Shapes: ASTM A500, Grade B, 46 ksi

6. HSS Round Shapes: ASTM A500, Grade B, 42 ksi

7. Pipe Shapes: ASTM A53, Grade B, 35 ksi

8. Plates and Bars: ASTM A36

9. Steel Sheets: ASTM A366

B. Stainless Steel Shapes:

1. Exterior and Submerged Uses: AISI, Type 316

2. Industrial Uses: AISI, Type 316

3. Interior and Architectural Uses: AISI, Type 304

4. For Welding: AISI, Type 304L, Type 316L

5. Shapes and Bars ASTM A276

6. Plate, Sheet and Strip ASTM A240

C. Aluminum Shapes:

1. Structural Shapes ASTM B308, Alloy 6061-T6

2. Extruded Pipe ASTM B429, Alloy 6063-T6

3. Aluminum Sheet& Plate ASTM B209, Alloy 6061-T6

D. High Strength Bolts for Steel Members ASTM A325

E. Steel Washers ASTM F436

F. Plain Unhardened Steel Washers: ASTM F844

G. Anchor Bolts: ASTM F1554, Grade 36 standard headed bolts with heavy hex nuts, Grade A washers, hot-dip galvanized, unless otherwise specified.

H. Stainless Steel Bolts and Nuts: F593 and F594, AISI Type 316

I. Connection Bolts for Wood Members: ASTM A307, galvanized where specified

J. Iron Castings: ASTM A48, Class 35

K. Galvanizing: ASTM A123, Zn w/0.5 percent minimum Ni.

L. Galvanizing, hardware: ASTM A153, Zn w/0.5 percent minimum Ni.

2.02 POST INSTALLED ANCHORS:

A. Mechanical Expansion Type Anchors: Anchors shall be qualified per ICC-ES AC193.

1. Products:

a. Hilti Corporation, Kwik-Bolt TZ

b. Powers Fasteners, Power Stud SD1+ Stud Anchor

c. Simpson Strong Tie, Strong Bolt

2. General:

a. Use Zinc or chromate-plated carbon steel where totally embedded, in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.

b. Use stainless steel in other locations or when attaching aluminum and stainless steel.

c. Do not use expansion anchors in submerged and dynamic load applications.

B. Adhesive Anchors:

1. Products:

a. Hilti Corporation, HIT-RE 500-SD

b. Powers Fasteners, PE1000+ Epoxy Adhesive Anchoring System

c. Simpson Strong Tie, SET-XP Epoxy-Tie or Acrylic-Tie

2. General:

a. Adhesive anchors shall be Stainless Steel Type 316 unless otherwise noted.

C. Adhesive Anchors for masonry:

1. Products:

a. Hilti Corporation, HIT-HY 20.

b. Powers Fasteners, AC100+ Gold

c. Simpson Strong Tie, SET High Strength Epoxy Tie

2. General:

a. Epoxy anchors shall be Stainless Steel Type 316 unless otherwise noted.

2.03 FABRICATION

A. Connections and Workmanship

1. Fabricate details and connection assemblies in accordance with Contract Drawings and Specifications, with projecting corners clipped and filler pieces welded flush.

2. Fit work together in fabrication shop and deliver complete or in parts, ready to be set in-place or assembled in field.

3. Provide work true to detail; with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture free from defects impairing strength or durability.

4. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

5. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion; smooth and well cleaned by shot blasting.

6. Welding:

a. Provide rigid and continuous welds or spot welded as specified and as shown on Contract Drawing. Dress the face of welds flush and smooth. Close fit exposed joints and locate where least conspicuous.

b. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration.

c. Weld aluminum in compliance with the latest edition of AWS D1.2. Support and clamp

component parts of built-up members in proper position for welding.

d. Weld shop connections and bolt or field weld connections, unless otherwise specified.

e. Grind exposed edges of welds to 1/8-inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.

f. Prepare welds and adjacent areas so there is:

(1) No undercutting or reverse ridges on weld bead.

(2) No weld spatter on or adjacent to weld or other area to be painted or coated.

(3) No sharp peaks or ridges along weld bead.

7. Bolting:

a. Use bolts of lengths required so bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

b. Provide holes required for connection of adjacent or adjoining work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of +/- 1/16-inch of dimensions indicated.

B. Galvanizing:

1. Galvanize after fabrication by hot-dipped process conforming with ASTM A123.

2. Ship and handle in manner to avoid damage to zinc coating.

C. Shop Painting:

1. Do not paint or coat ferrous metal surfaces embedded in concrete.

2. Comply with Section 09900.

PART 3 EXECUTION

3.01 EXAMINATION

A. Upon receipt of material at job site, inspect all materials for shipping damage. Replace damaged items at no cost to Owner.

B. Examine supports for size, layout and alignment.

C. Correct defects considered detrimental to proper installation.

3.02 INSTALLATION

A. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.

B. Erect to lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts using concealed connections when practicable.

C. Plumb and true vertical members to tolerance of +/- 1/8 inch in 10 feet. Level horizontal members to tolerance of +/- 1/8 inch in 10 feet.

D. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.

E. Anchor Bolts and Concrete Anchors:

1. Preset anchor bolts using templates. Do not use concrete anchors in place of anchor bolts.

2. After anchor bolts are embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of equipment or metalwork.

3. Do not install concrete anchors until concrete has reached specified minimum compressive strength.

4. Install concrete anchors in accordance with anchor manufacturer recommendation. Embedment depth of

anchor shall be as recommended by the anchor manufacturer, but not less than as shown on Contract Drawings.

5. Locate concrete anchors to clear reinforcing bars in concrete.

F. Weld headed anchor studs in accordance with manufacturer's recommendations.

G. Do not place new holes or enlarge unfair holes by use of cutting torch.

3.03 PAINTING, REPAIR, AND PROTECTION

A. Paint aluminum in contact with concrete in accordance Section 09900. Under no circumstances shall aluminum contact dissimilar metal.

B. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-inch thick neoprene isolator pads, 85 +/- 5 Shore A durometer, sized for full width and length of bracket or support.

C. Apply an anti-seize compound on all stainless steel fasteners to prevent galling.

D. Field paint in compliance with Section 09900.

E. Field repair of damaged galvanized coatings:

1. Clean and repair Zinc coating that has been burned by welding, abraded, or otherwise damaged after installation. Clean damage area by wire brushing and removing all traces of welding flux and loose or cracked zinc coating

2. Coat surfaces using zinc-rich paint.

F. Field repair of damaged primer.

1. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding with primer after welding.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 05515 ALUMINUM STAIRS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes materials, fabrication, and installation of aluminum stairs as indicated and in compliance with Contract Documents.

1.02 REFERENCES

A. Aluminum Association (AA):

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

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

1. A276: Standard Specification for Stainless Steel Bars and Shapes.

2. B26: Specification for Aluminum-Alloy Sand Castings.

3. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.

5. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

6. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

7. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. D1.1: Structural Welding Code - Steel.

1.03 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Shop drawings showing clearly the location, size and details of all members.

2. Indicate materials, dimensions, connection attachments, anchorage, size and type of fasteners, holes, finishes, and accessories.

3. Reference materials of construction by ASTM designation and grade.

4. Indicate welds including length and size of all shop and field welds by symbols conforming to AWS standards.

B. Product Data:

1. Manufacturer’s catalog sheets on pre-manufactured items.

2. Manufacturer’s specifications, load tables, anchor details, and installation details.

C. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Obtain field measurements and elevations prior to preparation of shop drawings and fabrication.

B. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Use welders, tackers and welding operators certified by test to perform type of work required in conformance with AWS Structural Welding Code. Maintain current test records certified by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.05 DELIVERY, STORAGE AND HANDLING

A. Identify and match-mark materials, items and fabrications, for installation and field assembly.

B. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.

C. Carefully handle and store materials, protected from weather, corrosion and other damage.

D. Store off the ground on suitable supports.

E. Accept material on site. Inspect for damage.

F. Do not incorporate damaged material in the work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum materials and welding electrodes per Section 05500.

B. Aluminum plates, shapes, pipe and castings shall conform to the following ASTM specifications, alloy and temper designations.

1. Extruded structural shapes, bars and tubes: ASTM B221 Alloy 6061-T6.

2. Extruded structural tube or pipe: ASTM B429 Alloy 6061-T6.

3. Sheet and plate: ASTM B209 Alloy 6061-T6.

4. Die and hand forgings: ASTM B247 Alloy 6061-T6.

5. Castings: ASTM B26.

6. Bolts, washers and nuts: Type 304 stainless steel.

7. Gratings (bearing bars): ASTM B211 Alloy 6061-T6 (connecting bars): ASTM B211 Alloy 6061-T5.

2.02 FABRICATION

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified.

2. Straighten work bent by shearing or punching.

3. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded.

4. Provide sufficient quantity and size of anchors for the proper fastening of the work.

5. Fabricate details and connection assemblies in accordance with drawings, with projecting corners clipped and filler pieces welded flush.

6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.

8. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.

B. Welding:

1. Grind exposed edges of welds to a 1/8 inch minimum radius. Grind burrs, jagged edges and surface defects smooth.

2. Prepare welds and adjacent areas such that there is no undercutting or reverse ridges on the weld bead and no sharp peaks or ridges along the weld bead.

3. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

C. Bolting:

1. Provide stainless steel stud bolts and nuts with heavy aluminum washers for fastening aluminum material.

2. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting to supports to a tolerance of 1/16-inch of exact dimensions indicated.

2.03 ALUMINUM STAIRS:

A. Provide aluminum stairs fabricated from structural aluminum channel stringers, aluminum pipe rails and aluminum treads.

B. Rectangular Bar Grating Treads:

1. Provide stair treads of the same type and bar spacing as grating specified.

2. Provide serrated top surface of bearing bars.

3. Provide minimum 3 inch by 3/16 inch carrier end plates welded to stair treads and punched for bolting to stringers.

4. Provide 1-1/4 inch abrasive nosings.

5. Manufacturers:

a. IKG Borden Metal Products Co.; Type B.

b. Ohio Gratings, Inc.; Type SG Series.

c. McNichols Co.; Type A.

PART 3 EXECUTION

3.01 GENERAL:

A. Set and secure in place as indicated. Where bolted connections are used, draw together and draw nuts tightly. Use bolts of lengths required so that they do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

B. Locate anchors and anchor bolts and build into connecting work.

C. Install stairs in accordance with accepted shop drawings.

3.02 STAIRS:

A. Provide structural aluminum angles, struts, rod hangers, closure plates, and brackets indicated.

3.03 CORROSION PROTECTION FOR ALUMINUM SURFACES:

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 09900.

B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.04 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 05520 METAL RAILINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Design, furnish and install handrails and railing systems, including connectors, fasteners, and system required accessories.

1.02 REFERENCES

A. Aluminum Association (AA):

1. Aluminum Association Designation System for Aluminum Finishes

2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

B. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures.

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

1. B210: Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

2. B221/B221M: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

3. B241: Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

4. B429: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

5. E935: Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

6. E985: Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

D. American Welding Society (AWS)

1. C5.6: Recommended Practices for Gas Metal Arc Welding

2. D1.1-1.17: Structural Welding Code.

E. International Code Council

1. FBC: Florida Building Code.

F. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. Guideline 1: Joint Finishes.

2. Metal Rail Manual.

1.03 PERFORMANCE/ DESIGN CRITERIA

A. Design and provide handrail and guardrail system to meet FBC, OSHA and the criteria specified herein. Railing shall be capable of withstanding the following loads without exceeding design allowable stress of materials for handrails, railing anchors and connections.

1. Top rail:

a. Uniform load of 50 pounds per foot applied in any direction.

b. Concentrated load of 200 pounds applied in any direction at any point.

c. Uniform and concentrated loads above need not be assumed to act concurrently.

2. Intermediate rail:

a. Uniform load of 50 pounds per foot applied in any direction. Uniform load above need not be assumed to act concurrently with loads acting on top rail.

B. Thermal movements: Provide adequate expansion within the system to allow for thermal expansion and contraction caused by a temperature change of 120 degrees F to 15 degrees F without buckling or warping, opening of joints, overstressing of components, failure of connections and other detrimental effects.

C. Control of corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Show fabrication and installation of handrails and railings assembled from standard components. Include plans, elevations, component details, materials, finishes, connection and joining methods, and mounting details to adjoining work.

2. Identify location and type indicated.

3. Submit certification demonstrating that the railing system will resist the loads specified herein, FBC and OSHA. Calculations shall be stamped by Professional Engineer registered in State where the Project is located.

B. Product Data:

1. Manufacture’s literature.

2. Assembly and installation instructions.

C. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. Submit certification that the railing system is in compliance with FBC and OSHA

D. Operation and Maintenance Data:

1. Manufacturer’s instructions describing procedures for maintaining including cleaning materials, application methods, and precautions as to use of materials which may be detrimental to finish when improperly used.

1.05 QUALITY ASSURANCE

A. Obtain field measurements prior to preparation of shop drawings and fabrication.

B. Handrails provided shall be end products of one manufacturer to achieve standardization for appearance, maintenance and replacement.

C. Manufacturer shall have minimum five years experience specializing in manufacturing products specified in the section.

D. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Each welder, tacker and welding operator shall be certified by test to perform type of work required in conformance with AWS Structural Welding Code. Testing shall be conducted, and witnessed by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.06 DELIVERY STORAGE AND HANDLING

A. Deliver, store and handle materials in manner preventing damage to finished surfaces.

B. Store materials in a dry, well ventilated, weather tight place away from uncured concrete or masonry.

1.07 SITE CONDITIONS

A. Field verify measurements prior to fabrication and indicate measurements in shop drawings.

PART 2 PRODUCTS

2.01 ALUMINUM RAILING SYSTEM AND COMPONENTS

A. Material: ASTM B429, alloy 6063-T6, Schedule 40, 1-1/2 inch diameter minimum extruded structural pipe or tube rails and schedule 80 posts.

B. Railings at open-side construction shall consist of two members with posts. Locate intermediate rails between top rail and finish floor as indicated on Drawings.

C. Provide 1/4-inch thick by 4 inch high or “S” type toe plate except on stairs and where concrete curb provided. Provide 1/4-inch clearance above floor level. Expansion joint location to match railing joint location.

D. Fabrication:

1. Angles, offsets, other changes in alignment, and joining of posts and rails shall be made with welded connections. Miter and weld joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Run top rails continuously over post.

2. Rail splices shall be butted and reinforced by tight fitting interior sleeve not less than 6 inch long.

3. Space posts not more than 5 feet. Erect posts plumb in each direction.

E. Anchorage:

1. For posts set on stair or platform stringers, provide base flange welded to post and bolted to stringer with minimum of two 1/2-inch bolts, or weld post to stringer.

F. Finishes:

1. Aluminum Association Finish Designation: AA-M12A41 (Mechanical finish, nonspecular, anodic coating, architectural Class I, clear coating 0.7 mil complying with AAMA 607.1 on exposed surfaces.

   a. Extruded Components: 0.7 mil anodized.

   b. Cast Components: 0.4 mil anodized.

2.02 DISSIMILAR METAL

A. Keep surfaces of dissimilar metal from direct contact by coating the dissimilar metal with a heavy coat of a two part epoxy.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as shown on Drawings and accepted Shop Drawings.

B. Set posts plumb and aligned in each direction to within 1/4-inch in 12 feet.

C. Set rails horizontal or parallel to rake of steps to within 1/4 inch in 12 feet.

D. Fit exposed connections together to form tight, hairline joints.

E. Provide anchorage devices and fasteners for securing handrails and railings and for transferring loads to structures.

F. Provide mechanical joints for permanently connecting railing components at nonwelded connections.

3.02 CLEANING

A. Wash thoroughly using clean water and soap, rinse with clean water.
B. Do not use acid solution, steel wool or other harsh abrasive.

C. When stain remains after washing, remove finish and restore in accordance with manufacturer’s instructions.

3.03 PROTECTION

A. Protect surfaces of completed installations to prevent damage during construction activities.

3.04 REPAIR OF DEFECTIVE WORK

A. Remove stained or otherwise defective work and replace with no additional cost to Owner.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 05530 METAL GRATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide metal grating as indicated and in compliance with Contract Documents.

B. This section includes:

1. Aluminum Bar Grating.

C. Furnish all labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES

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

1. B26: Specification for Aluminum-Alloy Sand Castings.

2. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

3. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

4. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

B. American Welding Society (AWS):

1. D1.1: Structural Welding Code.

2. D1.2: Structural Welding Code - Aluminum.

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. MBG 531: Metal Bar Grating Manual.

2. MBG 532: Heavy Duty Metal Bar Grating Manual.

3. MBG 533: Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.

D. Aluminum Association:

1. Aluminum Association Designation System for Aluminum Finishes

2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

1.03 DESIGN CRITERIA

A. Grating

1. Provide grating meeting the specified floor design live load but not less than a uniform live load of 100 psf or a concentrated load of 300 pounds over a 12 inch area at the center or span, whichever produces the greatest stresses.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Detail shop drawings indicating:

a. Dimensions.

b. Sectional assembly.

c. Location and identification mark.

d. Connections and fastening methods.

e. Size and location of supporting frames required.

f. Materials of construction.

g. Installation instructions.

2. Catalog data and design tables showing limits for span length and deflection under load.

1.05 QUALITY ASSURANCE

A. Obtain field measurements prior to preparation of shop drawings and fabrication.

B. Aluminum:

1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as accepted and in accordance with recommendations of AWS D1.2.

1.06 DELIVERY STORAGE AND HANDLING

A. Store to avoid damage.

B. Remove material that has become damaged as to be unfit for use.

C. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

1.07 FIELD MEASUREMENTS

A. Verify dimensions and make any field measurements necessary and be fully responsible for accuracy and layout of the work.

B. Review the Contract Drawings and report any discrepancies to the Engineer for clarification prior to starting fabrication.

PART 2 PRODUCTS

2.01 ALUMINUM BAR GRATING

A. Manufacturers:

1. IKG Borden Metal Products Co.; Type S/B.

2. Ohio Gratings, Inc.; Type SG Series.

3. McNichols Co.; GAL Series.

B. Provide aluminum alloy 6063-T6 grating material.

C. Provide 3/16-inch thick bearing bars spaced 1-3/16-inch center to center with cross bars pressure locked on 4 inch centers.

D. Fabricate in standard size sections where possible with a maximum panel weight of no more than 80 pounds.

E. Apply bearing bar banding at ends of grating sections and at fixture or pipe openings where two or more bearing bars are cut.

F. Anchor grating to support members using stainless steel saddle clips, grating clamps, or Z-Clips.

G. Provide top surface with mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Upon receipt of material at job site, inspect all materials for shipping damage. Damaged items shall be replaced at no cost to Owner.

B. Examine supports for size, layout and alignment. Surface shall be free of debris.

C. Correct defects considered detrimental to proper installation.

3.02 PROTECTION

A. Protect aluminum from contact with dissimilar metals, concrete, masonry or mortar. Paint aluminum in contact with concrete in accordance Section 09900. Under no circumstances shall aluminum contact concrete or dissimilar metal.

B. Apply one coat of bituminous paint coating.

C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot water and dry thoroughly.

3.03 INSTALLATION

A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.

B. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.

C. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 09900 PAINTING AND COATING

PART 1 - GENERAL

A. Description

This section includes materials and application of painting and coating systems for the following surfaces:

1. Submerged metal.

2. Exposed metal, including galvanized metal.

3. Buried metal.

4. Concrete and masonry.

5. PVC

6. Metal in contact with concrete.

7. Masonry

8. Exterior architectural coatings and finishes.

9. Interior architectural coatings and finishes.

10. Exposed Conduits and pipes.

It does not include coating steel water tanks and reservoirs.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer’s data sheets showing the following information:

a. Percent solids by volume.

b. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.

c. Recommended surface preparation.

d. Recommended thinners.

e. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.

f. Application instructions including recommended equipment and temperature limitations.

g. Curing requirements and instructions.

3. Submit color swatches.

4. Submit certificate identifying the type and gradation of abrasives used for surface preparation.

5. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

A. Painting and Coating Systems

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	**Title**	**Generic Coating**
Submerged Metal Coating Systems		
1.	Submerged Metal, Raw Water (Nonpotable) or Raw Sewage	Epoxy
2.	Submerged Metal, Raw Water (Nonpotable), Raw Sewage, or Chemical Waste Immersion	Epoxy
6.	Submerged Metal, Raw Sewage or Grit Slurries	Epoxy resin/ceramic
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
10.	Exposed Metal, Corrosive Environment	High-build epoxy with polyurethane topcoat
15.	Exposed Metal, Atmospheric Weathering Environment	Alkyd enamel
17.	Exposed Metal, High Temperature	Silicon acrylic

No.	Title	Generic Coating
18.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Organic zinc
19.	Exposed/Immersed Metal	Epoxy
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy
22.	Buried Metal	Polyurethane
23.	Buried Metal	Thixotropic coal-tar pitch
24.	Buried Metal	Corrosion-resisting grease
Concrete and Masonry Coating Systems		
31.	Exposed Concrete and Masonry, Corrosive Environment	Polyurethane
32.	Exposed Concrete and Masonry, Atmospheric Weathering Environment	Acrylic
33.	Submerged Concrete, Raw Water or Raw Sewage	Vinyl ester
34.	Concrete Floors, Wet Environment	Epoxy
36.	Exposed Concrete and Masonry, Corrosive Environment	High-build epoxy with polyurethane topcoat
37.	Exposed Masonry or Concrete, Atmospheric Weathering Environment	Cement-based grouting
38.	Concrete in Chemical Containment Service	Novalac Epoxy
PVC Coating System		
41.	PVC, Ultraviolet Exposure	Polyurethane
Coating Systems for Nonferrous Metals		
51.	Aluminum Insulation from Concrete and Carbon Steel	Bituminous
52.	Exposed Metal, Galvanized Steel	Synthetic resin
55.	Repair of Galvanized Surfaces	Cold galvanizing compound
Plaster, Wood, Masonry, and Drywall Coating Systems		

No.	Title	Generic Coating
66.	Fusion Epoxy-Coated Steel, Color Coding	Epoxy
Exterior Architectural Coatings and Finishes		
71.	Flat Finish on Exterior Concrete and Cement Plaster	Acrylic latex
72.	Semi-Gloss Finish on Exterior Metal	Acrylic latex
73.	Clear Sealer on Exterior Concrete and Masonry	Silane
Interior Architectural Coatings and Finishes		
81.	Semi-Gloss Finish on Concrete, Masonry, or Plaster	Vinyl acrylic
83.	Semi-Gloss Finish on Gypsum Wallboard	Vinyl acrylic
84.	Flat Finish on Gypsum Wallboard	Vinyl acrylic

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

B. Submerged Metal Coating Systems

1. System No. 1--Submerged Metal—Raw Water (Nonpotable) or Raw Sewage:

   Type: Epoxy having a minimum volume solids of 80%.

   Service Conditions: For use with metal pipes or structures (such as scum troughs, sluice gates, or piping) alternately submerged in raw sewage or raw water (nonpotable) and exposed to a moist saturated hydrogen sulfide atmosphere, as in raw sewage wet wells. Minimum temperature resistance of the coating shall be 140°F for moist heat conditions.

   Surface Preparation: SSPC SP-10.

   Prime Coat: Carboline Carboguard 891HS; Sherwin-Williams Tank Clad HS B62-W80; or Tnemec Series 446-1223 (red), 8 mils.

Finish Coat: Carboline Carboguard 891HS; Sherwin-Williams Tank Clad HS B60-V80; or Tnemec Series 446-1222 (gray), 8 mils.

2. System No. 2--Submerged Metal, Raw Water (Nonpotable) Raw Sewage, or Chemical Waste Immersion:

   Type: Polyamide cured epoxy prime, intermediate, and finish coats.

   Service Conditions: For use with metal pipes or structures (such as tanks, clarifier mechanisms, scum troughs, slide gates) immersed in raw water (nonpotable), raw sewage, or alkaline wastes or acidic wastes having a pH range of 5 to 11.

   Surface Preparation: SSPC SP-10.

   Prime Coat: Carboline Carboguard 891HS; Sherwin-Williams Tank Clad HS B62-W80; or Tnemec Pota-Pox Series N140, 8 mils.

   Intermediate/Finish Coats: One coat of Carboline Carboguard 891HS; Sherwin-Williams Tank Clad HS B60-V80; or one coat of Tnemec Pota-Pox Series N140, 8 mils.

   Total system thickness of prime, intermediate, and finish coats shall be 16 mils minimum.

3. System No. 6--Submerged Metal, Raw Sewage or Grit Slurries:

   Type: Two-component epoxy resin/ceramic having a 100% volume solids and having the following characteristics:

Tensile shear adhesion (ASTM D1002):	2,500 psi (min)
Shore D hardness (minimum):	85
Abrasion resistance (ASTM D4060):	0.8 mg (max) loss per 1,000 cycles

   Service Conditions: For use as a lining for pump volutes, pump impellers, piping, valves, and heat exchanger tubes, subject to severe abrasion service.

   Surface Preparation: SSPC SP-10.

Coating System: Apply two coats (of two different colors) to a minimum thickness of 10 mils per coat. Minimum total coating thickness shall be 20 mils. Product: THORTEX Cerami-Tech C.R. as applied by Western Industrial Technology, Inc., Fullerton, California, or Paragon Industries, Horsham, Pennsylvania; Belzona 1341; or equal.

4. System No. 7--Submerged Metal, Potable or Nonpotable Water:

Type: Epoxy.

Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or nonpotable water. For potable water service, coating must comply with NSF 61.

Surface Preparation: SSPC SP-10.

Coating System: Apply the manufacturer’s recommended number of coats to attain the specified minimum coating thickness. Products: Carboline Carboguard 891HS, Tnemec N140, Sherwin-Williams Tank Clad HS B62-W80/B60-V80, 16 mils total. Color of topcoat: white. Each coat shall be different color than the one preceding it.

C. Exposed Metal Coating Systems

1. System No. 10--Exposed Metal, Corrosive Environment:

Type: High-build epoxy intermediate coat having a minimum volume solids of 60%, with an inorganic zinc prime coat and a pigmented polyurethane finish coat having a minimum volume solids of 52%.

Service Conditions: For use with metal structures or pipes subjected to water condensation; chemical fumes, such as hydrogen sulfide; salt spray; and chemical contact.

Surface Preparation: SSPC SP-10.

Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Carboline Carbozinc 11,

11VOC or 11HS, Tnemec 90-97, or Sherwin-Williams Zinc-Clad II Plus.

Intermediate Coat: Carboline Carboguard 60, Tnemec 104, or Sherwin-Williams Macropoxy 646 B58-600, 5 mils.

Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane recommended by the manufacturer for overcoating a high-build epoxy coating. Apply to a thickness of at least 2 mils. Products: Carboline Carbothane 134HG, Tnemec Series 1075, or Sherwin-Williams Acrolon Ultra, B65-800.

2. System No. 15--Exposed Metal, Atmospheric Weathering Environment:

   Type: Semi-gloss acrylic having a minimum volume solids content of 46% with alkyd primer.

   Service Conditions: For use on exterior metal and piping subject to sunlight and weathering.

   Surface Preparation: SSPC SP-6.

   Prime Coat: Carboline Carbocoat 115, Tnemec Primer Series V10, Sherwin-Williams Kem-Bond HS B50NZ series, applied to minimum dry-film thickness of 2 mils.

   Finish Coat: Two coats of Carboline Carbocrylic 3359, two coats of Tnemec Series 1028, two coats of Sherwin-Williams DTM Acrylic B66 Series. Apply to a minimum dry-film thickness of 1.5 mils per coat.

3. System No. 17--Exposed Metal, High-Temperature Resistant (350°F):

   Type: Silicone acrylic with a minimum volume solids of 30% (ASTM D 2697) with inorganic zinc prime coat.

   Service Conditions: For use on exterior metal piping, such as air blower piping, having a maximum temperature of 350°F.

   Surface Preparation: SSPC SP-10.

   Prime Coat: Two-component inorganic zinc pigmented coating recommended by the manufacturer to be coated with a silicone acrylic topcoat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3

mils. Products: Carboline Carbozinc 11, 11VOC or 11 HS; Sherwin-Williams Zinc-Clad II Plus, B69-VZ12/B69-VZ15/B69-D11; Tnemec 90-96.

Finish Coat: Carboline Thermaline 4900, Flame Control 600, or equal; 1.5 mils

4. System No. 18— Exposed Metal, Organic zinc primer for shop coating and field touch-up

   Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.

   Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.

   Surface Preparation: SSPC SP-10.

   Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Carboline Carbozinc 859, Tnemec 90-97, Sherwin-Williams Corothane I GalvaPac B65G11; applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

5. System No. 19--Exposed/Immersed Metal:

   Type: Epoxy having a minimum solids content of 55% by volume.

   Service Conditions: For use with metal (steel, iron) such as canal gates, slide gates, and dam gates alternately immersed in raw water and exposed to an atmospheric weathering environment.

   Surface Preparation: SSPC SP-5.

   Prime Coat: Apply Carboline Carboguard 891HS (gray), Tnemec Series 1 Omnithane, Sherwin-Williams Macropoxy 646 (gray), to a minimum dry-film thickness of 5 mils.

   Finish Coat: Apply Carboline Carboguard 891HS (white), Tnemec Series 446-1222 (Gray), or Sherwin-Williams Macropoxy 646 (white), to a minimum dry-film thickness of 6 mils.

D. Buried Metal Coating Systems

1. System No. 21--Buried Metal:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Apply three or more coats of Carboline Carboguard 891HS, Tnemec 104HS, Sherwin-Williams Tank Clad HS B62-W80/B60-V80; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2. System No. 22--Buried Metal:

Type: Two-component polyurethane having the following characteristics:

a. Coatings shall contain no tar or hydrocarbon additives or solvent.

b. Hardness (ASTM D2240, Shore "D"): 65 to 85.

c. Abrasion Resistance (ASTM D4060, Taber CS-17): 25 mg (maximum) loss per 1,000 cycles or a maximum loss of 65 mg per ASTM C501.

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Carboline Polyclad 767, Madison Chemical Industries, Inc. Corrocote Plus (CM), Sherwin-Williams Poly-Cote 115. Apply to a total thickness of 30 mils.

3. System No. 23--Buried Metal:

Type: Thixotropic, coal-tar pitch having a minimum volume solids of 68% and complying with MIL-C-18480A.

Service Conditions: Buried metal, such as flanges, nuts and bolts, fittings, structural steel especially

subjected to corrosive conditions, such as acidic groundwater.

Surface Preparation: SSPC SP-10.

Prime Coat: Not required.

Finish Coat: Apply two coats of Carboline Bitumastic 50, 15 mils each; two or more coats of Tnemec 46-465, to a total thickness of 30 mils; or equal.

4. System No. 24--Buried Metal:

Type: Corrosion-resisting grease.

Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.

Surface Preparation: SSPC SP-3 or SP-6.

Coating: NO-OX-ID “GG-2” as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4-inch.

E. Concrete and Masonry Coating Systems

1. System No. 31 - Exposed Concrete and Masonry, Corrosive Environment

Type: two-component, minimum 98% solids, polyurethane, with primer having the following characteristics.

Tensile Strength on Concrete:	2,500 psi (minimum) per ASTM D412
Flexibility:	No effect bending 0.50 mm plate with 30-mil coating over 1/8-inch mandrel per ASTM D1737 or no effect bending 180 degrees over 1-inch mandrel with 15-mil coating per ASTM D522
Elongation:	50% (minimum) recoverable, per ASTM D412
Surface Hardness:	60 minimum, Shore "D" per ASTM D2240

Abrasion Resistance:	Weight loss of 80 mg (maximum) on Taber abraser, CS-17 wheel, 1,000 grams, 1,000 cycles per ASTM D4060

Service Conditions: Buried concrete and concrete submerged in raw wastewater and exposed to an atmosphere containing up to 1,000-ppm hydrogen sulfide, saturated with water vapor.

Surface Preparation: Prepare surface in accordance with ASTM D4259 to create a surface profile equal to ICRI CSP 5 or greater.

Concrete Resurfacing: Apply Carboguard 510, Tnemec Series 218 Mortarclad, or Sherwin-Williams Corobond 300 B58A310/B58V310/B58D310 to all surfaces at an average of 1/16-inch to fill voids and bugholes, restore surface to a paintable condition and to mitigate concrete outgassing.

Product: Carboline Primer (Self priming when concrete is dry. Use Carboguard 1340WB, Phenoline 311, Carboguard 690 or Plasite 4503 as primer when concrete is damp) with Carboline Reactamine 760; Sherwin-Williams Primer (Dura-Plate 235, B67-V235 Series) with Sherflex B65-V910 topcoat; Tnemec Series 27WB Primer with Tnemec Series 406 Elastoshield. Apply prime coat and finish coats to give a total dry coating thickness of at least 80 mils on walls and 125 mils on floor or ceiling slabs.

2. System No. 32--Exposed Concrete and Masonry, Atmospheric Weathering Environment:

Type: Acrylic enamel or acrylic latex having a minimum volume solids of 36%.

Service Conditions: Exposed concrete or masonry exposed to normal sunlight and weathering.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

Prime Coat: Water-borne acrylic or cementitious acrylic emulsion having a minimum solids volume of 40%. Apply one coat of Carboline Sanitile 100 to fill all voids,

pores, and cracks; Tnemec 1254 Masonry Filler; Sherwin-Williams Heavy Duty Block Filler B42W46; to masonry only from 75-125 square feet per coat.

Finish Coat: Two coats of Carboline Carbocrylic 3359, two coats Tnemec Series 6, Sherwin-Williams DTM Acrylic Coating Semi-Gloss B66-100 series. Apply to a thickness of 2 mils per coat.

3. System No. 33--Submerged Concrete, Raw Sewage or Raw Water:

   Modified aliphatic amine epoxy mortar, followed by Modified Polyamine Epoxy Topcoat. Must pass ASTM C 868 (Atlas Cell), no blistering, cracking, erosion, softening, loss of adhesion or gloss loss after 100 days continuous immersion at 100 deg f in 25% Sulfuric Acid. Not less than 12,331 psi Compressive Strength (ASTM D 695) (mortar), and not less than 9,427 psi Compressive Strength (ASTM D 695) (finish coat).

   Service Conditions: Concrete submerged in raw sewage and structures containing moist hydrogen sulfide such as manholes and sewage pumping station wet wells.

   Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.” Prepare surface in accordance with ASTM D4259 to create a surface profile equal to ICRI CSP 5 or greater.

   Concrete Resurfacing: Apply Carboguard 510, Tnemec Series 218 Mortarclad, or Sherwin-Williams Corobond 300 B58A310/B58V310/B58D310 to all surfaces at an average of 1/16-inch to fill voids and bugholes, restore surface to a paintable condition and to mitigate concrete outgassing.

   a. Prime Coat: Apply Carboline Plasite 5371; Tnemec Series 434 Perma-Shield H2S, or Cor-Cote SC Plus Mortar, 125 mils DFT.

   b. Finish Coat: Apply Carboline Plasite 4500S; Tnemec Series 435 Perma-Glaze; or Cor-Cote SC Plus; 15-20 mils DFT.

4. System No. 34--Concrete Floors, Wet Environment:

Type: Polyamide cured epoxy having a minimum volume solids of 53%.

Service Conditions: Concrete floors subject to pedestrian traffic or exposure to water splashing from pump seal water, cleaning, etc.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

Coating System: Two coats of Carboline Carboguard 890, two coats of Tnemec Series N69, two coats of Sherwin-Williams Macropoxy 646 B58-600 series. Apply to a minimum dry-film thickness of 5 mils per coat.

5. System No. 36--Exposed Concrete and Masonry, Corrosive Environment:

Type: High-build epoxy intermediate coat having a minimum volume solids of 60%, with an epoxy filler prime coat and a pigmented polyurethane finish coat.

Service Conditions: Concrete and masonry block exposed to corrosive atmospheres, such as hydrogen sulfide gas, chlorine gas, or chlorinated effluent sprays in wastewater treatment plants.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

Prime Coat: Epoxy filler compound or epoxy masonry filler having a minimum solids volume of 60%. Apply one coat to fill voids, pores, and cracks in masonry only. Products: Carboline Sanitile 600, Tnemec 1254, Sherwin-Williams Kem Cati-Coat HS B42 W400 series.

Intermediate Coats: Carboline Carboguard 890, Tnemec 104, Sherwin-Williams Macropoxy 646 B58-600 series. Apply multiple coats to a total minimum thickness of 15 mils. Thickness of any single coat shall not exceed 6 mils.

Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane recommended by the manufacturer for overcoating a high-build epoxy coating. Minimum volume of solids shall be 52%. Apply to a thickness of

at least 2 mils. Products: Carboline Carbothane 134HG, Tnemec Series 1075, Sherwin-Williams Acrolon Ultra B65-800 series.

6. System No. 37--Exposed Masonry or Concrete, Atmospheric Weathering Environment:

   Type: Cement-base, waterproofing grouting for concrete and masonry.

   Service Conditions: For use in waterproofing concrete, block, brick, stone, and other masonry.

   Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.” Dampen surface immediately ahead of application with clean water. Follow manufacturer’s instructions on mixing and application.

   Coatings: Apply two or more coats of Bonsal Sure-Coat to minimum total thickness of 1/16 inch or evenly distribute a base coat of Thoro Systems Products “Thoroseal” or equal, minimum 2 pounds per square yard. Then apply another coat at 1 pound per square yard for a total of 3 pounds per square yard.

7. System No. 38--Novalac Epoxy

   Type: 100% solids Novalac epoxy coating system. Water vapor transmission shall not exceed 0.0120 grain per hour per square foot per ASTM E 96. Permeability shall not exceed 0.0042 perm-inch.

   Service Conditions: Concrete submerged or intermittently exposed to 93% Sulfuric Acid, 25% Sodium Hydroxide and 100% Scale Inhibitor at a maximum temperature of 120°F.

   Secondary containment area concrete surfaces including floor, ramps, Equipment pads, sump pumps, and walls. Mix or broadcast sand or other fine material into coating as recommended by coating manufacturer for floor and stair tread surfaces where foot traffic is prevalent.

   Surface Preparation: SSPC SP13

   Concrete Resurfacing (as required): Apply Carboguard 510 blended with Portland cement (Type 1) and sand, Tnemec Series 218 Mortarclad or Sherwin-Williams Corobond 300

B58A310/B58V310/B58D310 to all surfaces at an average of 1/16-inch to fill voids and bugholes, restore surface to a paintable condition and to mitigate concrete outgassing.

Prime Coat: Apply Carboline “Semstone 110”, Tnemec 201 epoxy primer, or Sherwin-Williams Corobond 100 Epoxy Primer to a thickness of at least 8 mils DFT.

Apply filler and prime coat with roller or squeegee so that exposed aggregate is covered and the surface is level with the surrounding concrete.

Finish Coats: Apply one or more coats to a total thickness of 80 mils minimum. Observe manufacturer's recommended recoating time between coats. Products: Carboline Semstone 145 AFC, Tnemec 252SC-MK, Sherwin-Williams Cor-Cote HCR with 19lbs. Type S aggregate per 1.25 gallons @ 60.0-65.0 mils DFT. Topcoat with 1 coat of Cor-Cote HCRFF @ 10.0-15.0 mils DFT.

F. PVC Coating Systems

1. System No. 41-Color Coding of PVC exposed to sunlight

Type: Epoxy primer with a minimum volume solids of 54% and a pigmented polyurethane enamel having a minimum volume solids of 52%.

Service Conditions: Color coding of PVC exposed to sunlight.

Surface Preparation: SSPC SP-1. Then lightly abrade the surface with medium-grain sandpaper.

Prime Coat: One coat of Carboline Carboguard 60, Tnemec Series N69 Epoxoline, Sherwin-Williams Macropoxy 646 B58 series. Apply to a minimum dry-film thickness of 4 mils.

Finish Coat: One coat of Carboline Carbothane 134HG, Tnemec Series 1075, Sherwin-Williams Acrolon Ultra B65-800 series. Apply to a minimum dry-film thickness of 3 mils.

G. Coating Systems for Nonferrous Metals

1. System No. 51--Aluminum Insulation from Concrete and Carbon Steel:

Type: Bituminous paint having a minimum volume solids of 68% coal-tar pitch based.

Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

Surface Preparation: Solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Prime Coat: No primer required for Carboline or Tnemec.

Finish Coat: Carboline Bitumastic 50, Tnemec 46-465, or equal. Apply two coats to a minimum dry-film thickness of 12 mils each.

2. System No. 52--Exposed Metal, Galvanized Steel:

Type: Synthetic resin or epoxy primer.

Service Conditions: Coat galvanized steel and aluminum surfaces with this system before applying topcoat.

Surface Preparation of Galvanized Steel: Surfaces shall be flat with no protrusions. Remove high spots and tears in the galvanizing with hand and power grinders. Comply with ASTM D6386, paragraph 5.2.1. Do not remove the galvanized coating below the specified thickness. Solvent clean galvanized surfaces per ASTM D6386, paragraph 5.3.2. Then sweep blast per ASTM D6386, paragraph 5.4.1. Use one of the abrasive materials that is described in ASTM D6386, paragraph 5.4.1. Surface preparation for weathered and partially weathered galvanized steel shall be in accordance with ASTM D6386, paragraphs 6 and 7. Apply prime coating within one hour of the surface preparation.

Surface Preparation of Aluminum: Solvent clean or steam clean aluminum surfaces per SSPC SP-1; do not use alkali cleaning. Prime Coat: Carboline Galoseal WB, Tnemec N69-1211, Sherwin-Williams Macropoxy 646 B58-600 series. Apply to a minimum thickness of 4 mils.

Intermediate and Finish Coats: Epoxy and polyurethane as described in System No. 10. Do not include the inorganic zinc prime coat described in that system.

3. System No. 55--Repair of Galvanized Steel Surfaces:

Type: Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90%.

Service Conditions: Repair of damaged galvanized coatings on steel surfaces. Do not utilize if galvanized steel is being topcoated.

Surface Preparation: Clean damaged surfaces per SSPC SP-1 and SP-11.

Coating System: Apply Z.R.C. Galvanizing Compound, RAMCO Specialty Products “Zinckit,” NuWave “Galv-Match-Plus,” Devcon “Cold Galvanizing,” or Clearco “Cold Galvanizing Spray,” to a minimum dry-film thickness of 3 mils. Apply per ASTM A780, Annex A2.

H. Plaster, Wood, Masonry, and Drywall Coating System

1. System No. 66--Fusion Epoxy-Coated Steel, Color Coding:

Type: Epoxy having a minimum volume solids content of 60%.

Application: Color coding of pipe or steel surfaces already coated with fusion bonded epoxy.

Surface Preparation: SSPC SP-1. Then roughen the epoxy surface with power tool cleaning per SP-3 or a light sandblast per SP-7.

Prime Coat: None.

Finish Coat: One coat of Carboline Carboguard 890, Tnemec 104, or Sherwin-Williams Macropoxy 646 B58-600 series. Apply to a minimum dry-film thickness of 5 mils.

I. Exterior Architectural Coatings and Finishes

1. System No. 71--Flat Finish on Exterior Concrete and Cement Plaster:

Type: Acrylic flat with minimum volume solids of 40% with an epoxy acrylic sealer prime coat.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

Prime Coat: Carboline Sanitile 120, Tnemec Series 6; or equal; 2 to 3 mils.

Intermediate Coat: Carboline Sanitile 155, Sherwin-Williams Loxon Conditioner, or equal; 2 mils.

Finish Coat: Two coats, 1.5 mils dry each, or one coat, 3 mils total, of Carboline Sanitile 155, Sherwin-Williams A-100 A6 series, or Tnemec Series 6.

2. System No. 72--Semi-Gloss Finish on Exterior Metal:

   Type: Acrylic semi-gloss enamel with minimum volume solids of 35% with an acrylic or water-based inorganic zinc silicate metal primer.

   Surface Preparation: Exterior exposed galvanized surfaces shall be sweep abrasive blasted per ASTM D6286 to achieve a uniform anchor profile (1 – 2 mils).

   Prime Coat: Carboline Carbocrylic 3358 (ferrous) and Galoseal WB; Tnemec Series 18, or Sherwin-Williams Pro-Cryl Universal Primer B66W310; 3 mils.

   Finish Coat: Two coats, 1.5 mils dry each, of Carboline Carbocrylic 3359, Tnemec Series 1029, or Sherwin-Williams Metalatex B42-100.

3. System No. 73--Clear Sealer on Exterior Concrete and Masonry:

   Type: Silane with minimum solids of 22%.

   Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.”

   Prime Coat: One coat Carboline Carbocrete Sealer WB, one coat Prime-A-Pell, one coat Monochem Silane 20 Penetrating Sealer or Hydrozo Enviroseal 7, two coats Okon Block Plugger, one coat Rainstopper 140 or one coat

of Sherwin-Williams Loxon 40% A31T40. Apply at 80 square feet per gallon.

Finish Coat: One coat Carboline Carbocrete Sealer WB, one coat Prime-A-Pell, two coats Hydrozo Enviroseal 7, one coat Okon W-2, one coat Rainstopper 140 or one coat of Sherwin-Williams Loxon 40% A31T40. Apply at 80 square feet per gallon.

J. Interior Architectural Coatings and Finishes

1. System No. 81--Semi-Gloss Finish on Concrete, Masonry, or Plaster:

Type: Acrylic semi-gloss enamel with minimum volume solids of 30% with an acrylic primer-sealer.

Surface Preparation: In accordance with Part 3, subsection on “Preparation of Concrete and Masonry Surfaces To Be Coated.” Apply one coat of Carboline Sanitile 100 to fill all voids, pores, and cracks; Tnemec 1254 Masonry Filler; or Sherwin-Williams Heavy Duty Block Filler B42W46; to masonry only from 75-125 square feet per coat.

Prime Coat: Carboline Sanitile 120, Tnemec Series 6, or Sherwin-Williams DTM Acrylic B66 Series; 2 mils.

Finish Coat: Two coats, 1.5 mils dry each, of Carboline Carbocrylic 3359, Tnemec Series 1029, or Sherwin-Williams DTM Acrylic B66 Series.

2. System No. 83--Semi-Gloss Finish on Gypsum Wallboard:

Type: Acrylic semi-gloss enamel with minimum volume solids of 45% with an acrylic primer with minimum volume solids of 55%.

Surface Preparation: Surfaces shall be dry, clean, and free of contaminants. Sand joint compound smooth and feather edges.

Prime Coat: Carboline Sanitile 120, Tnemec PVA Sealer 51, or Sherwin-Williams Prep Rite B28W400; 1.4 mils.

Finish Coat: Two coats, 1.5 mils dry each, Carboline Carbocrylic 3359, Tnemec Series 1029, or Sherwin-Williams Pro Mar 200S/G B31W200.

3. System No. 84--Flat Finish on Gypsum Wallboard:

   Type: Acrylic flat with minimum volume solids of 29%, with a vinyl acrylic latex primer with minimum volume solids of 55%.

   Surface Preparation: Surfaces shall be dry, clean, and free of contaminants. Sand joint compound smooth and feather edges.

   Prime Coat: Carboline Sanitile 120, Tnemec PVA Sealer 51, or Sherwin-Williams Prep Rite B28W400; 1.5 mils.

   Finish Coat: Two coats, 1.5 mils dry each, of Carboline Sanitile 155, Tnemec Series 6, or Sherwin-Williams Pro Mar 200 Flat B30W200.

K. Abrasives for Surface Preparation

1. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:

   a. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.

   b. 20 to 40 mesh garnet.

   c. Crushed iron slag, 100% retained on No. 80 mesh.

   d. SAE Grade G-40 or G-50 iron or steel grit.

2. Abrasives used for preparation of copper and aluminum surfaces shall be one of the following:

   a. Crushed slag, 80 to 100 mesh.

   b. Very fine silica sand, 80 to 100 mesh.

3. Abrasives used for preparation of concrete and masonry surfaces shall be 16 to 30 or 16 to 40 mesh silica sand.

4. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

L. Organic Zinc Primer for Field Touch-Up and Shop Coating

Where shop-applied inorganic zinc primers cannot be used because of volatile organic compound (VOC) regulations, the

organic zinc primer described in System No. 18 may be substituted for the specified inorganic zinc primers.

PART 3 - EXECUTION

A. Weather Conditions

1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.

2. Do not apply paint when the relative humidity is above 85%.

3. Do not paint when temperature of metal to be painted is above 120°F.

4. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.

5. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

B. Surface Preparation Procedures

1. Prior to any painting, areas to be painted shall have a walk through inspection with the RPR. All corrective work shall be performed prior to the start of the painting process.

2. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.

3. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

4. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.

5. Do not abrasive blast PVC piping or equipment. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.

6. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.

7. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

8. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council), surface preparation specifications listed above.

9. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to

the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.

10. Brush-off blasting of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.

11. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner's Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner's Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner's Representative.

12. Do not apply any part of a coating system before the Owner's Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner's Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

13. Examine substrates, areas and conditions, with Applicator and factory representative present for compliance with requirements for paint application. Comply with procedures in PDCA P4.

    a. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

    b. Start of painting will be construed as Factory Representative and Applicator's acceptance of surfaces and conditions within a particular area.

    c. Factory Representative will provide documentation of acceptance of substrates prior to the application of coating.

14. On flanged pipe joints, trim excess gasket material and caulk joint prior to coating.

C. Abrasive Blast Cleaning

1. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.

2. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.

3. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.

4. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

D. Preparation of Concrete and Masonry Surfaces To Be Coated

1. Surface preparation of concrete and masonry surfaces shall be in accordance with SSPC SP-13 and the following.

2. Do not apply coating until concrete has cured at least 30 days. Finish concrete surfaces per Section 03350. Do not use curing compound on surfaces that are to be coated.

3. Concrete and masonry surfaces on which coatings are to be applied shall be of even color, gray or gray-white. The surface shall have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff-bristle fiber brush shall produce no dusting or dislodging of cement or sand. Sprinkling water on the surface shall produce no water beads or standing droplets. Concrete and masonry shall be free of laitance and slick surfaces.

4. Detergent clean the concrete or masonry surface with trisodium phosphate per ASTM D4258. Then sandblast surfaces (brush-off blast). Floor slabs may be acid etched per ASTM D4260 in lieu of sandblasting. After sandblasting, wash surfaces with water to remove dust and salts, per ASTM D4258 or D4261. The grain of the concrete surface to touch shall not be rougher than that of No. 10 mesh sand.

5. Prior to coating concrete, plaster, and masonry with System No. 31, 32, 33, 34, or 36, determine the presence of capillary moisture per ASTM D4263, except as modified below. Tape a 4-foot by 4-foot sheet of polyethylene plastic to the concrete surface to be coated. Allow the plastic sheet to remain in place at least 24 hours. After the specified time has elapsed, remove the plastic sheet and visually examine both the underside of the plastic sheet and the concrete surface beneath it. There shall be no indication of moisture on either surface. If moisture is indicated, allow additional curing time for the concrete and then retest. Provide one test sheet for every 500 square feet of concrete surface to be coated. For walls, provide one test sheet for each 10 feet (or fraction thereof) of vertical rise in all elevations starting within 12 inches of the floor or base slab.

6. Acceptance criteria for concrete surfaces shall be in accordance with SSPC SP-13, Table 1, “Severe Service.”

7. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable, not rising.

E. Procedures for Items Having Shop-Applied Prime Coats

1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.

2. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.

3. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

F. Field Touch-Up of Shop-Applied Prime Coats

1. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

2. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.

3. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.

4. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.

5. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive

particle sizes, short blast nozzle distance from surface, shielding, and/or masking.

6. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.

7. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer per System No. 18 to cover scratches or abraded areas.

8. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

G. Painting Systems

1. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

2. Deliver paints to the jobsite in the original, unopened containers.

H. Paint Storage and Mixing

1. Store and mix materials only in areas designated for that purpose by the Owner’s Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post “No Smoking” signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.

2. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional

components for reasons of color or otherwise, even within the same generic type of coating.

I. Procedures for the Application of Coatings

1. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

2. Prior to painting, Contractor shall verify that conditions meet coating Manufacturer's weather conditions in presence of the Owner. Information form shall be completed daily and at four (4) hour intervals during the work day.

3. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

4. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.

5. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.

6. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.

7. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

8. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

9. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.

10. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.

11. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.

12. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

J. Surfaces Not To Be Coated

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

1. Concrete walkways.

2. Mortar-coated pipe and fittings.

3. Stainless steel.

4. Metal letters.

5. Glass.

6. Roofings.

7. Fencing.

8. Electrical fixtures except for factory coatings.

9. Nameplates.

10. Grease fittings.

11. Brass and copper, submerged.

12. Buried pipe, unless specifically required in the piping specifications.

13. Fiberglass items, unless specifically required in the FRP specifications.

14. Aluminum handrail, stairs, and grating.

15. Insulated pipe.

K. Protection of Surfaces Not To Be Painted

Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

L. Surfaces To Be Coated

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as “corrosive environment,” “buried metal,” or “submerged metal.” Coat surfaces with the specific coating systems as described below:

1. Coat mechanical equipment, such as pumps, blowers, clarifier mechanisms, as described in the various mechanical equipment specifications. Color of finish coat shall match the color of the connecting piping.

2. Coat aboveground and exposed piping or piping in vaults and structures as described and as shown in the Piping Schedule/flow stream identification in the drawings. Color of finish coat shall be as shown in the Piping Schedule/flow stream identification in the drawings.

3. Coat submerged steel and ductile iron piping and piping in wet wells per System No. 1.

4. Coat valves the same as the adjacent piping. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.

5. Coat aluminum surfaces in contact with concrete per System No. 51.

6. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, and valve boxes per System No. 21. Coat buried bolt threads, tie bolt threads, and nuts per System No. 24.

7. Coat exposed indoor electrical conduit per System No. 52. Color of finish coat shall be specified by Owner.

8. Coat flashing and sheet metal per Section 07710.

9. Coat hollow metal doors and frames per Section 08110.

10. Coat gypsum wallboard as shown in the finish schedule in the drawings, system 81. Color of finish coat shall be as shown on the finish schedule in the drawings.

11. Concrete Coating Schedule:

    The following coating schedule is a general table to aid the General Contractor in describing the coating system to be applied within the major structures. The Contractor shall be responsible to reference the remainder of the Contract Documents for all other areas that require coating. Not all structures to be coated are identified within the following table.

Process Number(s)	Process Name	Exterior		Interior
		Below Grade	Above Grade	
065	NWRF Disk Filters	N/A	N/A	System 33
570	EWRF Disk Filters	N/A	N/A	System 33

12. If no coating system is specified for new structures provide coatings in accordance with the following:

Surface or Item	Coating System No.
Exposed interior concrete surfaces	31
Exposed exterior concrete surfaces	32
Interior masonry surfaces	81
Exterior masonry surfaces	71
Clear Sealer on Exterior Concrete & Masonry	73

M. Dry-Film Thickness Testing

1. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for aluminum with an eddy-current type thickness gauge per ASTM D1400. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.

2. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide

detector as manufactured by Tinker and Rasor or K-D Bird Dog.

3. Measure coating thickness specified for concrete or masonry surfaces in accordance with ASTM D4138. Test the finish coat of concrete and masonry surfaces in accordance with NACE RP-0188-90 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.

4. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

5. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.

6. For concrete surfaces, make five separate spot measurements spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness.

7. Perform tests in the presence of the Owner’s Representative.

8. All completed surfaces will be checked by the Owners Representative, and the Contractor shall provide the necessary properly calibrated gauges and the Contractor shall provide scaffolding and ladders as necessary for access to all coated areas. All nonferrous surfaces

shall be checked for number of coats and thickness by use of a Tooke gauge. All ferrous surfaces shall be checked for film thickness by use of a magnetic dry film gauge properly calibrated. In addition, submerged tank linings and metals shall be tested for freedom from holidays and pinholes by use of a TinkerRasor Model # M1. All defects shall be corrected to the satisfaction of the Owners Representative. Contractor shall provide two (2) each of the following equipment with all appurtenances to be retained by the owner: Bacharach Sling Psychrometer, wet film thickness gauges appropriate to coating system thickness, TinkerRasor Holiday detector Model # M1, Tooke gauge and DeFelsko Positector No. 6000 or Elcometer dry film thickness gauge for ferrous metals with plastic shims.

N. Repair of Improperly Coated Surfaces

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

O. Cleaning

1. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day’s work.

2. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.

3. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

SECTION 09954 POLYETHYLENE SHEET ENCASEMENT (AWWA C105)

PART 1 - GENERAL

A. Description

This section includes materials and installation of a polyethylene sheet encasement for buried steel and iron pipe, fittings, and valves.

B. Submittals

1. Submit shop drawings in accordance with General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog literature and product data sheets describing the physical, chemical, and electrical properties of the encasement material.

PART 2 - MATERIALS

A. Polyethylene Wrap

1. The encasement shall consist of color coded low-density polyethylene wrap of at least 8-mil thickness conforming to AWWA C105. The polyethylene wrap shall be colored per process___where possible, refer to flow stream identification in the drawings.

2. Polyethylene encasement for ductile-iron pipe shall be supplied as a flat tube meeting the dimensions of Table 1 in AWWA C105 and shall be supplied by the ductile-iron pipe manufacturer.

B. Plastic Adhesive Tape

1. Tape shall consist of polyolefin backing and adhesive which bonds to common pipeline coatings including polyethylene.

2. Minimum Width: 2 inches.

3. Products: Canusa Wrapid Tape; Tapecoat 35; Polyken 934; AA Thread Seal Tape, Inc.; or equal.

PART 3 - EXECUTION

A. Applying Sheet Coating to Buried Piping and Fittings

1. Apply wrapping per AWWA C105 as modified herein.

2. Apply a single wrapping.

3. Install the polyethylene to completely encase the pipe and fittings to provide a watertight corrosion barrier. Continuously secure overlaps and ends of sheet and tube with polyethylene tape. Make circumferential seams with two complete wraps, with no exposed edges. Tape longitudinal seams and longitudinal overlaps, extending tape beyond and beneath circumferential seams.

4. Wrap bell-spigot interfaces, restrained joint components, and other irregular surfaces with wax tape or moldable sealant prior to placing polyethylene encasement.

5. Minimize voids beneath polyethylene. Place circumferential or spiral wraps of polyethylene tape at 2-foot intervals along the barrel of the pipe to minimize the space between the pipe and the polyethylene.

6. Overlap adjoining polyethylene tube coatings a minimum of 1 foot and wrap prior to placing concrete anchors, collars, or supports. Hand wrap the polyethylene sheet, apply two complete wraps with no exposed edges to provide a watertight corrosion barrier, and secure in place with 2-inch-wide plastic adhesive tape.

B. Applying Sheet Coating to Buried Flexible Pipe Couplings

1. Wrap irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.

2. Apply two layers or wraps around the coupling. Overlap the adjoining pipe or fitting a minimum of 1 foot and secure in place with tape. Provide sufficient slack in polyethylene to allow backfill to be placed around fitting without tearing polyethylene. Apply tape around the entire circumference of the overlapped section on the adjoining pipe or fitting in two complete wraps,

with no exposed edges, to provide a watertight corrosion barrier.

C. Repair of Polyethylene Material

Repair polyethylene material that is damaged during installation. Use polyethylene sheet, place over damaged or torn area, and secure in place with 2-inch-wide plastic adhesive tape.

D. Applying Sheet Coating to Existing Buried Piping

When connecting polyethylene-encased pipe or fittings to existing pipe, expose existing pipe, thoroughly clean the surface, and securely tape the end of the polyethylene to the existing as specified above. When the existing pipe is polyethylene encased, wrap new polyethylene encasement over the existing, with overlap of at least 2 feet. Tape securely as specified above.

E. Backfill for Polyethylene-Wrapped Pipe, Valves, and Fittings

Place sand backfill within 1 foot of the pipe, valves, and fittings wrapped with polyethylene encasement per Section 02223.

F. Repair of Polyethylene at Service Taps

1. Wrap two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted.

2. Mount the tapping machine on the pipe area covered by the polyethylene tape. Then make the tap and install the corporation stop directly through the tape and polyethylene.

3. After making the direct service connection, inspect the entire circumferential area for damage and make repairs.

4. To minimize the possibility of dissimilar metal corrosion at service connections, wrap the corporation stop a minimum clear distance of 3 feet of copper service pipes with polyethylene or dielectric tape.

END OF SECTION

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SECTION 09961 FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 - GENERAL

A. Description

This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100% solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves, slide gates, and structural steel.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following;

2. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.

3. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 - MATERIALS

A. Piping and Equipment Surfaces

1. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.

2. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

B. Shop-Applied Epoxy Lining and Coating

Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red, or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

C. Field-Applied Epoxy Coating for Patching

Use a two-component, 80% solids liquid resin, such as Scotchkote 306.

D. Painting and Coating of Grooved-End and Flexible Pipe Couplings

Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 - EXECUTION

A. Shop Application of Fusion-Bonded Epoxy Lining and Coating--General

1. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.

2. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp

corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

3. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.

4. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

5. After cleaning and surface preparation, test the surface for residual chloride concentration. If the residual chloride concentration exceeds 5 $\mu g/cm^2$, then apply a phosphoric acid wash to the surface after sandblasting. Apply a phosphoric acid wash to the pipe, item, or piece of equipment after sandblasting. The average temperature, measured in three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be a 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the surface shall be determined by using the average temperature as tabulated below:

Surface Temperature (°F)	**Contact Time (seconds)**
80	52
85	45
90	36
95	33
100	28
105	24
110	21
130	10

After the acid wash has been completed, remove the acid with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

6. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall

not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

B. Shop Application of Fusion-Bonded Epoxy Lining and Coating to Pipe--Additional Requirements

1. Apply lining and coating per AWWA C213 except as modified herein.

2. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

C. Shop Application of Fusion-Bonded Epoxy Lining and Coating to Joint Areas of Ductile-Iron and Cast-Iron Fittings--Additional Requirements

Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

D. Quality of Lining and Coating Applications

The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

E. Factory Testing of Coating--General

1. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is less than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.

2. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value.

Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

F. Factory Testing of Lining and Coating of Pipe--Additional Requirements

Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

G. Field Repairs

Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80% solids (minimum), and liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply a two-part epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END OF SECTION

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SECTION 11399 DISK FILTERS AND APPURTENANCES

PART 1 - GENERAL

A. Description

Install tertiary disk filters units to both the NWRF and EWRF sites. The NWRF site will receive six (6) disk filter units and the EWRF site will receive five (5) disk filter units. A disk filter unit shall consist of the items listed in Part 2 A. of this specification. Contractor shall be responsible for partial installation of filter equipment and appurtenances onto the Filter unit such as, but not limited to; backwash pumps, valves, and piping in order to supply a complete functioning unit.

B. References

1. American Society for Testing and Materials International (ASTM):

   a. A48: Specification for Gray Iron Castings.

   b. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

2. National Electrical Manufacturers Association (NEMA):

   a. MG1: Motors and Generators.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

   a. Below shop drawings have been previously submitted under separate contract. Contractor shall coordinate with disk filter manufacturer to obtain approved submittals for reference during installation.

2. Submit manufacturer’s catalog data and descriptive literature and detail drawings showing all disk filter equipment, parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each piece of

equipment by tag number to which the catalog data and drawings pertain. Mark out inapplicable options.

3. Submit dimensional sketches of all equipment supplied. Show arrangement of equipment components including drive and motor, weirs, pumps, valves, instruments, piping connections, and supports.

4. Submit weight of equipment mounted on base and weights of all components.

5. Hydraulic performance data showing the relationship of head loss versus flow. Data based upon other manufacturer's data is not acceptable.

6. Submit performance data as specified below.

7. Shop and field inspection reports.

8. Submit motor data as specified in Section 16150.

9. Submit electrical drawings. Show wiring, controls, interlocks, terminals, and disconnects. Label each terminal, showing which control or electrical power wire connects to each terminal.

10. Provide elevation views of interior and exterior of all panels.

11. Submit list of spare parts to be supplied with the project in accordance with this specification.

12. Operation and Maintenance Manuals per Section 01300 with installation instructions, operation and start-up procedures including lubrication requirements and a complete bill of materials for all equipment.

13. Submit six (6) copies of a written report prepared by the manufacturer certifying that the equipment has been properly installed, lubricated, and test run.

14. Qualification/Installations meeting the requirements of Section 11399 Part 1. F.

    a. Provide current (verified) contact information for each installation.

    b. Provide number of filter units and average daily flow and peak flow per filter unit per facility.

c. Provide design and peak loading rates (gpm/sf) for peak hour and average day flow rates.

15. Installation Contractor shall submit as part of this contract the following submittals to the Engineer for review and approval. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

    a. Submit detailed drawings indicating all pipe, dimensions, equipment, required to install Vendor provided disk filters in the existing structure and piping is show on the Contract Documents.

    b. Submit electrical drawings from Vendor provided Control Panels to Existing MCC's. Coordination with Vendor and Owner shall be required.

    c. Submit a detailed start-up and testing plan that identifies proposed start-up and testing schedule. Identify coordination with Vendor, Owner and Staff, and Integrator that will be present. Indicate how Secondary Effluent test water will be supplied during testing, reject water routing, and coordination of Operations Staff for valve manipulation to correctly move water as required.

D. Quality Assurance

1. Equipment specified shall be the product of one manufacturer.

2. Obtain filters, panels, backwash pumps, valves and controls regardless of manufacturer, as a complete integrated package to ensure proper coordination, compatibility and operation of the system.

3. Equipment specified shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

4. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

5. Shop tests as specified.

E. Delivery, Storage and Handling

1. Comply with the manufacturer’s recommendations.

2. The disk filters purchased under separate contract are to be installed as part of this contract. Fabrication and delivery of the Disk Filter Units shall be the responsibility of the Manufacturer. Installation, maintenance during storage, and unloading of filters and equipment during delivery shall be the responsibility of the Contractor, and properly coordinated with Manufacturer and Owner.

3. Both NWRF and EWRF disk filters will be stored on site at predetermined locations, once immediate project sites have been prepared for installation, as part of this contract, the installation Contractor shall coordinate with Owner for removal of equipment as needed. The filter delivery costs shall be the responsibility of the Disk Filter Manufacturer. The installation of the filter units shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

A. System Description

1. Disk filter system capacities and operating data are indicated in the Performance Data in Part 3 C. of this specification.

2. Filters units (Furnished by Manufacuter) shall consist of the following: tank assembly, basin mounting brackets and hardware, centertube installation with cloth media disks, drive installation, actuated mechanism, backwash/sludge discharge pumps and actuated valves, pressure transmitter, vacuum transmitter (if applicable), level switches, filter control panels with sunshade and other components as specified herein.

3. The disk filters for both the NWRF and EWRF facilities have been designed to meet the requirements of the existing plant hydraulics. The following disk filter components shall be installed to match the elevations shown on the drawings such that the hydraulic conditions are met:

a. Influent Pipe Centerline Elevation

b. Influent Weir Elevations

c. Overflow Weir Elevation

d. Overflow Outlet Centerline Elevation

e. Outlet Weir Elevation

f. Outlet Pipe Centerline Elevation

B. Manufacturer

1. Alfa Laval Ashbrook Simon-Hartley (Manufacturer B)

PART 3 - EXECUTION

A. Installation

1. Install items in accordance with shop drawings with no exceptions noted, manufacturer's printed instructions and as indicated.

2. After alignment is correct, grout using high grade non-shrink grout.

   a. Do not imbed leveling nuts in grout.

3. Disk filters units shall be delivered to both the NWRF and EWRF sites and placed in a location determined by the Resident Project Representative. The Disk Filter Manufacturer is responsible for delivering the disks filters to each site.

4. Disk filters shall be installed as part of this contract.

B. Painting and Coating

1. All ferrous surfaces shall be shop coated with a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Epoxy coating shall be Scotchkote 134 or 206N, or Lilly Powder Coatings "Pipeclad 1500 Red.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Contractor to provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

4. After installation and testing with no exceptions noted by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

C. Service Conditions

1. Performance Data: See tables in this section.

Wastewater Flow	
Maximum Flow/Filter, mgd	6.0
Average Flow, mgd	3.0
Wastewater Composition	
Average TSS, mg/L Filter Influent	10.0
Average TSS, mg/L Filter Effluent	≤5.0
Maximum TSS, mg/L Filter Influent	20.0
Maximum TSS, mg/L Filter Effluent	5
BOD, mg/L Filter Influent	5.0
Phosphorous, mg/L Filter Influent	1.0
EWRF Filter Requirements	
Number of Filter Units	5
Number Operating	4
Type of Tank	304 SS
Peak Unit Capacity, mgd	6.0
Peak Hydraulic Loading, gpm/ft^2	6.50
Media Nominal Pore Size Rating, microns	10
Number of Discs/Unit	7-12
Minimum net filter surface (submerged, without frame work), ft^2 per disc	53.8
Minimum submerged filter area per unit, ft^2	576
Drive motor power, HP	1/3 – 2
Drive Motor Enclosure	TEFC

NWRF Filter Requirements	
Number of Filter Units	6
Number Operating	5
Type of Tank	304 SS
Peak Unit Capacity, mgd	6.0
Peak Hydraulic Loading, gpm/ft^2	6.50
Media Nominal Pore Size Rating, microns	10
Number of Discs/Unit	7-12
Minimum net filter surface (submerged, without frame work), ft^2 per disc	53.8
Minimum submerged filter area per unit, ft^2	576
Drive motor power, HP	1/3 – 2
Drive Motor Enclosure	TEFC
Filter Backwash Requirements (Alfa Laval)	
Total Backwash Capacity, gpm	400
Number of Backwash Pumps/Filter	2
Backwash Pump Design Point	200 gpm @ 30 ft TDH
Back-wash pump power, HP	5
Back-wash Pump Motor Enclosure	TENV
Number of Backwash Valves	8
Backwash valve size	4 inch
Number of Waste Valves	1
Waste valve size	3 inch

a. Provide the filters designed for continuous operation with varying flow rates and with filtration continuous during back-wash operation.

D. Field Testing

1. Following installation of the disk filters under this contract the disk filter manufacturer shall return to both the NWRF and EWRF sites and provide field testing as described below. The Contractor and Disk Filter

Manufacturer shall coordinate testing and shall be present during testing.

2. All testing shall be coordinated with the Owner and Engineer a minimum of fourteen (14) days in advance by submitting a C.A.R.

3. Comply with the requirements specified in Section 01664 and as specified herein.

4. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, and a completed and signed pretesting check list. See Division 1 for checklist.

5. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct a dry running test and a performance test for each unit in presence of the Engineer to determine its ability to meet the specified performance under specified conditions.

    a. Dry Testing:

        (1) Dry test each filter to demonstrate the correct alignment, smooth operation, proper and equal spacing of screen bars freedom from vibration, excessive noise and overheating of the moving parts and bearings.

        (2) All defects recorded during the above field tests and all defects and failures occurring within the first year of operation shall be corrected at no additional cost to the Owner.

    b. Performance Test:

        (1) During tests, observe and record influent and effluent flow rates, influent and effluent TSS and turbidity, hydraulic loading rate (gpm/sf), maximum solids loading rate (ppd/sf), TSS removal (ppd), backwash rate (gpm) and backwash duration.

        (2) Twenty four (24) samples of the above mentioned parameters shall be taken each day during performance testing. Samples shall be

taken from mid-depth of the filter influent and effluent boxes. Sampling and quality control practices shall be per 40 CFR part 136. Sampling and sample analysis shall be provided by the Contractor through a laboratory certified in the state where the Project is located. Engineer shall witness the tests.

(3) Test Duration: Five (5) days total, two (2) days at peak capacity hydraulic loading rate and three (3) days at the average day flow of 3.0 MGD. Hydraulic loading rate (gpm/sf) shall be defined as the total effluent flow divided by the number of filters in service divided by the effective submerged filtration area of each filter.

(4) The disk filter system shall be deemed to pass the performance test when 100% of the collected samples meet the maximum effluent TSS requirement defined in Performance Data Table in Section 11399 Part 3 C.

(5) Each filter must demonstrate thirty (30) days of continuous, defect-free operation prior to final acceptance.

(6) Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

c. Repeat tests until specified results are obtained.

6. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Contract Closeout

Provide in accordance with Section 01700.

F. Certification

Provide a written certification from the equipment manufacturer that the equipment has been properly installed according to the plans, specifications and manufacturer's recommendations, and that the equipment is operating

normally. Make all necessary corrections and adjustments at no additional cost to the Owner prior to start up.

END OF SECTION

SECTION 13300 PROCESS INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

A. Scope of Work

1. A single Instrumentation System Supplier (ISS) shall furnish all services and equipment defined herein and in other Specification Sections as listed below under Related Work, and as shown on Instrumentation Drawings.

2. The ISS shall provide all materials, equipment, labor, and services required to achieve a fully operational system. The ISS shall design and coordinate the instrument and control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these Specifications and with related existing equipment.

3. The disk filter control panels shall be provided by the disk filter manufacturer and installed/integrated by the ISS.

4. ISS shall provide SCADA network communication hardware to enable connection of each disk filter control panel PLC to both the Profinet network and the plant SCADA network.

5. The ISS shall be responsible for providing, installing and integrating all control system hardware, software, and instrumentation outside the disk filter control panels as shown in the drawings.

6. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided by other suppliers under other Sections of these Specifications, shall be included whether they are shown on the instrument drawings or not.

7.

8. Substitutions on functions or type of equipment specified will not be acceptable. In order to insure the interchangeability of parts, the maintenance of existing equipment, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the ISS to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required.

9. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detailed Drawings, Specifications, engineering data, instructions and recommendations of the equipment manufacturer as accepted by the Engineer.

10. To facilitate the Owner's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.

11. Equipment removed in the course of this work shall be the property of the Owner. Contractor shall coordinate with Contractor and Owner in the removal of all designated existing equipment.

12. The Orange County East and Northwest Regional Water Reclamation Facilities are operating facilities, and all work shall be coordinated with its operating personnel to minimize impact on its daily operation.

13. All equipment and installations shall satisfy applicable Federal, State, and local codes.

14. Supplementing this Section, the Drawings and the related Specification sections provide additional details showing panel elevations, instrument device schedules, functional requirements of the system, and interaction with other equipment.

15. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner such that the monitoring and control functions are available when the equipment is ready to be placed into service.

B. Related Work

1. The ISS shall furnish all materials, labor and services specified in the following Specification Sections as required to ensure a single, coordinated system is supplied:

   a. Section 13310 – Programmable Logic Controllers (PLC) and Digital Equipment

   b. Section 13315 – Field Instrumentation

   c. Section 13320 – Fiber Optic Data Highway Network

   d. Section 13325 – Control Panels And Panel Mounted Equipment

2. Divisions requiring coordination shall include, but not be limited to, the following:

   a. Division 11 – Equipment

   b. Division 13 Special Construction

   c. Division 15 – Mechanical

   d. Division 16 Electrical

C. Coordination Meetings

1. The ISS shall schedule three (3) mandatory coordination meetings. The meetings shall be held at the Owner's or Engineer's offices and shall be attended by, as a minimum, attendance by the Owner, the Engineer, the ISS project engineer, the Application Programming Supplier

(APS) as defined in Section 13305, and the Electrical Subcontractor.

a. The first meeting shall be held in advance of the first ISS shop drawing submittal. The purpose of the meeting shall be for the ISS to: summarize their understanding of the project; discuss the design intent and philosophy of each control loop to assist in development of loop narratives; discuss any proposed substitutions or alternatives; schedule testing and delivery milestone dates; discuss number and type of graphic displays and reports; provide a forum for the ISS, APS, Engineer and Owner to coordinate hardware and software related issues; discuss exact number and content of submittals; and request any additional information required from the Engineer and Owner. The ISS should bring draft working documents to the meeting to provide the basis for the Engineer's and Owner's input into their development.

b. The second meeting shall be held after the first complete shop drawing package has been reviewed by the Engineer and returned to the ISS. The purpose of the second meeting is to discuss comments made on the submittal package; to review proposed graphics and finalize appearance and function, to refine scheduled milestone dates; and to provide a forum for any further required coordination, ensuring that the design intent is preserved.

D. Submittals

1. Submit Shop Drawings in accordance with Section 01300. These Shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Submittals shall be bound in separate three ring binders, with an index and sectional dividers, with all Drawings reduced to a maximum size of 11 in x 17 in for inclusion within the binder.

2. Project Plan Submittal

a. The Project Plan shall provide an overview of the proposed system including the approach to work, proposed system architecture diagrams (both Ethernet and PROFINET), a preliminary bill of materials of major items to be provided, the proposed work schedule indicating milestones and meetings, project personnel and organization, overviews of testing procedures and training, and a paragraph by paragraph review of the Specifications indicating any proposed deviations.

b. The schedule shall illustrate all major project milestones including the following:

i Schedule for all subsequent project submittals.
ii Tentative dates for all project design review meetings.
iii Schedule of manufacture and staging of all instrumentation and control system equipment.
iv Schedule for all tests.
v Schedule for shipment of all instrument and control system equipment and all peripheral devices.
vi Schedule for equipment startup.
vii Schedule for all training.

c. The project personnel section shall include the project manager, project engineers and all field technicians/staff anticipated to be used on this project. Provide up to date résumés for all personnel identified.

d. The Project Plan must be submitted and approved before any further submittals will be accepted.

3. Instrumentation Submittal

a. This submittal shall provide complete documentation of all field instruments, panel components, and other instrument and control equipment not specified to be submitted elsewhere.

i Provide data sheets for each component listing all model numbers, optional, and ancillary devices that are being provided. The data sheets shall be provided with an index and proper identification and cross referencing. They shall include but not be limited to the following information:

1) Plant Equipment Number and ISA tag number per the Loop Diagrams.
2) Product (item) name used herein and on the Contract Drawings.
3) Manufacturers complete model number.
4) Location of the device.
5) Input output characteristics.
6) Range, size, and graduations.
7) Physical size with dimensions, enclosure NEMA classification and mounting details.
8) Materials of construction of all components.
9) Instrument or control device sizing calculations where applicable.
10) Certified calibration data on all flow metering devices.

b. Provide equipment specification sheets which shall fully describe the device, the intended function, how it operates, and its physical, environmental and performance characteristics. Each data sheet shall have appropriate cross references to loop or equipment identification tags. As a minimum the specification sheets shall include the following:

i Dimension, rigid clearances.
ii Mounting or installation details.
iii Connection.
iv Electrical power or air requirements.
v Materials of construction.
vi Environmental characteristics.
vii Performance characteristics.

c. Detailed drawings covering control panels, consoles and/or enclosures which shall include:

i Cabinet assembly and layout Drawings to scale. These shall include both front and rear layouts.
ii Fabrication and painting specifications.
iii Color selection samples for selection by the Engineer.
iv Panel wiring diagrams showing all power connections to equipment within and on the enclosure, combined panel power draw requirements (volts, amps), breaker sizes, fuse sizes, and grounding. This wiring diagram shall be in ladder logic format and shall reference the appropriate Loop Drawing for continuations or details where required. Show all wire numbers and terminal block designations.

d. The submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the ISS to proceed with the detailed site preparation for all equipment.

e. This submittal shall include:
i A list of and descriptive literature for tools, spares, expendables, and test equipment as specified in Instrumentation Specifications.
ii A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the ISS.
iii Unit and total costs for the additional spare items recommended for each subsystem.
iv Storage instructions for all spare parts.

4. Digital System Hardware Submittal

a. This submittal shall provide complete documentation of the proposed control room and system equipment other than that included in the Instrumentation submittal: computers, communications equipment, peripherals, fiber optic cable, radio telemetry equipment, etc.

b. Provide a complete system block diagram(s) showing in schematic form, the interconnections between major hardware components such as: control centers, panels, power supplies, consoles, computer and peripheral devices, telemetry equipment, local digital processors and like equipment. The block diagram shall reflect the total integration of all digital devices in the system and shall reflect any HMI locations. All components shall be clearly identified with appropriate cross references to the location of each. The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.

c. Provide a data sheet and manufacturer cut sheets for each hardware component listing all model numbers, optional, auxiliary and ancillary devices that are being provided. The data sheets shall be provided with an index and proper identification and cross referencing.

d. The Digital System Hardware submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, radio survey information, plug identifications, safety precautions or guards, and equipment layouts in order to enable the ISS to proceed with the detailed site preparation for all equipment.

e. The ISS shall provide fiber optic power budget for each cable run in excess of 500 feet. Cable budget shall include transmitter power, receiver sensitivity, connector losses, cable losses and a 3 dB aging margin. Fiber optic transmission line shall maintain a minimum of 3 dB safety margin.

f. This submittal shall include:
   i A list of and descriptive literature for tools, spares, expendables, and test equipment as specified in Instrumentation Specifications.

ii A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the ISS.
iii Unit and total costs for the additional spare items recommended for each subsystem.
iv Storage instructions for all spare parts.

5. Testing Submittals

a. The test plan shall be submitted after all hardware submittals have been approved by the Engineer.

b. The test plan shall demonstrate that the ISS has designed and configured a system that meets the design specifications. The documents for the test plan shall be structured so that the Owner understands what the inputs are, what the predicted outputs should be and what the actual outputs are. The test plan should have sign off and date block for the ISS, the Engineer and the Owner, and where applicable, the APS.

c. The complete test plan should include as a minimum descriptions for the following:
i System hardware and software summary.
ii A schedule for the testing describing the specific tasks to be performed and the time allotted for each.
iii Communications test to the various PLCs for Discrete and Analog I/O data transfer.
iv 100 percent I/O point test including all spare points based upon the previously submitted System I/O list.

d. Test Procedures: Submit the procedures proposed to be followed during the test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests.
i Preliminary test procedure submittals: Prior to the preparation of the detailed test procedures, submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and checklists. The same test

forms may be used for unwitnessed and witnessed tests.

ii Test Procedure Submittals: After the preliminary test procedure submittals have been reviewed by the Engineer and returned stamped either "approved" or "approved as noted, confirm" submit the proposed detailed test procedures. Testing may not be started until all Testing Submittals have been approved.

e. Test Documentation: Submit a copy of the signed off test procedures upon completion of each required test.

6. Training

a. The training plan shall include:
   i Definitions of each course.
   ii Specific course attendance.
   iii Schedule of training courses including dates, duration, and locations of each class.
   iv Resumes of the instructors who will actually conduct the training.

7. Refer to Related Sections of the Specifications for other required submittals.

E. Reference Standards

1. American Society for Testing and Materials (ASTM).

a. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

2. International Society of Automation (ISA)

a. ISA-5.1 – Instrumentation Symbols and Identification
b. ISA-5.2 Binary Logic Diagrams for Process Operations
c. ISA-5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems

d. ISA-5.4 Instrument Loop Diagrams
e. ISA-5.5 – Graphic Symbols for Process Displays

3. American National Standards Institute (ANSI)

a. ANSI X3.5 Flowchart Symbols and Their Usage in Information Processing

4. National Electrical Manufacturers Association (NEMA)

a. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

F. Quality Assurance

1. The ISS shall perform all work necessary to select, furnish, install, connect, and place into operation all hardware specified within this Division.

2. Actual installation of the system need not be performed by the ISS's employees; however, the ISS shall be responsible for the onsite technical supervision of the installation.

3. The ISS shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

4. The ISS shall be one of the following:

a. Curry Controls Company
P. O. Drawer 5408
Lakeland, FL 33807
TEL: (863) 646-5781

b. ITG Technologies
11235 Industrial Pkwy N, Suite 2
Jacksonville. FL 32246
TEL: (904) 425-4760

c. Revere Control Systems
2240 Rocky Ridge Rd.
Birmingham, AL 35216
TEL: (205) 824-0004

d. No Exceptions

G. System Description

1. The responsibilities of the ISS shall include, but not be limited to, the following:

a. Furnish and install all field devices and instrumentation as shown on the Contract Drawings and called out in Sections 13300 and 13315.

b. Furnish and install the new PLC panels, Remote I/O (RIO) panels, fiber optic converter panels, and other control panels (except those indicated as furnished by others), as shown on the Instrumentation Drawings. Provide modifications to existing control panels as required. Panels and panel components shall conform to the requirements of Sections 13300, 13310 and 13325.

c. Applications software programming, including PLC ladder logic, Human-Machine Interface (HMI) graphics, networking, redundancy, database, reports, and local panel HMI screen and database programming, will be provided by the Applications Programming Supplier (APS), as defined in Section 13305.

2. ISS shall refer to the Contract Drawings and the Specifications for complete information concerning all equipment and services to be furnished under this contract.

3. Any disputes or conflicts over scopes of work shall be settled by the Engineer.

H. Delivery, Storage and Handling

1. Identification

a. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

b. A permanent plastic tag, black letters on white background, shall be firmly attached and permanently and indelibly marked with the instrument tag number, as given in the Drawings, to each piece of equipment supplied.

2. Storage

a. Equipment shall not be stored out of doors. Equipment shall be stored in dry permanent shelters including in line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be replaced by the ISS at his own cost and expense.

I. Project/Site Requirements

1. Environmental Requirements. Indoor, non-process areas require NEMA Type 12 painted enclosures. All other areas require NEMA Type 4X 316 stainless steel enclosures. Refer to Division 16 for area environmental hazardous classifications. Outdoor areas require sun shields.

2. Elevation. Equipment shall be designed to operate at a ground elevation of approximately 15 to 20 feet above mean sea level. Equipment mounted below grade shall be NEMA Type 4X, 6, or 6P.

3. Temperature. Indoor areas' equipment shall be suitable for 10 to 40 C degrees ambient. Outdoor areas' equipment shall be suitable for -30 to 50 C degrees ambient. Storage temperatures will range from 0 to 50 C degrees ambient. Additional cooling or heating shall be furnished if required by the equipment furnished.

4. Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 80 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.

5. Power Supply. 120 volts AC sources of electric supply will be unregulated industrial panel boards.

J. Tools, Spare Parts and Expendables

1. In addition to those defined in related Specification Sections, furnish the following, or approved equals.

2. Tools

   a. Electro-Mechanical Tool Kit, JTK-88.

   b. LAN/PC Tool Kit, Jensen JTK-5000.

   c. Handheld multifunction calibrator, Fluke 725, with complete set of instrument modules, leads and clamps, belt holster, and spare batteries/battery charger.

3. Spares and Expendables

   a. Spare parts shall be as defined in the related specification sections. All spare parts shall be new and unused.

   b. All spare parts shall be individually packaged and labeled, and packed in a manner suitable for long term storage and adequately protected against corrosion, humidity and temperature.

   c. Provide one gallon of touch up paint, in one quart containers, for each type and color used for all cabinets, panels, consoles, etc.

K. Final System Documentation

1. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished. The ISS shall submit the final documents after the review and acceptance of the Engineer as specified in Section 01300.

2. Provide at least the following documentation as a minimum:

   a. A comprehensive index.

   b. A complete "As Constructed" set of corrected and completed Shop Drawings.

   c. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

   d. Full specifications on each item.

   e. System schematic drawings "As Constructed", illustrating all components, piping and electrical connections of the systems supplied under this Section.

   f. Detailed service, maintenance and operation instructions for each item supplied.

   g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

   h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic Drawings and instructions.

   i. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

3. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

4. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

5. If the ISS transmits any documentation or other technical information which he considers proprietary, such information shall be so designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

6. The requirements for the final documentation are as follows:

    a. As built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the System resulting from the Factory and/or Field Acceptance Tests shall be incorporated in this documentation.

    b. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the System in good

operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:

i Operation Information This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

ii Preventative Maintenance Instructions These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

iii Corrective Maintenance Instructions These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

iv Parts Information This information shall include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between the Instrumentation System Supplier's part number and manufacturer's part numbers shall be provided.

7. Electronic O&M Information

a. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals on CD-R or DVD-R. Electronic documents shall be supplied in PDF format or as specified below.

b. Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Word and PDF format as applicable.

c. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.

d. Each PLC and PC shall be backed up onto CD-R or DVD-R after Final Completion and shall be turned over to the Owner. Provide all final as-built PLC and HMI project files in their respective native formats. Each file must contain all instruction and rung comments.

PART 2 - PRODUCTS

A. General Equipment Requirements

1. Instrumentation

a. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals which are established standards for the water and wastewater industries.

b. Digital or discrete (on/off) control signals shall be 120VAC, 60Hz. Analog measurement signals shall be 24VDC, 4-20 mA. No zero based signals will be allowed.

c. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

d. Wall- or surface-mounted instruments that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

e. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Electrical Drawings, to comply with the National Electrical Code.

f. All indicators and recorder read outs shall be linear in process units, unless otherwise noted.

g. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent.

h. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

i. All equipment, cabinets and devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

j. The field mounted digital system equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

k. All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC compliant.

2. Electrical

a. All equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplied required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

b. Materials and equipment used shall be U.L. listed wherever available.

c. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

d. Existing signal and control wiring may be wired through intermediate junction boxes/termination cabinets. Note that all new wiring shall not utilize junction boxes or termination cabinets, but shall be

connected directly between PLC or other control system panels, and field devices, equipment or motor control panels.

B. Lightning/Surge Protection

1. General

a. Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure. All contact points to be copper with nickel plating. The transient response of units shall be less than 1 nanosecond.

b. The surge protector should meet UL 1449, NEMA LS-1, and IEEE C62.41 Standards, as applicable. This requirement can be met using UL itself or a Nationally Recognized Testing Lab (NRTL) testing to UL standards, in accordance with FTC rules.

c. The manufacturer shall be Current Technology/ Joslyn, Dehn, EDCO, or Surge Suppression Inc. (SSI).

2. Installation

a. The following standards shall be observed:

i All analog signal lines, or PROFINET “daisy chains”, that include an outdoor instrument and

a control panel, shall be protected by surge suppressors at all termination points.

ii All 120V power to outdoor instruments shall be protected with a local surge suppressor mounted at the instrument, as indicated above. Main power to a panel should be on a circuit breaker.

iii Network cable (other than fiber optic) shall be protected at both ends if it runs beyond the walls of a structure.

C. Tubing and Fittings

1. All instrument air header takeoffs and branch connections less than 2-inch size shall be 316 stainless steel.

2. All instrument shut off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. Fittings shall be Swagelok 316 stainless steel or equal and valves shall be Whitney 316 stainless steel or equal.

3. All instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of O.D. scratches having the following dimensional characteristics as required to fit the specific installation:

   a. 1/4 in to 1/2 in O.D. x 0.035 wall thickness.

   b. 5/8 in to 1 in O.D. x 0.049 wall thickness.

   c. 1 in O.D. x 0.065 wall thickness.

   d. 1 1/4 in O.D. x 0.065 wall thickness.

   e. 1 1/2 in O.D. x 0.083 wall thickness.

   f. 2 in O.D. x 0.095 wall thickness.

4. All process connections to instruments shall be annealed 1/2 in O.D. stainless steel tubing, Type 316.

5. All tube track shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 - EXECUTION

A. General Installation

1. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as accepted by the Engineer during construction. Obtain in the field all information relevant to the placing of process control work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work.

2. The instrumentation loop diagrams indicate the intent of the interconnection between the individual instruments. Any exceptions should be noted. Two complete sets of As Constructed shop drawings shall be kept at the job site during all on site construction. Both sets shall be identically marked up to reflect any modifications made during field installation or start up. All markings shall be verified and initialed by the Engineer or his designated representative.

3. Following completion of installation and the operational readiness test, one set of the marked up drawings shall be provided to the Engineer, the other retained by the ISS for incorporation of the mark ups into final as built documentation. Record drawings shall be as called out in Section 01340 of these specifications.

4. The instrumentation installation details on the Contract Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the

American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.

5. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the ISS shall bear full responsibility for such violations and assume all costs arising therefrom.

6. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the ISS shall bear full responsibility for such violations and assume all costs arising there from.

7. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

8. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut off valves.

9. Field instruments requiring power supplies shall be provided with local electrical shutoffs and fuses as required.

10. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

11. The ISS shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the ISS shall be required to ship his material in sections sized to permit passing through restricted areas in the building. The ISS shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).

12. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

13. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

14. The ISS shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's review. He shall be responsible to insure that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to insure a satisfactory functioning installation. The ISS hereunder shall schedule and coordinate his work under this section with that of the electrical work specified under applicable Sections of Division 16.

B. Tests (General)

1. The ISS shall test all equipment, hardware and software, to be furnished under this Contract at ISS's own facility before transporting it to the project site.

2. As a minimum, the testing shall include the following:

   a. Unwitnessed Factory Test (UFT).

b. Witnessed Factory Test (WFT).

c. Operational Readiness Tests (ORT).

d. Functional Demonstration Tests (FDT).

e. Performance Acceptance Test (PAT).

3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

4. All tests shall be conducted in accordance with prior Engineer reviewed procedures, forms, and check list. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

5. Copies of these sign off test procedures, forms, and check lists will constitute the required test documentation.

6. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.

7. The ISS shall coordinate all testing with the Engineer, the Applications Programming Supplier (APS), all affected Subcontractors, and the Owner.

8. The Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the previously accepted test procedures.

9. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

10. No equipment shall be shipped until the engineer has received all test results and the system is ready for shipment.

11. The ISS shall furnish the services of servicemen, all special calibration and test equipment and labor to perform the field tests.

C. Unwitnessed Factory Tests (UFT)

1. The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All control loops and programs shall be tested. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/ functions.

2. All panels and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, specifications, and Contract Drawings.

3. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.

4. All PLC and HMI software programming, including the integration of PROFINET and Ethernet (or ProfiBus DP, if used) networked devices, must be completed and debugged by the APS prior to the Unwitnessed Factory Test. UFT test results shall include full testing of software and programming.

D. Witnessed Factory Test (WFT)

1. Implicit in the scheduling of the Witnessed Factory Test is the assumption that the ISS has determined through his own tests and quality assurance programs that the equipment is ready for shipment.

2. Prior to start of the Witnessed Factory Test, all previous unwitnessed test results shall have been submitted to the Engineer for review and approval.

3. All system tests specified for the Unwitnessed Factory Test shall be repeated, including software and programming tests.

4. After the Unwitnessed Factory Test approval has been received by the ISS, the ISS shall notify the Engineer, the APS, and the Owner in writing that the system is ready for the Witnessed Factory Test, and allow the Engineer and/or Owner to schedule a test date within 30 days of receipt of the "Ready to Test" letter. At the time of notification, the ISS shall submit any revisions to the detailed test procedure previously approved by the Engineer.

5. The purpose of the test shall be to verify the functionality, performance, and stability of the hardware and software. The system must operate continually for 100 hours without failure before the test shall be judged successful. Successful completion of this test, as determined by the Engineer, shall be the basis for approval of the system to be shipped to the site.

6. The various tests performed during the Engineer and/or Owner witnessed factory demonstration test shall be designed to demonstrate that hardware and software fulfill all the requirements of the Specifications. The test conditions shall resemble, as closely as possible, the actual installed conditions. Any additional hardware or software that may be required to successfully verify system operation shall be supplied at no cost.

7. The test shall perform but not be limited to the following:

    a. Demonstrate operability, and conformance to Specifications and to approve Shop Drawings, of all equipment.

b. 100 percent point check of all I/O including all wiring.

c. Check of all Loops on a loop-by-loop basis, using the programs as installed on all provided equipment, including both OIPs and PC HMI.

d. Demonstrate operability of the data communication network and all devices in it, under anticipated full load conditions.

e. Demonstrate failure modes of all equipment, such as loss of network communications, loss of main power, and loss of CPU in a redundant pair.

8. During the test for a period of time equal to at least 20 percent of the test duration, the Engineer's and/or Owner's representative shall have unrestricted access to the system.

9. All analog control panels shall be included in these tests.

10. All deficiencies identified during these tests shall be corrected and retested prior to completing of the Witnessed Factory Test as determined by the Engineer.

11. The following documentation shall be made available to the Engineer at the test site both before and during the Witnessed Factory Test:

    a. All Contract Drawings and Specifications, addenda, and change orders.

    b. Master copy of the test procedure.

    c. List of the equipment to be tested including make, model and serial number.

    d. Design related hardware submittal applicable to the equipment being tested.

12. The Witnessed Factory Test shall generally cover a period of no more than 5 days. The daily schedule during these tests shall be as follows:

    a. Testing and meetings: Nominally 8 hours per day; 10 hours per day if required to meet schedule.

    b. Morning meetings to review the day's test schedule.

    c. Evening meetings to review the day's test results and to review or revise the next day's test schedule.

    d. Unstructured testing period by the witnesses.

    13. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

    14. All costs associated with the Witnessed Factory Testing, including travel, airfare (if desired), parking, rental car, upscale accommodation and food for one Engineer and up to three of the Owners' representatives, shall be the responsibility of the ISS and shall be included in the Contract price.

    15. Should the Witnessed Factory Test fail to perform as required, it shall be rescheduled as many times as necessary to provide a complete working system as specified herein. ISS shall be responsible for all costs associated with Factory Testing for Engineer and Owners' representatives as stated above for each additional test.

E. Operational Readiness Test (ORT)

1. General: Prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, tested, and documented) that it is READY for operation.

2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop by loop and component by component basis to ensure that it is in conformance with related submittals and these Specifications.

   a. The Loop/Component Inspections and Tests shall be implemented using Engineer forms and check lists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the ISS:

      i Project Name.

      ii Loop Number.

      iii Tag Number for each component.

      iv Checkoffs/sign offs for each component.
         1) Tag/identification
         2) Installation
         3) Termination wiring
         4) Termination tubing
         5) Calibration/adjustment

      v Checkoffs/sign offs for the loop.
         1) Panel interface terminations
         2) I/O interface terminations
         3) I/O signal operation
         4) Inputs/outputs operational: received/sent, processed, adjusted
         5) Total loop operation

      vi Space for comments.

   b. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign off by the ISS:

i Project Name.

ii Loop Number.

iii Component Tag Number of I/O Module Number.

iv Component Code Number Analog System.

v Manufacturer (for Analog system element).

vi Model Number/Serial Number (for Analog system).

vii Summary of Functional Requirements. For example:

1) For Indicators and Recorders: Scale and chart ranges
2) For Transmitters/Converters: Scale and chart ranges
3) For Computing Elements: Function
4) For Controllers: Action (direct/reverse) control Modes (PID)
5) For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
6) For I/O Modules: Input or output

viii Calibrations. For example:

1) For Analog Devices: Required and actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
2) For Discrete Devices: Required and actual trip points and reset points.
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Required and actual inputs or outputs for 0, 10, 50, and 100 percent of span, rising and falling.

ix Space for comments.

x Space for sign off by the ISS.

c. The ISS shall maintain the Loop Status Reports and Components Calibration sheets at the job site and make them available to the Engineer/Owner at any time.

3. These inspections and tests do not require witnessing. However, the Engineer will review and initial all Loop Status Sheets and Component Calibration Sheets and spot check their entries periodically and upon completion of the Operational Readiness Tests. Any deficiencies found shall be corrected.

4. Any loop status reports or calibration sheets that are signed off on but found to be incomplete or deficient shall be cause for conducting a complete witnessed test by the Engineer at the Contractor’s expense.

F. Functional Demonstration Test (FDT)

1. Prior to startup and the Functional Demonstration Test, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the operational readiness tests.

2. Once the facility has been started up and is operating, a witnessed Functional Demonstration Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop and site by site basis.

3. Loop specific and non-loop specific tests shall be the same as specified under Operational Readiness Test except that the entire installed system shall be tested and all functions demonstrated.

4. Updated versions of Shop Drawings shall be made available to the Engineer at the job site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available to the Engineer at the job site both before and during testing.

5. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.

G. Performance Acceptance Test (PAT)

1. After completion of the Operational Readiness and Functional Demonstration Tests, the ISS shall be responsible, with respect to all components and services provided under this Section, for operation of the entire system for a period of 5 consecutive days, under conditions of full plant process operation, meeting all process requirements, without a single non field repairable malfunction.

2. During this test, plant operating, ISS and APS personnel who have an intimate knowledge of the hardware and software of the system shall be present as required.

3. While this test is proceeding, the Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.

4. Any malfunction during the tests shall be analyzed and corrections made by the ISS and/or the APS as appropriate. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

5. Any malfunction during this test period, which cannot be corrected within 24 hours of occurrence by the ISS's personnel, or more than two similar failures of any duration, will be considered as a non-field repairable malfunction.

6. Upon completion of repairs by the ISS, the test shall be repeated as specified herein.

7. In the event of rejection of any part or function, the ISS shall perform repairs or replacement within 90 days.

8. The total availability of the system shall be greater than 99.0 percent during this test period. Availability shall be defined as "Avail. = (Total Time Down Time)/Total Time". Down times due to power outages or other factors outside the normal protection devices or back up power supplies provided, shall not contribute to the availability test times above.

9. Upon successful completion of the 5 day PAT and subsequent review and acceptance of complete system final documentation, the system shall be considered complete and the one year warranty period shall commence.

H. Training

1. The cost of Owner training programs shall be included in the Contract price.

2. All Technicians, Operators, Engineers, and Managers of the Treatment Facility will require training on the System. The Instrumentation System Supplier shall be responsible for providing detailed Operation and Maintenance (O&M) Manuals and training courses.

3. The O&M Manuals shall include specific details of the equipment supplied and details of operations specific to this Project. The training courses will deal with fundamentals of Programmable Logic Controller (PLC) and Digital Equipment hardware and software, telemetry systems, field devices, and maintenance.

4. All instructors must be intimately familiar with the operation and control of the Owner’s facility.

5. The training shall be structured as follows:

   a. The system training program shall be structured such that the operating personnel will understand the system's operation, and the functions available in the system.

b. The level and amount of training will be based on the understanding of the individual staff members. Preventive and corrective maintenance of system devices and hardware shall be presented.

c. A number of basic theory courses shall be provided to give the operators an appreciation of how the system can help them perform their jobs.

6. The ISS shall provide detailed manuals and shall include specific details of equipment supplied and operations specific to the project.

7. The ISS shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.

8. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

9. On Site Training for operator personnel shall deal with fundamentals of system hardware and software, field devices, instrumentation calibration and maintenance. Training shall cover all aspects of the instrumentation and controls system. Training is expected to cover a period of not less than three (3) eight-hour days.

I. Warranty / Maintenance Requirement

1. A written maintenance contract executed by the ISS shall be provided to the Owner for onsite warranty services. This contract shall include all labor and emergency calls providing on site response within 24 hours, to provide complete system operability for a period of one year after the successful completion of the PAT.

2. The costs for a three year maintenance service contract shall be included as a separate line optional adder in the ISS's Contract Price. An additive two year warranty in addition to the three year warranty shall be provided as a separate line item to be evaluated. Refer to Section 01025.

J. Control System Diagrams and Details

1. To assist the ISS in determining the scope of work, a series of Process & Instrumentation Diagrams (P&IDs) and Details are provided. Unless specifically stated otherwise, the ISS shall be responsible for providing all instrumentation, control equipment and auxiliary devices necessary to perform the functions specified herein and as shown and described on these diagrams. Any auxiliary devices such as lightning/surge protectors, relays, timers, signal isolators, signal boosters, etc. which are necessary for operation shall be included, whether or not they are specifically shown or tabulated on the Loop Diagrams.

2. The intent of the P&IDs is to describe in as much detail as possible, the hardware, software and functional requirements of a process measurement and control system. They are not intended to describe all required functionality, such as alarming, (fail to start, fail to stop, etc.), process interlocks, alarm buffering and deadbands, scaling, ranging, or any other program functions expected by best practice. These functions are required. Neither are the P&IDs intended to convey requirements for conduit and wiring between panels or system components. This information is included in appropriate Electrical Specifications and Drawings.

END OF SECTION

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SECTION 13305 APPLICATION ENGINEERING SERVICES

PART 1 - GENERAL

A. Scope of Work

1. All work done under this Section, and as shown on Instrumentation Drawings and indicated in Related Work, other than that provided by the Instrumentation System Supplier (ISS) as defined in Section 13300, shall be provided by an Applications Programming Supplier (APS).

2. The ISS shall integrate the proposed disk filter process into the existing plant SCADA system. The ISS shall integrate the disk filter manufacturer-furnished control panels into the overall plant SCADA system such that all display, indications, and functionality that is available at each disk filter control panel is also available through the plant SCADA system.

3. The APS shall provide all applications programming and services required to achieve a fully integrated and operational system. The APS shall coordinate the control system for proper operation with related equipment and materials under other sections of these specifications and with related existing equipment, especially with the ISS.

4. Auxiliary and accessory programming structures necessary for system operation or performance shall be included whether or not they are shown on the Contract Drawings.

5. All equipment shall be controlled in full conformity with detail Contract Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer.

6. To facilitate the Owner's future operation and maintenance, PLC programming and human interface development shall utilize standards as agreed upon by the Owner and Engineer.

7. The Orange County East and Northwest Water Reclamation Facilities are operating facilities, and all work shall be coordinated with its operating personnel to minimize impact on its daily operation.

8. Supplementing this section, the Contract Drawings and related specification sections provide additional details showing instrument device schedules, functional requirements of the system, and interaction with other equipment.

B. Related Work

1. Divisions requiring coordination shall include, but not be limited to, the following:

   a. Division 1 - General Requirements

   b. Division 11 - Equipment

   c. Division 13 - Special Construction

   d. Division 15 - Mechanical

   e. Division 16 - Electrical

C. Coordination Meetings

The APS shall participate in meetings as defined in Section 13300.

D. Submittals

1. Submit shop Drawings in accordance with Section 01300. These shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Each submittal shall be securely bound with an index and sectional dividers. Drawings shall be reduced to a maximum size of 11-in x 17-in for inclusion within the binder. Separate submittals shall be as follows:

   a. Operator Interface and Process Control Strategy

   b. O & M Data

2. Submittal Descriptions

   a. Operator Interface and Process Control Strategy

i. This submittal shall cover the specific plant control schemes as well as the details of the plant reports and process graphic displays.

ii. The submittal shall contain the semifinal details of all logs, reports, and process graphic displays. The specifics of what shall appear on each display and what calculations are required to support them shall be developed and submitted.

iii. Submitted process graphic displays shall be no less than 8-1/2 inches by 11 inches and in full color.

iv. A complete listing of all signals to be collected for long term historical information shall be provided. This listing shall include frequency of data sampling and duration for which the data shall be immediately accessible.

v. A complete listing of all signals to be collected for trend display shall be provided. This listing shall include frequency of data sampling and duration for which the data shall be immediately accessible.

vi. The process control schemes shall be developed in a ladder logic diagram or functional block (logic) diagram presentation based on information from the Specifications. Included with each diagram shall be:

    1) Brief scope of the Control Function
    2) Listing of all scanned inputs to the control function
    3) A loop narrative for each control loop
    4) Any assumptions made in developing the program
    5) I/O database listing showing all field inputs and outputs (i.e., AI, DI, AO, DO) associated with the control function.
    6) Cross reference list of all I/O showing to which I/O modules or software modules they are linked
    7) Listing of all operator inputs/outputs to and from the control function. Any special CRT displays related to the function shall be illustrated. A description of the operation of any panels shall be described as it relates to the control function.

vii. Failure contingencies shall be described in detail.

viii. This submittal shall cover all of the associated ladder logic developed under this Contract required to implement the control functions specified.

ix. Submit annotated ladder logic in 8-1/2″ x 11″ format and as a PDF file on CD-ROM for all logic developed. Annotation shall be 3 lines of 6 characters each for every logic contact. In addition, each network or rung shall be annotated so that a non-technical person can read and easily comprehend what control function the rung or network is performing.

x. This submittal shall also include copies of the PLC I/O configuration tables, I/O reference usage table, complete cross reference too specific rung used of all inputs, outputs, internal coils, data registers, and special purpose coils. In addition, any special switch settings or hardware configuration requirements such as communications port configurations shall be described in detail and submitted.

b. O & M Data. Provide O & M Data per Sections 01300 and 13300.

E. Reference Standards

1. Instrument Society of America (ISA)

a. ISA-5.1 – Instrumentation Symbols and Identification

b. ISA-5.2 - Binary Logic Diagrams for Process Operations

c. ISA-5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems

d. ISA-5.4 - Instrument Loop Diagrams

e. ISA-5.5 – Graphic Symbols for Process Displays

2. American National Standards Institute (ANSI)

a. ANSI X3.5 - Flowchart Symbols and Their Usage in Information Processing, 1987.

F. Quality Assurance

1. The APS shall be one of the following:

a. Curry Controls
Company 4245 South
Pipkin Road Lakeland,
Florida 33811 TEL:
(863) 646-5781

b. Revere Control Systems
2240 Rocky Ridge Rd.
Birmingham, AL 32216
TEL: (205) 824-0004

c. ITG Technologies(Information Technologies Group, LLC) 11235 St. John's Industrial Parkway, Unit #2 Jacksonville, FL 32246
TEL: (904) 425-4760

d. No Exceptions

e. The ISS and APS may be the same firm.

G. System Description

1. The APS is responsible for providing all programming and configuration services to accomplish the control and monitoring functions as described in the contract specifications and drawings. The APS shall provide all programming functions including but not limited to control strategies and communications, including the integration of controls using ProfiNet, Ethernet, or Profibus DP, networking protocols. ProfiNet is to be utilized wherever possible. Ethernet or ProfiBus DP may be used if use of ProfiNet is not possible. The APS shall also provide all programming and configuration services necessary to produce the operator interface (graphic displays, trends, historical archive, reports, etc.) as described in the Specifications and Drawings.

2. The APS shall coordinate with the ISS in the selection of programmable logic controller (PLC) components, PC Workstation hardware, software, and any other equipment, to ensure that they are adequate for application needs.

3. The ISS will purchase all hardware and software, and deliver it to the APS for programming and configuration. After completion of the Witnessed Factory Test, the APS shall deliver all hardware to the ISS for installation on site. At substantial completion, the APS shall deliver all software to the Owner.

4. The APS shall develop and provide all graphic screens for the systems provided. The graphics shall be designed and function with the plant's existing Human Machine Interface (HMI) software. The developed graphic displays shall represent all existing and new process flow paths and all associated equipment. All processes and equipment shown on the P&ID drawings shall also be shown on the process graphics in a similar manner.

H. Programming and Configuration Guidelines and Deliverables

1. General

a. Upon PC power on or reset, the system shall automatically boot to, and begin running, the HMI application. Alarms, displays, etc. shall be functional. User login shall be required for access to all runtime or development functions.

Access levels shall be as defined elsewhere in this Section.

b. The Windows environment shall be masked, and not normally available to the Operator. Login shall be required for access to the Windows environment.

c. It is intended that the HMI computers only be used for the HMI applications software.

2. Real Variables Processing

a. Real Variables shall represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at their selected scan frequency, and perform the proper conversions and scaling to obtain the instantaneous engineering values. These values shall be used to update real-time data on HMI displays, check for alarm conditions, and store for use in the historical files. Scan rate for all analog inputs shall be maximum one minute.

b. The instantaneous values of all variable data shall be displayed on the appropriate HMI screen, and shall be added to the historical database whenever the present value exceeds a preprogrammed compression dead band. The compression dead band will be field adjusted by the ISS to provide for maximum storage utilization.

c. Provide for storage of historical data for an adjustable file period of daily, weekly, monthly, quarterly, or yearly period for the purpose of trends or data analysis.

d. Variables such as rate of flow shall have their instantaneous values integrated with respect to time and their quantities totaled. The storage of each of these totals shall be done on an hourly basis into the historical file.

3. Calculated Variables Processing

a. Calculated variables shall represent process parameters for which there are no direct analog inputs to the system. These variables shall utilize Real Variables, and manually entered constants or laboratory data to compute their value. The computer system shall perform periodic real time calculations upon selected database parameters. Calculations shall be operator configurable, including: PLUS, MINUS, MULTIPLY, DIVIDE, EXTRACT ROOTS, INTEGRATE, DIFFERENTIATE, AND BOOLEAN LOGIC.

b. There shall be two types of calculated variables defined:

i. Calculated Variables which utilize one or more Real Variables and/or manually entered constants. These variables shall be treated in the same manner as Real Variables and shall have the same attributes as Real Variables (including alarming and control), with the exception that the calculation shall be performed automatically every 5 seconds.

ii. Calculated Variables which are used only for the Daily, Monthly, and Annual Operation Summary reports, and which utilize laboratory input data shall be computed once a day for inclusion in the Daily report and stored for

use in the Monthly and Annual reports. The capability to display these variables shall be provided.

4. Manual Input Data Handling

   a. The application software shall provide the capability to manually enter data from any operator's HMI screen/keyboard. This data shall consist of additional values for the current data file (e.g., laboratory analyses), inserting alarm limits, setpoint changes, adjustments to process constants, control system setpoint changes, and system tuning parameter adjustments.

   b. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the data entry device prior to incorporation to the database.

5. Graphic Displays

   a. The HMI system shall support multiple display types including lists, graphics, trends, etc. The ISS shall provide all HMI Screens necessary for the efficient operation of the system and process as described herein.

   b. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers.

   c. Generally, graphic displays shall consist of three parts, a menu bar, a process area, and an alarm summary area. The menu bar shall have shortcut buttons to a full page alarm summary, report viewers, HMI network status. It shall also provide a navigational device (such as a pull-down menu) that allows any screen to be called up. The Process area shall show the overview, or more detailed displays. The Alarm area shall show the last four alarms and status. Design of the graphic displays shall maximize the area available for the process area section.

d. Graphic displays shall make maximum use of the colors available. Colors for status such as open/close, start/stop shall be the same as the indicators on the existing process control system.

e. All items that can be manipulated shall indicate this property by displaying some visual change, such as a bounding box, on mouse-over.

f. The system shall allow the operator to manually control the status of pumps, valves, etc. as indicated on the Drawings. Control shall be provided via a pop- up box, called by clicking on the device, which shall accept keyboard and GUI manipulation. There shall be no secondary acknowledgement required for any issued command. Equipment that is sensitive to rapidly changing start-stop commands shall be protected by timers in the PLC that enforce a minimum delay between commands. This delay condition shall be indicated, and shall not lock the control pop-up, or otherwise prevent navigation to other displays. Manually entered setpoints, or other variables shall have filters that refuse incorrect settings.

g. Index displays: Provide Index display(s) as a complete and logical listing of the names and number of all screens.

h. Graphics capability shall include conditional color (i.e., where the color of a symbol or value changes upon some condition), and dynamic graphics (i.e. vary symbol presentation based upon its analog value). A hierarchical structure for the displays with a maximum of four levels should be employed. Graphic displays provided shall include:

   i. Process Overview. This shall present the overall process in limited detail to allow the operator to view the complete plant process on a single display.
   ii. Individual process schematics. Each process area shall be indicated with a separate graphic. Each display shall depict all elements involved in that particular process area (e.g. pumps, tanks, valves, flowmeters, etc.).
   iii. System Status. Provide displays of this type for the Control System Architecture (based on Drawing I-2) and for the Electrical System

(graphical and/or text screen). Indicate through color the status of each sub-system (e.g. PLC, communications links, etc.).

i. The Color Code for equipment status is the following: On – Red – Open; Off – Green – Close; Trouble – Yellow
– Fail. Equipment that is in alarm shall be flashing until the alarm is acknowledged.

j. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be operator adjustable from the operator interface, with the appropriate
access.

k. Pop-ups shall provide the following features:

i. All status indications, in colored text, pertinent to the device.
ii. All interlocks and permissives, in colored text, pertinent to the device.
iii. All control buttons pertinent to the device.
iv. Process variable display or PID control pop-ups, where needed, shall be in graphical and numerical form. Provide bar graphs that indicate current value, the alarm limits, and if applicable, setpoint and output values.

l. Data Entry displays. Where required, provide pop-ups for manual data entry.

m. Trend control. The operator shall be able to define trends of any variable in the system database (real-time trending) or in the historical database (historical trending) as follows:

i. Trend displays shall present the operator with multiple options (e.g., with or without limits, time scale).
ii. A cursor line or point shall be provided which can be moved along the curve to obtain exact readings at any point.

iii. It shall be possible to overlay different trend curves to facilitate the comparison of related parameters.

iv. It shall be possible to trend up to four different parameters on the same scale, each parameter being represented by a different color.

6. Alarm/Equipment Status Reporting

a. Alarm and Event Logging

i. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

ii. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The status monitoring shall be capable of being disabled and/or suppressed from the operator's console. The equipment status log shall include the time, equipment name, tag number, and the particular change in status. The log file shall be in a readily readable format, such as CSV.

iii. The alarm and event log(s) shall be available in an open file format for viewing or printing on demand. Alarm information shall consist of point identification number, point name, time of occurrence, and type and priority of alarm.

b. Alarm and Status Reports

i. Equipment and Point Status Summary Report. This report shall list the status of all points in the system, including contact inputs, real variables with analog inputs, and calculated variables. This report will be initiated manually, and shall consist of the tag number, tag name, and its current status (i.e., Running, Off, High, Low, Active, Disabled, ON-scan, OFF-scan, etc.).

ii. Alarm Summary Reports

1) Provide the ability to generate reports listing alarm data for:
   (a) the current day;
   (b) the previous day;
   (c) all points currently in alarm.

2) Normally, this report shall be initiated manually but provision shall be made so that it may be initiated automatically every day if desired.
3) The capability shall be provided to sort both daily and current alarm summary reports by operator defined groups. (i.e., print all power failure alarms, all suppressed alarms, etc.)

7. Control Standards

a. The following control standards shall be implemented in conjunction with all project drawings. Include these features where applicable as described herein, whether indicated directly in the P&IDs or not.

b. All programming and development functionality of each PLC shall be available via the ProfiNet network. This capability shall be password protected to allow access by supervisory personnel who are given clearance by the Owner.

c. All instrument and equipment data registers that are available for a given device through a digital network (e.g. ProfiNet) shall be mapped to tags in the associated facility PLC, whether called out in the Drawings and Specifications or not. Only the points actually required on the Drawings shall be polled, displayed, recorded and/or trended. The other registers shall be left disabled for future use.

d. For all "package systems" provided by vendors other than the ISS, coordinate with the equipment submittals to verify the I/O and data points that are shown in the Loop Diagrams.

e. Disagreement Alarms

i. For all controlled devices such as pumps, valves, etc., if the device is commanded to Start or Stop (or Open or Close) by the PLC, and the device feedback state does not match the commanded state within a preset time delay, an equipment Disagreement Alarm is generated by the PLC for display and alarming at the HMI, and the device is commanded to Stop (valves shall remain in the last state).

ii. If a duty pump, or system, is commanded to start and does not start within the preset time, the standby pump, or system, shall be commanded to start.
iii. If a device feedback state does not match the commanded state at any time, excluding the change of state described above, an equipment Failure Alarm is generated by the PLC for display and alarming at the HMI and the device is commanded to Stop (valves shall remain in the last state).
iv. The default time delay for all equipment shall be
90 seconds.
v. After a Disagreement Alarm occurs the device cannot be started (or Opened/Closed) again until a Reset has been issued by the Operator at the HMI.
vi. All controlled devices with feedback shall indicate Failure alarms on the associated process graphic displays even if not shown on the Drawings.

f. All analog alarms generated in the PLC or at the HMI (such as a high level alarm) shall be generated as follows. If the analog point's value exceeds or drops below the alarm limit value for a preset time period, then an alarm shall be generated. To eliminate excessive alarm reporting, the analog point shall remain in alarm until the analog point's value returns beyond the limit set by the analog limit deadband. Only the alarms shown in the Loop Diagrams shall be configured; standard process limit alarms (i.e. low- low, low, high, high-high) that are not used shall be disabled in the software.

g. For analog measurement points (such as level, flow, pressure, etc.) where indicated on the Loop Diagrams, if the value of the analog point changes by more than a preset deadband since the last time the analog point was scanned, a Rate-of-Change Alarm shall be generated at the HMI. The alarms shall remain in effect until it is logged at the HMI and the change in value falls toless than the preset deadband the next time the analog point is scanned. All analog points shall indicate a Rate-of-Change Alarm on the associated process graphic displays even if not shown on the loop drawings.

h. For analog measurement points, an Out-of-Range alarm shall be generated when the signal exceeds its proper span, either below 3.6mA or above 20.4mA. All analog points shall indicate a Rate-of-Change Alarm on the associated process graphic displays even if not shown on the loop drawings.

i. For all process analyzers, store the last good value measured, and hold it for an adjustable period in the event the input signal goes out of range. This period shall be no less than 1 minute for all analyzers and no less than 10 minutes for all chlorine residual analyzers. Note that this "last good value" shall be distinguished from an actual good value by turning on the Out-of-Range alarm, and by changing the color of the value on the HMI screen.

j. For PID loops, if a pump or valve is commanded to maintain a specific process parameter, and the process feedback signal deviates from the setpoint by a preset deadband for a preset time period, a Setpoint Deviation Alarm is generated by the PLC for display and alarming at the HMI.

k. All tuning parameters for each PID in the PLC shall be available at the server/workstations for monitoring and adjustment even if not shown on the loop drawings. Tuning trends shall be provided to monitor the PID functions. However, these parameter settings shall be password protected to allow access by supervisory personnel who are given clearance by the Owner.

l. PID loop control shall be suspended whenever a process variable or final control element associated with that loop has lost power or signal, as determined either by the Disagreement Alarms described above, or by power monitoring data.

m. All automatic pump starts and stops in response to a PID loop shall include operator-adjustable time delays.

n. All alarm and control setpoints shall be adjustable by the Operator even if not shown on the drawings. However, these setpoints shall only be accessible by individuals logged in with appropriate access levels as defined herein.

o. Run times for all motorized equipment shall be totalized in the PLC, except where the total is available from the equipment electronics itself, and indicated at the HMI with one (1) hour resolution even if not shown on the loop drawings. The total runtime shall be resettable from the HMI; however, this reset shall be password protected to allow access by supervisory personnel who are given clearance by the Owner.

p. Start Counts for all motorized equipment shall be totalized in the PLC and indicated at the HMI even if not shown on the loop drawings. The start counts shall reset on a daily basis.

q. All analog points shall be historically logged. The hourly maximum, minimum and average values for that point shall be calculated and stored.

r. All flows shall be totalized in the PLC, except where totals are available from the flowmeter itself. Yesterday's total flow and today's flow shall be indicated at the HMI even if not shown on the loop drawings. The total flows shall be resettable from the HMI; however, this reset shall be password protected to allow access by only the Operators who are given clearance by the Owner.

s. Chemical usage shall be calculated on a daily basis for each chemical used. Current day usage and previous day usage shall be indicated and recorded at the HMI.

8. Reports

a. The final format of all reports shall be developed by the APS and Owner following Contract Award. All reports shall be capable of automatic and on-demand printing. All reports shall be archived for future use.

b. All reports built by the APS will utilize a web interface to the County's existing SQL Server with Visual Studio, to enter data or otherwise access a report. Coordinate with Owner.

c. All reports shall include the ability to manually edit data in case of data loss, and for manual entry for equipment not connected to the HMI.Manual entries shall be flagged in the

database, and the spreadsheet cell shall be shaded in the printed report or otherwise clearly indicated.

d. Examples of some of the following reports will be included in Appendix A of this Section. Coordinate with Owner for full templates.

e. The following reports shall be provided:

i. Alarm Reports as described elsewhere in this Section.
ii. Daily Analyzer Report. Min/Max/Average for Day plus each of 24 Hours. All NWRF & EWRF Disk Filters Turbidity Analyzers
iii. Daily Operational Lab Sheet. Min/Max/Average for Day plus each of 24 Hours. Add to the Daily Operational Lab Sheet all readings from the EWRF and NWRF Disk Filters including Disk Filter Effluent Turbidity.
iv. Network Uptime Report. Monthly report. 0-100% uptime for each distinct SCADA node (Server, Workstation, PLC, etc.) and for each Profibus device.

9. System Database

a. The structure of the system database shall be hierarchical, and initial configuration of the database shall be performed by the APS. The database shall have the following features:

i. Analog Inputs: Point identification number; point name; current value; scan period assigned; the type of raw input either linear or non-linear, and if nonlinear, the linearization used; instrument input range (reasonability limits); high and low emergency and advisory alarm limit pairs; instantaneous and sustained rate of change alarm limits, flags for Return-to-Normal alarms; and physical termination point information.
ii. Contact Inputs: Point identification number; point name; current status; normal state; scan period assigned; and physical termination point information.
iii. Analog Outputs: Point identification number; point name; current status; and physical termination point information.

iv. Contact Outputs: Point identification number; point name; current status; period of actuation if momentary; and physical termination point information.

b. Historical Data Management. The following features shall be provided for processing and storage of system historical data:

i. Data Processing. The real time application for calculations shall pass averages accumulated totals (as applicable) for all Control System variables to the Historical data base. The primary server shall transfer the averages to the redundant machine.
ii. Data Storage. Historical data and Maintenance Management data shall be retained on the Network Attached Storage (NAS) device for a minimum of 1 year.
iii. Data archiving. Hourly and daily data, laboratory data, logs, and administrative data, shall be automatically archived to the NAS as they are generated.

10. Security

a. Primary login to HMI Workstations shall be via fingerprint scanners. Coordinate with Owner to issue a username and password to each employee as a backup to the fingerprint access. Login credentials at the EWRF should utilize SIMATIC Logon, a centralized subsystem that is part of the WinCC HMI.

b. Access levels shall be as follows, with each succeeding level having all the capabilities of the prior levels as well as its own as described.

i. Guest. Guest is the default login mode. Guest can view all operational screens (process, alarms, trends), but is strictly view only.
ii. Operator. Operator can start/stop equipment, open/close valves, set equipment auto/manual, make setpoint changes, and manage alarms. Operator cannot perform certain functions restricted to Lead Operator.
iii. .Lead Operator. Lead Operator can modify setpoints related to compliance instruments. Coordinate with Owner for more Lead Operator restricted functions.

iv. Administrator. Administrator can reset flow or equipment totals, change PID parameters or analog scaling.

c. Workstations shall logout after being idle for 10 minutes, and default to Guest login.

d. All HMI login and logout activity shall be recorded. The log file shall be in a readily readable format, such as CSV.

PART 2 - PRODUCTS

A. Supplementary Control Narratives

1. The following control narratives are provided as supplements to the schematic and written information provided in the Instrumentation Drawings. Not all controls are represented in this Section. All questions and proposed alternatives should be coordinated with the Engineer and/or the Owner.

2. NWRF & EWRF Disk Filters (Processes 065 & 570, respectively). The following control strategy will reside within the disk filter manufacturer's control panels and will be programmed by the disk filter manufacturer. The ISS shall program the SCADA Interface Panel to communicate with all Disk Filter Control Panels and integrate all miscellaneous signals that are not within the scope of the Disk Filter Manufacturer.

a. The disk filters system will be controlled via individual filter control panels. The individual filter control panels will be the responsibility of the filter manufacturer and will provide control of the components internal to each filter as well as communicate with the actuated filter influent valves. Each individual disk filter control panel will relay specific information to and from the Plant SCADA system, as well as communicate with common components external to the filter units

b. During normal operation all disk filters will be placed in service with their influent valves open. Each filter will be controlled via a dedicated filter control panel supplied by the filter manufacturer. A submersible level transducer shall

provide the level within each filter to the filter control panel. Two level switches shall also be supplied with the filter. The activation of the backwash level switch shall initiate the backwash sequence through the filter control panel. The filter shall remain in operation with the influent valve open during backwash operations. The overflow level switch shall be activated prior to the filter discharging over the overflow weir. Upon activation of the filter overflow level switch the filter control panel shall automatically close the filter influent valve to take the individual filter out of service. Filter influent valve shall remain in last position in the event of loss of power.

c. Provide the capability for the operator to manually control the filter influent vale to override automatic overflow control.

d. Each filter influent valve shall have a position setpoint and position indication (0-100% Open) available in SCADA such that the operator can adjust the position of each influent valve remotely. Open limit and closed limit positions shall also be displayed at SCADA.

e. The following filter conditions shall provide an alarm to SCADA:
   i. Filter High Level (Backwash)
   ii. Backwash Pump Fail
   iii. Disk Filter #XX Valve Fail (Common valve alarm for all valves on each filter)
   iv. Backwash Low Flow

f. The following filter conditions shall provide an alarm to SCADA and remove the corresponding filter vessel from service:
   i. Filter High High Level (Overflow)

PART 3 - EXECUTION

A. Tests (General)

1. The APS shall test all programming, configuration and

networking services to be furnished under this Contract. The APS shall conduct its testing as an integral part of, and in coordination with, the Instrumentation System Supplier’s required testing as defined in Section 13300.

B. Training

1. The cost of Owner training programs shall be included in the Contract price.

2. All Technicians, Operators, Engineers, and Managers of the Treatment Facility will require training on the System. The APS shall be responsible for providing detailed Operation and Maintenance (O&M) Manuals and training courses.

3. The O&M Manuals shall include specific details of the equipment supplied and details of operations specific to this Project. The training courses will deal with

   fundamentals of the software and networks utilized in the project, and the specific application programming developed for it.

4. All instructors must be very familiar with the operation and control of the Owner’s facility.

5. The training shall be structured as follows:

   a. The system training program shall be structured such that the operating personnel will understand the system's operation, and the functions available in the system.
   b. The level and amount of training will be based on the understanding of the individual staff members. Preventive and corrective maintenance of system devices and hardware shall be presented.

   c. A number of basic theory courses shall be provided to give the operators an appreciation of how the system can help them perform their jobs.

6. The APS shall provide detailed manuals and shall include specific details of equipment supplied and operations specific to the project.

7. The APS shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.

8. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

9. On Site Training for operator personnel shall deal with fundamentals of system hardware and software, field devices, instrumentation calibration and maintenance. Training shall cover all aspects of the instrumentation and controls system. Training is expected to cover a period of not less than three (3) eight-hour days.

C. Warranty / Maintenance Requirement

1. A written maintenance contract executed by the APS shall be provided to the Owner for on-site warranty services. This contract shall include all labor and emergency calls providing on-site response within 24 hours, to provide complete system operability for a period of one year after the successful completion of the Performance Acceptance Test.

2. The costs for the one-year maintenance service contract shall be included as a separate line optional adder in the APS's Contract Price.

END OF SECTION

APPENDIX A

SAMPLE REPORTS

Eastern Service Area
Daily Operational Lab Sheet

DATE	11/1/2012				CHLORINE RESIDULE			TURBIDITY		CHLORINE DOSING RATES AND LOCATIONS							
time	Influent Hourly Flow Rate	pH								Phase 2 CCC		Phase 2 A B W		Phase 3 CCC		Phase 3 A B W	
		Phase 2	CC 3	CC 4	Phase 2	CC 3	CC 4	Phase 2	Phase 3	Speed	Stroke	Speed	Stroke	Speed	Stroke	Speed	Stroke
1:00	23.0	7.8	7.6	7.4	4.0	1.1	2.8	1.5	4.9	40	40	30	30	75	75	40	40
2:00	16.0	7.8	7.6	7.5	4.9	1.4	4.1	1.4	2.2	40	40	30	30	75	75	40	40
3:00	16.0	7.8	7.6	7.7	4.9	1.1	5.0	1.1	2.2	40	40	30	30	75	75	40	40
4:00	14.0	7.8	7.7	7.7	4.9	1.9	5.0	1.3	2.9	40	40	30	30	60	60	40	40
5:00	14.0	7.8	7.7	7.7	4.9	4.0	5.0	1.4	2.7	40	40	30	30	50	50	40	40
6:00	17.0	7.8	7.7	7.7	4.9	4.2	5.0	1.2	2.6	40	40	30	30	50	50	40	40
7:00	26.0	7.8	7.7	7.6	4.9	4.1	5.0	1.1	2.0	40	40	30	30	60	60	40	40
8:00	30.0	7.8	7.7	7.5	4.9	3.9	0.8	1.4	2.3	40	40	30	30	70	70	40	40
9:00	28.0	7.8	7.9	7.5	4.8	1.6	3.5	1.5	1.6	40	40	30	30	80	80	40	40
10:00	27.0	7.7	7.6	7.5	3.7	2.0	3.1	1.5	4.5	40	40	30	30	90	90	40	40
11:00	27.0	7.7	7.6	7.7	3.2	4.5	3.2	1.6	1.3	40	40	30	30	90	90	40	40
12:00	27.0	7.7	7.6	7.7	3.7	4.9	3.3	1.3	1.6	40	40	30	30	90	90	40	40
13:00	29.0	7.7	7.6	7.7	4.8	4.1	3.3	1.4	1.4	40	40	30	30	90	90	40	40
14:00	28.0	7.7	7.7	7.7	4.8	4.6	3.1	1.5	1.4	40	40	30	30	90	90	40	40
15:00	24.0	7.7	7.7	7.8	4.5	4.8	3.1	1.3	4.9	40	40	30	30	90	90	40	40
16:00	26.0	7.7	7.7	7.8	4.5	4.9	3.4	1.3	2.9	40	40	30	30	80	80	40	40
17:00	27.0	7.7	7.7	7.8	4.5	4.8	3.5	1.4	1.7	40	40	30	30	80	80	40	40
18:00	28.0	7.7	7.7	7.8	4.5	4.7	3.4	1.4	1.6	40	40	30	30	80	80	40	40
19:00	28.0	7.7	7.7	7.7	4.3	4.6	3.0	1.4	1.5	40	40	30	30	80	80	40	40
20:00	31.0	7.7	7.6	7.7	3.5	2.8	3.1	1.5	1.9	40	40	30	30	100	100	40	40
21:00	31.0	7.7	7.6	7.5	3.1	1.0	4.2	1.5	3.0	40	40	30	30	140	100	40	40
22:00	31.0	7.7	7.5	7.5	2.9	1.0	4.1	1.5	1.9	40	40	30	30	140	100	40	40
23:00	25.0	7.7	7.5	7.4	3.0	1.3	3.7	1.5	2.0	40	40	30	30	140	100	40	40
0:00	23.0	7.7	7.6	7.3	3.0	1.3	2.8	1.6	1.8	40	40	30	30	140	100	40	40
TOTAL	596.0	185.7	183.6	182.9	101.1	74.6	86.5	33.6	56.8	960.0	960.0	720.0	720.0	2115.0	1955.0	960.0	960.0
AVERAGE	24.8	7.7	7.7	7.6	4.2	3.1	3.6	1.4	2.4	40.0	40.0	30.0	30.0	88.1	81.5	40.0	40.0
Min	14.0	7.7	7.5	7.3	2.9	1.0	0.8	1.1	1.3	40.0	40.0	30.0	30.0	50.0	50.0	40.0	40.0
Max	31.0	7.8	7.9	7.8	4.9	4.9	5.0	1.6	4.9	40.0	40.0	30.0	30.0	140.0	100.0	40.0	40.0

Chlorine Useage

	Phase 2				Phase 3			
	start	stop	used		start	stop		used
1	1800	1550	250	1	1800	1550		250
			0					0
2	1800	1550	250	2	1800	1550		250
			0					0
3	1800	1550	250	3	1800	1550		250
			0		1800	1550		250

Total by Phase			
Phase 2	750	Phase 3	1000
Total Chlorine Usage (day total)			1750

Phase 2					Phase 3					
Month:	Daily MLSS	7Day Avg. MLSS	Daily RAS	7Day Avg. RAS	Month:	Daily MLSS	7Day Avg. MLSS	Daily RAS	7Day Avg. RAS	Month:
	2900	2900	6400	6400		3300	3300	8200	8200	
	3000	2950	7600	7000		3500	3400	9900	9050	
	3400	3100	9300	7767		4200	3667	9900	9333	
	3200	3125	8500	7950		3700	3675	8800	9200	
	3500	3200	8900	8140		3800	3700	8700	9100	
	3600	3267	6800	7917		4000	3750	8800	9050	
	3600	3314	7000	7786		4000	3786	8700	9000	
1/29/00	3600	3414	6500	7800	1/29	4000	3886	8700	9071	1/29
1/30/00	3500	3486	6700	7671	1/30	3900	3943	8800	8914	1/30
1/31/00	3800	3543	7700	7443	1/31	3900	3900	8800	8757	1/31
2/1/00	3600	3600	7800	7263	2/1	3800	3914	8900	8771	2/1
2/2/00	3500	3600	6700	7029	2/2	3900	3929	8800	8786	2/2
2/3/00	3800	3629	7700	7157	2/3	3900	3914	8800	8786	2/3
2/4/00	3600	3629	7800	7271	2/4	3800	3886	8900	8814	2/4
2/5/00	2700	3500	5800	7171	2/5	2900	3729	7600	8657	2/5
2/6/00	2900	3414	5400	6986	2/6	3000	3600	7600	8486	2/6
2/7/00	2800	3271	5700	6517	2/7	2900	3457	7500	8300	2/7
2/8/00	2900	3171	6100	6457	2/8	3000	3343	7600	8114	2/8
2/9/00	2700	3057	6000	6357	2/9	3000	3214	7800	7971	2/9
2/10/00	2800	2914	7000	6257	2/10	3000	3086	7200	7743	2/10
2/11/00	2800	2800	5800	5971	2/11	2900	2957	7800	7586	2/11
2/12/00	3100	2857	7800	6257	2/12	3300	3014	7600	7586	2/12
2/13/00	3500	2943	7000	6486	2/13	3300	3057	7700	7600	2/13
2/14/00	3400	3029	7400	6729	2/14	3300	3114	7700	7629	2/14
2/15/00	3600	3129	7400	6914	2/15	3400	3171	7800	7657	2/15
2/16/00		3200		7067	2/16		3200		7633	2/16
2/17/00		3280		7080	2/17		3240		7720	2/17
2/18/00		3400		7400	2/18		3325		7700	2/18
2/19/00		3500		7267	2/19		3333		7733	2/19
2/20/00		3500		7400	2/20		3350		7750	2/20
2/21/00		3600		7400	2/21		3400		7800	2/21
2/22/00		#DIV/0!		#DIV/0!	2/22		#DIV/0!		#DIV/0!	2/22
2/23/00		#DIV/0!		#DIV/0!	2/23		#DIV/0!		#DIV/0!	2/23
2/24/00		#DIV/0!		#DIV/0!	2/24		#DIV/0!		#DIV/0!	2/24
2/25/00		#DIV/0!		#DIV/0!	2/25		#DIV/0!		#DIV/0!	2/25
2/26/00		#DIV/0!		#DIV/0!	2/26		#DIV/0!		#DIV/0!	2/26
2/27/00		#DIV/0!		#DIV/0!	2/27		#DIV/0!		#DIV/0!	2/27
2/28/00		#DIV/0!		#DIV/0!	2/28		#DIV/0!		#DIV/0!	2/28
avg.	3256	#DIV/0!	6794	#DIV/0!	avg.	3400	#DIV/0!	8089	#DIV/0!	avg.
min	3800	#DIV/0!	5400	#DIV/0!	min	4000	#DIV/0!	7200	#DIV/0!	min
max	3800	#DIV/0!	7800	#DIV/0!	max	4000	#DIV/0!	8900	#DIV/0!	max

Phase 4

Daily MLSS	7Day Avg. MLSS	Daily RAS	7Day Avg. RAS
3600	3600	7900	7900
4050	3825	9900	8900
4200	3950	9900	9233
3800	3913	8700	9100
3900	3910	8300	8940
4100	3942	8200	8817
4100	3964	7700	8657
3900	4007	7900	8657
3900	3986	8000	8386
4300	4000	8200	8143
3700	3986	8000	8043
3900	3986	8386	8055
3900	3957	8200	8055
3700	3900	8000	8098
3000	3771	7800	8084
3100	3657	7200	7969
3000	3471	7600	7884
3200	3400	7400	7798
3100	3286	7500	7671
3400	3214	6000	7357
3300	3157	7900	7343
3300	3200	8100	7386
3300	3229	6800	7329
3400	3286	7000	7243
3600	3343	7500	7257
	3383		7217
	3380		7460
	3400		7350
	3433		7100
	3500		7250
	3600		7500
	#DIV/0!		#DIV/0!
	#DIV/0!		#DIV/0!
	#DIV/0!		#DIV/0!
	#DIV/0!		#DIV/0!
	#DIV/0!		#DIV/0!
	#DIV/0!		#DIV/0!
	#DIV/0!		#DIV/0!
3500	#DIV/0!	7638	#DIV/0!
4300	#DIV/0!	6000	#DIV/0!
4300	#DIV/0!	8386	#DIV/0!

EWRF					
Mass Balance					
Phase II					
Base Numbers					
Fermentation	499784	gallons	Flow	0	MGD
1st Anoxic	912,500	gallons	Avg MLSS	0	mg/l
Air Bays	3015218	gallons	Settleometer	0	
2nd Anoxic	501669	gallons	Avg Raw TSS	0	mg/l
Re-Aeration	55741	gallons	Avg Raw CBOD	0	mg/l
Total	4984912	gallons	WAS Flow	0	MGD
			RAS concentration	0	mg/l
			WAS Pounds	0	
Calculations					
Pounds of solids within biological treatment tankages				**0**	
Pounds of solids in raw sewage				**0**	
Pounds of CBOD in raw sewage				**0**	
Waste pounds				**0**	
Sludge Age (days)				**#DIV/0!**	
SRT (days)				**#DIV/0!**	
SVI				**#DIV/0!**	
F/M Ratio				**#DIV/0!**	
Desired waste pounds		Desired MLSS	3000	**124722**	
Desired waste rate		Based on pounds under air		**#DIV/0!**	(MGD)
Phase III					
Base Numbers					
Fermentation	593278	gallons	Flow	0	MGD
1st Anoxic	1,070,296	gallons	Avg MLSS	0	mg/l
Air Bays	3769300	gallons	Settleometer	0	
2nd Anoxic	584644	gallons	Avg Raw TSS	0	mg/l
Re-Aeration	92416	gallons	Avg Raw CBOD	0	mg/l
Total	6109934	gallons	WAS Flow	0	MGD
			RAS concentration	0	mg/l
			WAS Pounds	0	
Calculations					
Pounds of solids within biological treatment tankages				**0**	
Pounds of solids in raw sewage				**0**	
Pounds of CBOD in raw sewage				**0**	
Waste pounds				**0**	
Sludge Age (days)				**#DIV/0!**	
SRT (days)				**#DIV/0!**	
SVI				**#DIV/0!**	
F/M Ratio				**#DIV/0!**	

Desired waste pounds		Desired MLSS	3000	**152871**	
Desired waste rate		Based on pounds under air		**#DIV/0!**	(MGD)
	=	Calculated formulas	10	10	

Phase II 10 day SRT needed waste #DIV/0! Phase III 10 day SRT needed waste #DIV/0!

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SECTION 13310 PROGRAMMABLE LOGIC CONTROLLER (PLC) AND DIGITAL EQUIPMENT

PART 1 - GENERAL

A. Scope of Work

1. The General Provisions of Section 13300 apply to this Section.

2. All the Work in this Section shall be the product of the Instrumentation System Supplier (ISS). Components and enclosures may be provided to the ISS by sub-suppliers and/or manufacturers, but the packaging of these components and the production of the final product shall conform to this specification and shall be the sole responsibility of the ISS.

B. Submittals

Refer to Section 13300.

C. Delivery, Storage and Handling

Refer to Section 13300.

D. Spare Parts

1. In addition to the spare parts listed in other instrumentation sections, provide the following:

2. Programmable Logic Controller (PLC) and associated equipment:

   a. Provide one (1) spare plus one for every ten (10) of any given component supplied.

   b. Provide one (1) spare CPU battery for each CPU supplied.

   c. Provide a spare removable nonvolatile memory card for each new and modified PLC, pre-loaded with the as-built program for that PLC.

3. Networking equipment: one (1) spare plus one for every ten (10) of each type of ProfiNet and Ethernet (or ProfiBus) communications device supplied.

4. Network patch cables, CAT-6: One (1) per every five (5) furnished.

5. Storage media: a minimum of twenty-five (25) of each type of media used by the PCs, such as CD-Rs and DVD+Rs, with storage cases.

PART 2 - PRODUCTS

A. Personal Computer (PC) Servers and Workstations: General Requirements

The Contractor ISS shall provide the PC. The ISS shall use these specifications as a guide to determine the cost of the equipment required. The exact PC hardware shall be the latest proven technology available at the time of actual purchase of equipment.

B. SCADA Servers

1. Provide new SCADA servers, uninstalled.

2. Quantity:

   a. EWRF 4

   b. NWRF 3

3. Meet the following requirements:

   a. Processors: Intel Xeon E5-2699A v4 2.4 GHz, 55M Cache, 9.60GT/s QPI, Turbo, HT, 22C/44T. Upgrade to Two Processors.

   b. 2 CPU Standard Processor Thermal Configuration

   c. Memory DIMM type and Speed: 2400MT/s RDIMMs

   d. Trusted Platform Module

   e. Chassis configuration: up to 16 2.5” hard drives, MLK

   f. Performance Optimized Memory Configuration Type

   g. Memory Capacity: 32GB RDIMM, 2400MT/s, Dual Rank, x4 Data Width

   h. RAID 5 configuration for H330/H730/H730P (3-16 HDDs or SSDs)

i. PERC H730P RAID Controller, 2GB NV cache

j. Hard Drives: 1.6TB Solid State Drive SATA Mix Use MLC 6Gbps 2.5in Hot-plug drive, S3610

k. Broadcom 5720 QP 1Gb Network Daughter card

l. Embedded Systems Management: IDRAC8 Enterprise, Integrated Dell Remote Access Controller Enterprise

m. Internal SD Module with 1x 8GB SD Card

n. Internal Optical Drive: DVD+/-RW, SATA

o. Quick Sync Bezel

p. Readyrails sliding rails with cable management arm

q. Power Management BIOS Settings: Power Saving Dell Active Power Controller

r. Power Supply: Dual, Hot-plug, Redundant Power Supply, (1+1), 1100W

s. Power cords: NEMA 5-15P to C13 Wall Plug, 125 V, 15 Amp, 10 feet, power cord, North America

t. Electronic System Documentation and OpenManage DVD Kit

u. Operating System: Windows Server 2012R2, Standard Ed, Factory Inst, No MED, 2SKT, 2VM, NO CAL

v. Windows Server 2012R2, STD OS Media Kit with Factory Inst STD DGRD images

w. 10-pack of Windows Server 2012 User CALs

x. PCle Risers with uo to 1, x8 PCle Slots +2, x16PCle Slots

y. ProSupport Plus Hardware Support Services, 7 year Mission Critical 4 hour Onsite Service

z. ProDeploy Plus Dell Server R Series 1U/2U Deployment services

aa. Deployment Consulting 1 year 1 Case Remote Consulting Services

bb. Keep Your Hard Drive, 7 years

cc. Dell Proactive Systems Management

dd. Manufacturer: Dell PowerEdge R730 Rack Server, no equal.

4. If the manufacturer/model specified is not available at the time of construction, or has been superseded by a newer model, coordinate and update specific model to be provided with the Owner/Engineer.

C. Printers

1. Provide new Ethernet network printers uninstalled.

2. Quantity:

a. EWRF 1

b. NWRF 1

3. Manufacturer/model: HP Color LaserJet Enterprise Flow M651XH, no equal.

4. If the manufacturer/model specified is not available at the time of construction, or has been superseded by a newer model, coordinate and update specific model to be provided with the Owner/Engineer.

D. Desktop Operator Workstation Monitors

1. Provide new Desktop Operator Workstation monitors, uninstalled.

2. Quantity:

a. EWRF 4

b. NWRF 2

3. Manufacturer/model: Dell U3415W, no equal.

E. Wall Mount Monitors

1. Provide new Wall Mount monitors, uninstalled.

2. Quantity:

a. EWRF 4

3. Manufacturer/model: Planar PS Series 65” with wall mounts, no equal.

F. Operator Workstation Computers

1. Provide new Operator Workstation computers, uninstalled, to be operated as thin clients.

2. Quantity:

a. EWRF 2

b. NWRF 2

3. Provide Dell Optiplex Desktop 3000 series computers, or approved equal.

G. Panel Mounted Industrial Workstations

1. Panel Mounted Industrial Workstations shall be mounted on control panels where indicated on the Drawings, and shall be set up to run the HMI software applications and other software.

2. Manufacturer: Siemens Simatic HMI model 6AV2124-0QC13-OAXO, no equal.

H. PROFINET Network Switch

1. General: Provide PROFINET network switch(es) for the control network as shown in the Drawings and specified herein. Include a PROFINET network switch at each Disk Filter PLC location.

2. Physical Features:

a. Fiber uplinks: 100/1000 FX ports, as required plus 25 percent

b. Copper ports: 10/100/1000 TX RJ45 ports, as required plus 25 percent

c. Operating temperature: 32 to 130 degrees F

d. Power: 120VAC, 60Hz

e. Enclosure: Metal case. Provide 19” rack form factor, or DIN-rail mounted for industrial environments, as required for the location.

3. Network Features:

a. Fault tolerant for use in a ring topology if shown on drawings

b. Full duplex on all ports

c. Auto negotiation and manual configurable speed and duplex

d. Wire speed switching fabric

e. IEEE 802.1w RSTP

f. IGMP snooping

g. IGMP filtering

h. Configuration password protected

i. Configuration backup capability required

j. SNMP V3

4. Manufacturers:

a. Siemens Scalance, model X212-2

I. SCADA Network Switch

1. General: Provide SCADA Ethernet network switch(es) for the control network as shown in the Drawings and specified herein. Provide a heavy duty, managed Ethernet network switch at each Disk Filter PLC location.

2. Physical Features:

a. Fiber ports: 10/100/1000 Mb Fiber ports, as required

b. Copper ports: Four 10/100 TX RJ45 ports, as required

c. Operating temperature: 32 to 130 degrees F

d. Power: 120VAC, 60Hz

e. Enclosure: Aluminum case. Provide 19” rack form factor, or DIN-rail mounted for industrial environments, as required for the location.

3. Network Features:

a. Fault tolerant for use in a ring topology if shown on drawings

b. Full duplex on all ports

c. Auto negotiation and manual configurable speed and duplex

d. Wire speed switching fabric

e. IEEE 802.1w RSTP

f. IGMP snooping

g. IGMP filtering

h. Configuration password protected

i. Configuration backup capability required

j. SNMP V3

4. Manufacturers:

a. Existing switches at NWRF Facility are Garretcom Magnum 6KQE, add one (1) Garretcom Magnum 6KQE at each Disk Filter PLC location, no equal.

b. At EWRF, provide Garretcom Magnum 6KQE at each Disk Filter PLC location, or approved equal

J. Human-Machine Interface (HMI) Software

1. ISS shall purchase, and turn over to the APS for use in application development, the following software. The software licenses shall be in the Owner’s name, and shall be turned over to the Owner upon conclusion of the project.

2. WinCC Process Historian, for up to 65k tags, qty (1)

3. Process Historian server, qty (1)

4. WinCC Change Control, qty (1)

5. WinCC Audit, qty (1)

6. WinCC Web Navigator, 10 client, qty (1)

7. WinCC Web Navigator Load Balancing, qty (2)

8. WinCC license, make sure version is compatible.

9. Separate server box for reporting at EWRF.

K. Programmable Logic Controller (PLC)

1. ISS shall furnish and install PLC equipment as required by the Drawings and the following Specification and in accordance with the attached data sheets, including all necessary auxiliary equipment, in order to provide a fully integrated and working system.

2. Components shall be chosen from the list in this Section and assembled such that the intended function is achieved. In general, each PLC shall be equipped with one (1) CPU and one (1) Power Supply per rack, input/output modules as needed, and any communication modules needed to interface with remote I/O racks, the existing plant network, or other network devices. Furnish all cables, connectors, and ancillary devices necessary for the complete functioning of each PLC. Any components needed that are not listed shall be by Siemens or those recommended by Siemens, or its authorized representative in writing.

3. The system shall include in each location:

   a. One PLC processor.

   b. One communication module for PROFINET, in each PLC rack, connected to a PROFINET network switch.

   c. One communication processor for the Plant SCADA Ethernet, in each PLC rack, connected to a Plant SCADA Ethernet network switch.

   d. I/O modules as required.

   e. Patchcords and cables as necessary

4. Provide a minimum of twenty-five percent (25%) active spare I/O points of each type, and twenty-five percent (25%) room for future I/O modules in each PLC. All new, existing, and future I/O points, as shown on the Drawings or discovered in field investigation, shall be included in the total count for the purpose of determining the quantity of spares required.

5. CPU usage shall be tested, and shall not exceed 50% of capacity under full load conditions. ISS shall coordinate with APS (Application Programming Supplier) to ensure that the CPU and RAM selected are adequate to the application needs.

6. Distribute series of I/O points across multiple modules and racks so as to eliminate a single point of failure. For example, if there are two identical pumps, terminate the I/O for each pump in a different card and a different rack with separate power supply where possible.

7. Components used shall be manufactured by Siemens, and selected from the following list:

Product Description	Article Number
Siemens Simatic CPU 1516-3 PN/DP	6ES7516-3AN01-0AB0
Memory Card, 256 MB	6ES7954-8LL02-0AA0
Load Current Supply PM 190W, 120/230 VAC, 24VDC, 8A	6EP1333-4BA00
IM 155-5 PN HF	6ES7155-5AA00-0AC0
System Power Supply, PS 60W 24/48/60V DC	6ES7521-1BH00-0AB0
Digital Input Card DI 16x24 VDC HF	6ES7521-1BH00-0AB0
Digital Output Card DQ 16x24 VDC/0.5A HF	6ES7522-1BH01-0AB0
Analog Input Module AI 8xU/R/RTD/TC HF	6ES7531-7PF00-0AB0
Analog Output Module AQ 4xU/I HF	6ES7532-5ND00-0AB0
Mounting Rail S7-1500, 482 mm, for 19” cabinets	6ES7590-1AE80-0AA0
Mounting Rail S7-1500, 2000 mm,	6ES7590-1BC00-0AA0

Product Description	Article Number
Front Connector, push-in system for 35mm modules, 40-pin	6ES7592-1BM00-0XB0
SIMATIC STEP 7 Professional COMBO SUS Standard	6ES7810-5CC04-0YE2
Communication Module, CM 1542-1, PROFINET Controller	6GK7542-1AX00-0XE0
Communication Processor, CP 1543-1, Industrial Ethernet	6GK7543-1AX00-0XE0

a. For any required components that are not included in this list, reference OCU SCADA Appendix H-21.

L. Uninterruptible Power Supply (UPS) for Control Panels

1. Unless otherwise indicated on the Drawings, the power supplied to all microprocessor-based equipment within a PLC control panel shall be protected by an Uninterruptible Power Supply (UPS) mounted within the panel. The UPS shall prevent spikes, sags, surges, noise, and harmonics from adversely affecting digital equipment.

2. UPS input and output shall be galvanically isolated from one another. Input power shall be 120 VAC, 60 Hz. Output power may be 120VAC, 24VDC, or as needed to support connected equipment.

3. UPS shall contain internal backup batteries sufficient to allow all connected equipment to run continuously for no less than 15 minutes at full load. Provide load calculations which show these requirements to be met.

4. UPS shall include normally closed contact outputs for “On Battery” and “Low Battery/Fault”, which shall be picked up by the PLC for operator notification.

5. UPS units shall be UL508/1778 labeled and capable of being mounted within UL508 approved cabinets without derating.

6. UPS shall be Siemens UPS1600 (6EP4136-3AB00-2AY0) panel-mounted UPS, no equal.

7. Provide and install UPS1100 Battery Module (6EP4135-0GB00-OAYO), no equal.

PART 3 - EXECUTION

Refer to Section 13300.

END OF SECTION

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SECTION 13315 FIELD INSTRUMENTATION

PART 1 - GENERAL

A. Scope of Work

1. The General Provisions of Section 13300 apply to this Section.

2. Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.

B. Related Work

Refer to Section 13300.

C. Submittals

Refer to Section 13300.

D. Reference Standards

Refer to Section 13300.

E. Quality Assurance

Refer to Section 13300.

F. Spare Parts

1. Furnish one year's supply of items recommended by the Manufacturer of the equipment for each component.

2. Provide other spare parts as indicated on the individual device specifications.

PART 2 - PRODUCTS

A. Float Switch

1. Type: Ball float switch.

2. Functional/Performance:

a. Differential: Less than one inch.

b. Switch Rating: Form C, 20 amps at 120V AC, 10 amps at 240V AC.

3. Physical:

   a. Float: 316 stainless steel or PVC, 5½-inch diameter.

   b. Switch: Totally encapsulated “environmentally friendly” non-mercury switch.

   c. Cable: Heavy duty, PVC jacketed, integral to float.

4. Options/Accessories Required:

   a. Provide 316 stainless steel mounting hardware.

   b. The floats shall be mounted on hooks inside the wetwell, to be provided and installed by the Contractor. Refer to detail on Drawing D-110-101 for typical installation.

   c. The lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the wetwell.

   d. Provide a NEMA 4X junction box outside the wetwell with terminals for all floats and tapped as required for conduit connections.

5. Manufacturer:

   a. Anchor Scientific

   b. US Filter (Consolidated Electric Co.)

   c. Warrick Controls

6. Units To Be Supplied By ISS at EWRF:

   a. LSH 570-1A : Disc Filter High Alarm Level

7. Units To Be Supplied By ISS at NWRF:

   a. LSH 065-1A : Disc Filter High Alarm Level

B. Flood Level Switch

1. Type: SPST hermetically sealed reed switch.

2. Functional/Performance:

a. Switch Rating: 20 VA: 0.17 amps at 120V AC, 0.08 amps at 240V AC.

3. Physical:

a. Switch: Hermetically sealed reed switch.

4. Options/Accessories Required:

a. Provide 316 stainless steel mounting hardware.

b. The floats shall be mounted inside the channel or containment area, to be provided and installed by the Contractor.

c. The lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the wet area.

d. Provide a NEMA 4X junction box outside the wet area with terminals for all switches and tapped as required for conduit connections.

5. Manufacturer:

a. Dwyer Instruments Model F6-SS, or approved equal.

6. Units To Be Supplied By ISS at EWRF:

a. LSHH 570-1B : Disc Filter Effluent Channel High-High Alarm Level
b. LSH 570-1C: Containment High Level
c. LSH 570-1D: Containment High Level

7. Units To Be Supplied By ISS at NWRF:

a. LSHH 065-1B : Disc Filter Effluent Channel High-High Alarm Level
b. LSH 065-1C: Containment High Level
c. LSH 065-1D: Containment High Level

C. Turbidity Analyzer

1. Type: Micro processor based, continuously flowing, 90 degree light refractive type turbidimeter.

2. Functional/Performance:

a. Accuracy: +/-2% of reading or +/-0.020 NTU (whichever is greater) from 0 to 40 NTU; +/-5% of reading from 40

to 100 NTU. The repeatability of the unit shall be +/- 1% of the reading.

b. Resolution - The resolution shall be 0.001 NTU

c. Range - the instrument shall be capable of measuring turbidity from 0 to 100 NTU.

d. Output – Profibus DP serial connection transmitting measured suspended solids concentration, and all available diagnostic data.

e. Stability - The device shall be able to operate within 0 to 40 degrees Celsius and shall produce accurate readings under 0-95 % non condensing humidity conditions.

f. Power Requirements - 120 Vac with internal surge protection.

3. Physical:

a. The turbidimeter shall have a 1/4" female inlet with a 1/4" compression fitting. The drain shall be 1/2" NPT female with a 1/2" hose barb.

b. Provide a complete handrail mounting system or flow through tee mounting system as required to meet the application. The handrail mounting system shall include PVC mounting pipe (length as required) and stainless steel mounting hardware. The flow through tee mounting system shall include all flow regulators, pressure regulators, shutoff valves, sample pumps, etc, as detailed or required for complete operational system.

c. Provide sensor cable of sufficient length for installation without splices between the sensor and transmitter.

4. Manufacturers:

a. Hach Solitax sc Turbidity sensor and sc1000 transmitter

5. EWRF Units To Be Supplied By ISS

a. 580-AE/AIT-1: Disk Filters Effluent Turbidity
   i. Scale: 0-10 NTU

b. 580-AE/AIT-2: Disk Filter Effluent Turbidity

i. Scale: 0-10 NTU

D. Flow Switch

1. Type: Diaphragm flow sensing device.

a. Power Requirements - 120 Vac.

2. Physical:

a. Housing – NEMA 4X enclosure.

3. Manufacturers:

a. McDonnell & Miller Series FS6-W Flow Switch, or approved equal.

4. NWRF Units To Be Supplied By ISS

a. 065-FS-1: Emergency Eyewash Flow Switch

b. 065-FS-2: Emergency Eyewash Flow Switch

c. 065-FS-3: Emergency Eyewash Flow Switch

5. EWRF Units To Be Supplied By ISS

a. 570-FS-1: Emergency Eyewash Flow Switch

b. 570-FS-2: Emergency Eyewash Flow Switch

c. 570-FS-3: Emergency Eyewash Flow Switch

E. Capacitance Level Sensor

1. Type: Capacitance level sensor and transmitter. Provide inverse frequency shift capacitance continuous level transmitter for liquid applications.

2. Functional/Performance:

a. Accuracy : Deviation <0.5% of actual measurement value.

b. Range – 1.66 to 3300 pF.

c. Output – 4-20 mA loop current.

d. Power Supply – 12-30 VDC any polarity, 2-wire current loop circuit.

3. Physical:

   a. Provide a complete handrail mounting system as required to meet the application. The handrail mounting system shall be constructed of 316 stainless steel mounting hardware.

   b. Sensor wetted parts shall be PFA, 316L stainless steel.

   c. Provide sensor cable of sufficient length for installation without splices.

4. Manufacturers:

   a. Siemens SITRANS LC300, or approved equal.

5. Units To Be Supplied By ISS

   a. LT 10A102, one for each Disk Filter at both EWRF and NWRF Facilities

F. Pressure Transmitter

1. Type: Digital transmitter for gauge pressure measurement.

2. Functional/Performance:

   a. Accuracy : 0.04%.

   b. Range – 0.01 psi to 2320 psi.

   c. Communication – 4-20 mA loop current, Profibus PA.

3. Physical:

   a. Provide a complete mounting system as required to meet the application. Mounting system components shall be constructed of 316 stainless steel mounting hardware.

   b. Diaphragm materials shall be stainless steel.

   c. Provide sensor cable of sufficient length for installation without splices.

4. Manufacturers:

   a. Siemens SITRANS P410, or approved equal.

5. Units To Be Supplied By ISS

a. NWRF: 065-PIT-1A, one for each Disk Filter

b. EWRF: 570-PIT-1A, one for each Disk Filter

PART 3 - EXECUTION

A. Sunshields

Electronic transmitter or converter boxes that are exposed to direct sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material, of sufficient size to cover the top, sides, and rear of the device (where applicable), and to hang over the front of the device to shade any indicators or displays located there. Sunshield pieces shall be secured by bolts and shall have no less than 1 inch of clearance from the device and from one another, to allow for air circulation over the sunshield surfaces and access to device panel door(s).

END OF SECTION

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SECTION 13320 FIBER OPTIC DATA HIGHWAY NETWORK

PART 1 - GENERAL

A. Scope Of Work

Refer to Section 13300.

B. Submittals

1. Submit to the Engineer, in accordance with Section 13300, the following:

2. Complete manufacturer’s product data. Product data shall be provided for the data highway cables, connectors, patch panels, spares and test equipment. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts and any power supply requirements.

3. Installation Test reports as specified.

4. The ISS shall provide a fiber optic power budget for each cable run in excess of 500 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses and a 3db aging margin. Fiber optic transmission line shall maintain a minimum of 3db safety margin.

5. Manufacturer's Instructions.

C. Reference Standards

1. National Fire Protection Association (NFPA)

   a. NFPA-70 - National Electrical Code (NEC) Article 770.

2. Underwriters Laboratories, Inc. (UL)

   a. UL 1581 VW-1 - Vertical Tray Cable Flame Test

   b. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts.

   c. UL 910 - UL Standard for Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.

3. Institute of Electrical and Electronics Engineers (IEEE)

   a. IEEE Standard 383 - Flame Retardancy.

4. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)

   a. EIA-STD-RS-455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices

5. National Electrical Code Article 770, Optical Fiber Cable and Raceways

   a. NFPA 70

6. Fiber Optic Test Method and Instrumentation

   a. DOD-STD-1678

7. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

D. Quality Assurance

1. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic suppliers who have been providing these types of materials for the past three years. The Fiber Optic suppliers shall provide personnel capable of providing technical assistance and fiber testing during installation.

2. The installation of fiber optic cabling system materials furnished under this Section shall be performed by the fiber manufacturers certified installation contractor who has been installing these types of materials for the past three years.

3. All cabled optical fibers shall be 100% attenuated tested. The attenuation of each fiber shall be provided with each cable reel.

4. The cable manufacturer shall be ISO 9001 registered.

5. The Engineer shall determine whether a product is an "Approved Equal" based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the

manufacturer's data sheets in order to be accepted as an "Approved Equal." Supplier must furnish five (5) working installation references for any alternate equipment along with owner, contact, and telephone number.

E. Delivery, Storage and Handling

1. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

2. When the length of an order requires a large wooden reel the cable will be covered with a three (3) layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

3. Test tails shall be at least two (2) meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.

4. Wooden reels shall be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.

5. The attenuation shall be measured at 850 nm and 1300 nm for multimode fibers. The manufacturer shall ship the test results along with the fiber.

6. Packaging

   a. The completed cable shall be packaged for shipment on non-returnable wooden reels. It is the responsibility of the Contractor to determine all required cable lengths.

   b. Top and bottom ends of the cable shall be available for testing.

   c. Both ends of the cable shall be sealed to prevent the ingress of moisture.

d. Each reel shall have a weather proof reel tag attached identifying the reel and cable.

e. Each cable shall be accompanied by a cable data sheet.

PART 2 - PRODUCTS

A. Manufacturers

1. Corning Cable Systems

2. Or approved equal.

B. Fully Water Blocked Fiber Optic Cable (Outdoor/Indoor)

1. General Considerations

a. All fiber optic cable shall be multimode.

b. The cable shall meet all requirements stated in the specification. Refer to the Control System Block Diagram to determine cabling requirements.

c. Furnish cable containing no fewer than twenty-four (24) fibers.

d. Provide stainless steel ST style connectors for all fiber optic connections. The connectors shall be designed for use with 62.5/125 micron cable, and shall be capable of operating in a range of 0 to 80 degrees C. Each connector shall cause a maximum signal attenuation of 1.6 dB. Connectors shall be provided by Siecor. All fiber optic cables shall be tested for performance and loss after termination and installation to verify that at least a 3 dB power safety margin is obtained between all transmitters and receivers. Test data for each fiber and safety margin calculations for each fiber path shall be provided to the Owner and Engineer after installation to verify conformance with this specification.

2. Fiber Characteristics

a. All fibers in the cable must be usable fibers and meet required specifications.

b. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

c. Multimode: The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492A-1989, "Detail Specification for 62.5 µm Core Diameter/125 µm Cladding Diameter Class la Multimode, Graded Index Optical Waveguide Fibers."
   i Core diameter: 62.5 ± 3.0 µ.
   ii Cladding diameter: 125.0 ± 2.0 µm.
   iii Core-to-Cladding offset: ≤ 3.0 µm.
   iv Cladding non-circularity: ≤ 2.0 %.
      Defined as: [1 - (min. cladding dia./ max. cladding dia.)] x 100
   v Core non-circularity: ≤ 5.0 %.
      Defined as: [1 - (min. core dia. / max. core dia.)] x 100
   vi Coating diameter: 245 ± 10 µm.
   vii Colored fiber diameter: nominal 250 µm.
   viii Graded index.
   ix Numerical Aperture: 0.275 ± 0.015 µm.
   x Limited to the fiber runs of no more than 1000’ between electronics

d. The coating shall be a dual layered, UV-cured acrylate applied by the fiber manufacturer.

e. The coating shall be mechanically strippable.

3. Fiber Specification Parameters

a. Required Fiber Grade - Maximum Individual Fiber Attenuation.

b. (Multimode only) The minimum normalized bandwidth of multimode optical fibers shall be ≥ 160 MHZ•km at 850 nm and ≥ 500 MHZ•km at 1300 nm.

c. The fiber manufacturer shall proof-test 100% of the optical fiber to a minimum load of 100 kpsi.

4. Specifications for Cables

a. Cable shall be flame-retardant, UV stabilized, fully water blocked for use in indoor/outdoor applications. Cable shall be suitable for installation in duct, aerial, and riser environments. Cable shall meet UL OFNR specifications and not require transition splicing upon building entry in order to meet fire

codes. The cable shall be the FREEDM series as manufactured by Siecor or approved equal.

b. Optical fibers shall be placed inside a buffer tube.

c. Each buffer tube shall contain up to 12 fibers.

d. Each fiber shall be distinguishable by means of color coding according to TIA/EIA-598-A, "Optical Fiber Color Coding."

e. Buffer tubes containing fibers shall be color coded with distinct and recognizable colors according to TIA/EIA-598-A, "Optical Fiber Color Coding."

f. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

g. Buffer tubes shall be kink resistant within the specified minimum bend radius.

h. Fillers may be included in the cable core to lend symmetry to the cable cross-Section where needed.

i. The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

j. The cable core shall contain a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents. Cable shall contain water blocking threads between tubes.

k. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

l. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns.

m. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

n. All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene (MDPE). The minimum normal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

o. Armored cables shall have armor composed of a corrugated steel tape, plastic-coated on both sides for corrosion resistance, and shall be applied with on an overlapping seam with the corrugations in register. All armor splices shall be recoated with plastic to maintain the armor's corrosion resistance. The outer jacket shall be applied over the corrugated steel tape armor. The outer jacket shall be a medium density polyethylene with a minimum nominal jacket thickness of 1.25 mm. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

p. The jacket or sheath shall be free of holes, splits and blisters.

q. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

r. Cable jackets shall be marked with manufacturers' name, sequential meter or foot markings, the year of manufacture, and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within $\pm$ 1 % of the length markings. The marking shall be in contrasting color with the cable jacket. The height of the marking shall be approximately 2.5 mm.

s. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 600 N (135 lbf) long term installed.

t. The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be -30°C to +70°C.

u. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic

Components," the average change in attenuation at extreme operational temperatures (-40°C to +70°C) shall not exceed 0.05 dB/km at 1550 nm for single-mode fiber. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm. For multimode fiber, the average change in attenuation shall not exceed 0.50 dB/km with 80% of the measured fibers not exceeding 0.25 dB/km.

5. General Cable Performance Specifications

a. When a one meter static head or equivalent continuous pressure is applied at one end of a one meter length of unaged cable for 24 hours, no water shall leak through the open cable end. When a one meter static head or equivalent continuous pressure is applied at one end of a one meter length of aged cable of one hour, no water shall leak through the open cable end. The aging cycle is defined as exposing the cable to +85 $\pm$ 2°C for 168 hours and two cycles of -40°C to +70°C with cable held at these temperatures for 24 hours. The water penetration test is completed at the end of the 24-hour hold. Testing shall be performed in accordance with the industry standard test, FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

b. When testing in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable," the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at +65°C.

c. The cable shall withstand a minimum compressive load of 440 N/cm (250 lbf/in) for armored cables and 220 N/cm (125 lbf/in) for non-armored cables applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for ten minutes. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater the 0.1 dB at 1550 nm (SM). The average increase in attenuation for the fibers shall be $\leq$ 0.20 dB at 1300 nm (MM). The repeatability of the measurement system is typically $\pm$ 0.05 dB or less. No

fibers shall exhibit a measurable change in attenuation after load removal.

d. When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycles per minute around a sheave diameter not greater than 20 times the cable diameter. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically ± 0.05 dB or less. The average increase in attenuation for the fibers shall be ≤ 0.20 dB at 1300 nm (MM). For armored cables, the inside or outside of the armor surface shall be inspected for fractures. Any visible cracks causing separation of the armor shall not have propagated more than 5 mm. The outer cable jacket shall not exhibit evidence of cracking or splitting when observed under 5x magnification.

e. When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," the cable shall withstand 25 impact cycles. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically ± 0.05 dB or less. The average increase in attenuation for the fibers shall be ≤ 0.40 dB at 1300 nm (MM). The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.

f. When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a tensile load of 2700 N (608 lbf) applied for one hour (using "Test Condition II" of the procedure). In addition, the cable sample, while subjected to a minimum load of 2660 N (600 lbf), shall be able to withstand a twist of 360 degrees in a length of less than 3 meters (9.9 feet). The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement

system is typically ± 0.05 dB or less. The average increase in attenuation for the fibers shall be ≤ 0.40 dB at 1300 nm (MM). The cable shall not experience a measurable increase in attenuation when subjected to the rated residual tensile load, 890 N (200 lbf).

g. When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 2 meters will withstand 10 cycles of mechanical twisting. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (SM). The repeatability of the measurement system is typically ± 0.05 dB or less. The average increase in attenuation for the fibers shall be ≤ 0.40 dB at 1300 nm (MM). For armored cables, the inside or outside of the armor surface shall be inspected for fractures. The cable jacket will exhibit no cracking or splitting when observed under 5x magnification after completion of the test.

h. When tested in accordance with FOTP-181, "Lightning Damage Susceptibility Test for Optic Cables with Metallic Components," the cable shall withstand a simulated lightning strike with a peak value of the current pulse equal to 105 kA. A damped oscillatory test current shall be used with a maximum time-to-peak value of 15 µs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time to half-value of the waveform envelope shall be from 40 - 70 µs.

C. Patch Cables, Fiber Connectors

1. Manufacturers

a. Corning Cable Systems

b. Or approved equal.

2. Connectors

a. Provide ceramic or composite style connectors for all fiber optic fibers. The connectors shall be designed for use with 62.5/125 micron cable, and shall be capable of operating in a range of minus 40 to 75 degrees F. Each connector shall cause a maximum signal attenuation of 1.6 dB. Connector

specifications shall be as follows:

b. Insertion loss (typical): 0.5 dB

c. Durability (mating cycles): 1000 (minimum)

d. Repeatability: Less than 0.2 dB

e. Operating Temperature: minus 40 to plus 75 degrees F

3. Fiber Optic Patch Cables and Connectors

a. Fiber optic patch cable shall be 2 fiber zipcord 62.5/125 core/clad micron multimode riser rated cable.

b. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

D. Patch Panels and Splices

1. Patch Panels: Suitable for wall mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch block with connectors and ground lugs as indicated. Panels shall be NEMA 1 or 12 construction for use in indoor, air-conditioned areas, or NEMA 4X construction for outdoor and process areas, and shall be lockable. Patch panels shall be suitable for multimode system operation at 800 and 1300 nm. The Patch panels shall be sized to handle the number of fibers indicated on the drawings. All fibers shall be terminated in the patch panel. Manufacturer shall be Corning Cable Systems or approved equal. Fusion Splice equipment shall be turned over to County upon completion of work. Fusion Splicer shall be S123M12-V2-KIT

2. Pigtail Splicing

a. For termination of fiber cables at a termination or connector panel (patch panel), with one end of a piece of cable preconnectorized and the other end unterminated for splicing to the cable that needs to be terminated. Splicing and connectors shall meet the requirements listed in this Section.

b. A splice/termination tray shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure. Splice tray shall be compatible with the selected patch panel and installed for easy access to the spliced cable sections.

c. Pigtail assemblies shall match fiber cable type and model.

d. Manufacturer shall be Corning Cable Systems or approved equal.

3. Baying Enclosure

a. Where indicated on the Drawings, provide dual baying enclosures for fiber optic patch panels at distribution points.

b. Each enclosure shall be a Special TS8 Baying Enclosure by Rittal, with two component enclosures mounted back-to-back. Combined size shall be 2.2 m height, 1.6 m width, 0.6 m depth. Colors shall be RAL 7035 structure standard.

c. The component enclosures shall be TS8 enclosures, part number 8806540, rated NEMA 4, solid front door (each unit 130° hinged on the appropriate side), no rear wall or door, roof internally and externally fastened, solid base with plinth of height 200mm.

d. Accessories for each baying enclosure shall include the following, plus any additional parts necessary to make a complete unit:

i P/N 8612180, Qty. 4, TS SYSTEM CHASSIS F/800MM HOR
ii P/N 8612100, Qty. 4, TS SYSTEM CHASSIS F/1000MM HOR
iii P/N 8106500, Qty. 4, SIDEWALL TS ASSY TY2006
iv P/N 8800885, Qty. 4, TS BAYING COVER, TOP
v P/N 8602060, Qty. 4, 0200H0600D TS PLINTH SIDE TRIM RAL7022T
vi P/N 8602800, Qty. 4, 0200H0800W TS PLINTH ELEMENTS RAL7022T
vii P/N 8611290, Qty. 2, TS COMFORT HANDLE RAL7035
viii P/N 8611190, Qty. 2, TS LOCK INSERT-PUSHBUTTON
ix P/N 8108504, Qty. 2, 2000H0800D TS SUITING KIT
x P/N 2340700, Qty. 2, EMC SWING FRAME 40HU
xi P/N 1994835, Qty. 2, HDWR KIT F/600MM WIDE SWING
xii P/N 8800500, Qty. 6, TS BAYING QUICK WEDGE
xiii P/N 8800430, Qty. 4, TS BAYING BRACKET F/TS-TS

E. Spare Parts and Test Equipment

1. Spare Parts

a. Provide twenty (20) spare ST style connectors.

b. Provide ten (10) spare patch cables with ST connectors (both ends) terminated.

2. Test Equipment

a. One (1) complete fiber optic connector termination tool kits. The kit shall be UNICAM Premium Tool kit by Corning Cable Systems or approved equal.

b. Corning OV-1000 OTDR with ST, SC and FC adapters with capabilities for SM and MM. No equal.

PART 3 - EXECUTION

A. General

1. Provide all material, equipment and labor to install and test the fiber optic cables as indicated and as specified.

2. Installation shall be in accordance with the National Electrical Code.

3. Installation shall comply with EIA/TIA Standards 568 and 569.

4. Fiber optic cables shall be continuous from component to component as shown on the Drawings. Intermediate fiber splices shall not be allowed.

5. Provide delivery, storage, and handling of materials and equipment in accordance with Section 01600.

B. Installation

1. All cable shall be installed in conduit.

2. Direct buried cable shall be installed in conduit within one (1) foot of turning up or entering a structure.

3. An outdoor patch panel shall be provided for transitioning from direct buried cable to cable in conduit at each building entrance.

4. Inspect raceway prior to pulling cables. Notify the Engineer of any conditions which would prevent installation of the specified cables, before proceeding with the installation. Rod and swab out ducts prior to installing cables.

5. Install non-breakout cables in conduit systems inside buildings and structures.

6. Pull cables prior to attachment of connectors.

7. Pull cables by directly pulling only on the strength member.

8. Lubricate cables with lubricants specially formulated for fiber cabling jackets during installation. Do not exceed cable manufacturers specifications for tensile strength and bending radius. Pulleys used to aid in the installation of the fiber optic cable must be sized according to the minimum bending radius. The pulling tension of all fiber cables during installation shall be recorded using a strip recorder. The printout of the strip recorder shall be submitted to the Engineer.

9. Ground outer sheath and steel armor before entering building. Remove outer sheath and steel armor from indoor installation.

10. Do not make splices in cable unless approved by the ENGINEER. Splices shall be made in designated enclosures above ground only. Provide adequate put-up lengths on cable reels to make termination-to- termination runs without splices. Where splices are unavoidable, subject to the approval of the ENGINEER, provide fusion splices with attenuation losses of 0.3 dB or less. Make splices watertight and provide mechanical protection equal to the cable jacket, or better.
11. Provide breakout kits, signal transceivers, power supplies, patch panels, pigtails and jumpers as required and as indicated to install a complete data highway communications network. Patch panels and splice enclosures shall be wall mounted.

12. Support cables in riser conduits at intervals as required by National Electric Code.

13. Installation tools and materials shall be approved by the cable manufacturer.

14. If the Siecor Unicam connector system is not used, the polishing process of terminal connectors shall be a two stage wet process using 3.0 micron lapping film for an initial polish followed by 0.3 micron lapping film for the final polish.

15. Within manholes, protect cable by providing flexible, corrugated, polyethylene slit duct. Connect slit duct to duct bank by using hose clamps. Support duct at ten (10) foot intervals.

C. Identification

1. Label each termination point.

2. Tag each cable in junction boxes, manholes and hand holes. Provide permanent nylon/plastic tie-wrap type tags with waterproof markings.

3. Label each cable, buffer tube and fiber with permanent waterproof typewritten tags.

D. Physical Checkout

1. General Procedures:

a. Conduct physical checkout of the fiber optic data highway network.

b. Physical checkout shall be performed prior to functional testing.

2. Check Procedures:

a. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.

b. Submit to the Engineer all test data provided by the fiber manufacture.

c. Verify that the optical fibers of the cable assembly are the type and quantity as specified and as recommended by the Instrumentation System Supplier.

d. Verify that cable construction is the type specified.

e. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.

f. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's recommendations.

E. Field and Functional Testing

1. Make the following site tests *before* removing cable from cable reels:

a. Determine attenuation losses of each fiber from end to end. Use an optical time domain reflectometer (OTDR) to capture and record. Provide a printout of the captured data.

b. Submit to the Engineer all test data and models of test equipment, calibration standards and tests.

2. Make the following field tests *after* cable and connector installation:

a. All fiber optic cables shall be tested for performance and loss after cable installation and connector termination to certify that at least a 3dB power safety margin is obtained between all transmitters and receivers. Test data for each fiber and safety margin calculations for each fiber path shall be provided to the Owner and Engineer after installation to verify conformance with this specification. The following tests shall be performed as a minimum:
   i Visually, inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 200X (minimum) inspection microscope.
   ii Check optical continuity of each fiber from terminal to terminal. Use test equipment as specified herein and provide typewritten report certifying each fiber in every cable.
   iii Verify the calculated attenuation power losses of each fiber from both the transmit and receive terminals of each data communications loop (both directions). The light source and operating wavelength of the test equipment shall be representative of the actual operating equipment. Use an OTDR.

b. Submit to the Engineer all test data and models of test equipment, calibration standard and tests.

3. Owner or Engineer may observe testing. Inform Owner/ Engineer of testing schedule at least one week prior to start of testing.

F. Training

1. Provide half day training for up to three (3) students on termination techniques and testing prior to installation.

2. Provide training as soon as possible following submittal of proposed fiber optic cable.

G. Warranty

The Contractor shall submit a warranty certificate from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for twenty (20) years, commencing at the time of final acceptance by the Owner.

END OF SECTION

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SECTION 13325 CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1 - GENERAL

A. Scope of Work

1. The General Provisions of Section 13300 apply to this Section.

2. Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.

3. New disk filter control panels to be provided by the disk filter manufacturer.

B. Submittals

Refer to Section 13300.

C. Delivery, Storage and Handling

1. The panels shall be mounted on wood skids four inches high. Adequate crating will be provided for the panel being shipped where a transfer from one truck to another is planned.

2. Instruments shall be blocked and tied to prevent damage during shipment. Front-panel mounting instruments shall be removed and prepacked in their original containers for shipment.

3. Accessories, drawings, instruction bulletins, etc., shall be packed and shipped with the panel.

4. Refer to Section 13300.

D. Spare Parts

1. In accordance with Section 13300, provide the following spares and consumables:

a. Fuses: 20 percent of each size and type used, but no less than ten of each size and type.

b. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.

c. Relays: One (1) spare unit for every ten (10) of each type installed, minimum one.

d. Panel-Mounted Lights and Switches: One (1) spare mechanism for every ten (10) of each type installed, minimum one; plus 10 units or 20 percent of bulbs and colored lenses installed, whichever is more.

e. Corrosion Inhibiting Vapor Capsules: Provide 10 of each type and size used.

E. Warranty

Refer to Section 13300.

PART 2 - PRODUCTS

A. General

Refer to Section 13300.

B. Lightning/Surge Protection

Refer to Section 13300.

C. Control Panel - General Requirements

1. Furnish and install the panels per Specifications and Drawings.

2. The construction and wiring shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear, and sides of the panels.

3. Unless otherwise specified on applicable panel drawings, all panels shall be of the fully enclosed type designed for use with high-density instrumentation mounting.

4. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for each local panel provided under this Contract shall be keyed alike.

5. The instruments designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

6. Conductors running from the field to the panels shall be continuous without splices, except at junction boxes. The junction boxes shall have terminal blocks with 20 percent spare terminals. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance. Cables entering panels shall be multiconductor. Conduit and multiconductor cables entering panels shall be sealed to prevent the intrusion of gas and moisture.

7. Multiconductor cable shall be used between junction boxes and the panels.

8. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component. Components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and ISS's data.

9. The internal framework of each panel shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete.

10. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

11. All panels shall be supplied with suitable nameplates which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be approximately 1-in x 3-in constructed of white and black laminated, phenolic material having engraved Micarta letters approximately 1/8-in high, extending through the white face into the black layer. Nameplates shall be beveled and attached to panels with epoxy glue.

12. Control panels shall be built in a UL 508 shop and shall be UL labeled and listed.

D. Control Panel - Materials and Construction

1. General

a. All panels located in indoor climate-controlled areas shall be of NEMA 12 construction and shall be labeled by Underwriters Laboratories. Freestanding panels shall be constructed of 12 gauge or thicker sheet steel, suitably braced internally for structural rigidity and strength. Wall or Unistrut mounted panels shall be 14 gauge or better steel. All exposed welds, seams, or edges shall be ground smooth. Front panels or panels containing instruments shall be 10 gauge or thicker sheet steel, reinforced to prevent warping or distortion. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three point latches.

b. All panels located in outdoor areas, or in indoor areas that are not air conditioned, and where otherwise specified in the Contract Documents, shall be of NEMA 4X construction and shall be labeled by Underwriters Laboratories. NEMA 4X panels, whether wall or Unistrut mounted panels or freestanding panels, shall be of all 316 Stainless Steel construction. Minimum thickness shall be 12 gauge for freestanding panels, 14 gauge for wall or Unistrut mounted panels. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three-point latches. Panels with door clamps instead of three-point latching will not be accepted. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument mounting.

c. Provide explosion-proof enclosures where required in hazardous areas.

d. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel details. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. All doors shall open a minimum of 90 degrees.

e. Refer to panel details and other Drawings for approximate panel size and equipment layout.

f. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

g. Support Structures. Do not use expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions. Do not use power-actuated fasteners and devices.

2. Finish Requirements

a. All sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

b. Panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

c. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.

d. All FRP panels located in direct sunlight shall be provided with a protective coating to prevent discoloration and cracking.

e. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.

f. Panel exterior color shall be ANSI 61 Gray.

3. Manufacturer. All panels shall be by Hoffman or acceptable equal.

E. Control Panel - Temperature Control

1. The internal temperature of all panels shall be regulated so as not to exceed 100 degrees Fahrenheit. Should sufficient heat be generated within a panel where dissipation cannot be adequately accomplished with natural convection, an air conditioner shall be provided. Under no circumstances shall the panel cooling equipment compromise the NEMA rating of the panel.

2. NEMA 4X rated panels that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

F. Control Panel - Corrosion Control

Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Instruments Model Zerust VC; Hoffman Engineering Model A-HCI; or equal. Corrosion inhibitors shall not be installed and activated until the panel is delivered to the site.

G. Control Panel - Internal Construction

1. Internal Electrical Wiring

a. Panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with the National Electrical Code. Wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring/connection diagrams. Wiring and connection diagrams shall comply with ISA-5.4 and shall be submitted by the manufacturer as part of the Shop Drawings for review by the Engineer.

b. Power and low voltage DC signal wiring shall be routed in separate wire ways. Crossing of the two system wires shall be at right angles.

c. Power wire shall be 12 AWG Type THHN/THWN stranded and shall be insulated for not less than 600 volts unless specified otherwise. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90°C.

d. Control and signal wire shall be 1 pair 16 AWG stranded. Analog signal wire shall be shielded. Conductors shall be of tinned copper construction.

e. Electronic Communications cable (such as RS-232) shall be low-capacitance, double-shield cables consisting of twisted pairs with 22 AWG stranded conductors and PVC jacketing.

f. Wire colors shall be:

Line Power	Black
Neutral	White
AC Control	Red
DC Control	Blue
DC common	Gray
Equipment/Chassis Ground	Green
Externally-Powered Interlocks	Yellow

g. Wiring shall terminate at a master terminal board, rigid type and numbered.

h. Terminal blocks shall be arranged in vertical rows and separated into groups (Power, AC control, DC signal, and alarm). Terminal strips shall be provided for the purpose of connecting all control and signal wiring. Terminal blocks shall be Phoenix style, IEC rated, Allen-Bradley or similar, with the appropriate voltage rating (600 volts minimum).

i. Each 4-20 mA analog signal loop shall be individually fused. Each group of discrete loops for a common piece of equipment shall be fused.

j. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the

subpanel by using stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

k. Wire connectors shall be the hook fork type with insulated barrel for crimp type compression connection to the wire.

l. Each wire shall be provided with a numbered heat shrink tubing identification marker, with the same number at both ends. Numbering shall be in accordance with the Control Panel Drawings and shall include the instrument Loop Number. Identification markers shall be pretyped. Handwritten markers or paper markers will not be permitted.

m. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-in of the side panel or adjacent terminal.

n. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.

o. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

p. Each panel shall have a magnetic reed switch pair mounted to the frame of each door, that will indicate a common panel intrusion condition in the PLC within that panel, when any door is opened. Magnetic reed switches shall be heavy-duty, GE Magnetic Contacts model 2505A or approved equal.

q. Each panel shall have a specification grade duplex convenience receptacle mounted internally within a stamped steel device box with appropriate cover.

r. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

s. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

t. Each panel, where applicable, shall be provided with analog signal isolation (I/I) where analog signals are sent from one panel or console to another.

u. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical and electronic equipment. Surge suppressor grounding shall be accordance with the manufacturer's recommendations. Refer to Section 13300.

v. Each panel shall be provided with a fused power disconnect switch.

w. All wiring to hand switches and the like which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

x. Panels shall have an initial installed capacity of I/O (terminal blocks, fuses, surge suppressors, interposing relays as required) plus a minimum of twenty-five percent (25%) active spare I/O points of each type, and twenty-five percent (25%) room for future I/O points. All new, existing, and future I/O points shown on the Drawings or discovered in field investigation shall be included in the total count for the purpose of determining spares.

2. Pneumatic Tubing

a. Refer to Section 13300.

3. Print Storage Pockets

a. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment.

H. Direct Current (DC) Power Supply

1. Provide a 24 VDC power supply in the control panel to power instrument loops, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

2. Control panels that are principally designed to house Profibus DP fiber optic modules shall include battery backup capability.

3. Components shall meet the following requirements:

   a. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

   b. Output voltage: 24 VDC.

   c. Output voltage adjustment: 5 percent.

   d. Line regulation: 0.05 percent for 10 volt line change.

   e. Load regulation: 0.15 percent no load to full load.

   f. Ripple: 3 mV RMS.

   g. Operating temperature: 32 to 140 degrees Fahrenheit.

   h. Batteries: sealed high-temperature type with charger.

4. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity. Battery shall be sized to support full load operation for 30 minutes upon loss of power.

5. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

6. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

7. Power supply shall be manufactured by Siemens, SITOP PSU8600 40A/4X 10A PN Stabilized.

I. Panel Components

1. Pilot Type Indicating Lights

   a. Type: Heavy duty oil-tight type which utilizes a low voltage lamp.

   b. Functional/Performance:
      i Units shall be provided with low voltage lamps suitable for the voltage supplied. Lights supplied with 120VAC power shall have integral reduced voltage transformers.
      ii Lamps shall be replaceable from the front of the unit.

iii Units shall be push-to-test.

c. Physical:
   i Lens color shall be as indicated on the instrument device schedule. Lens shall be approximately 1-1/4-in diameter.
   ii Provide legend faceplates engraved to indicate the required function of each device.
   iii Units shall be rated NEMA 13 for indoor panels. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.

d. Manufacturers:
   i Siemens Sirius Act
   ii Allen Bradley
   iii General Electric
   iv Square D

2. Rotary Hand Switches and Push Buttons

a. Type: Control devices shall be heavy duty, oil-tight type with stackable contact blocks.

b. Functional/Performance: Provide contact arrangement and switching action as required for the control system specified.

c. Physical:
   i For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide silver sliding contacts rated 5 amps at 125VDC, for electronic (millivolt/ milliamp) switching provide contacts rated 1 amp at 28VDC.
   ii Push buttons shall have flush type operators. Selector switches shall have knob or wing lever operators.
   iii Units shall be rated NEMA Type 13 for indoor service. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.
   iv Provide legend plates denoting switch/push button position/function.

d. Options/Accessories Required:
   i Provide lock-out-push buttons, key-operators, etc., as indicated on the instrument device schedule.
   ii Provide make-before-break bridging contacts where required.

e. Manufacturers:

i Siemens Sirius Act
ii Allen Bradley
iii General Electric
iv Square D

3. Industrial Relays and Time Delays

a. Type: Industrial heavy duty relays.

b. Functional/Performance:
i Contact arrangement/function shall be as required to meet the specified control function specified.
ii Contacts shall be rated 10 amps continuous at 600 volts.
iii Relays shall be provided with convertible contact blocks.
iv Pneumatic time delay relays shall be used on time delays less than 180 seconds and shall be adjustable.
v Solid state time delay relays shall be used on time delays between 180 seconds and one hour.

c. Options/Accessories Required:
i Provide all mounting rails, etc. that are required.

d. Manufacturers:
i Siemens Sirius Act
ii Allen Bradley
iii General Electric
iv Square D

4. General Purpose Relays and Time Delays

a. Type: Units shall be of the general purpose plug-in type.

b. Functional/Performance:
i Coil voltage shall match supply voltage.
ii Contact arrangement/function shall be as required to meet the specified control function.
iii Mechanical life expectancy shall be in excess of 10,000,000 operations.
iv Duty cycle shall be rated for continuous operation.
v Units shall be provided with integral indicating light to indicate if relay is energized.
vi Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

vii Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

c. Physical:
   i For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide contacts rated 5 amps at 28VDC, for electronic (milliamp/ millivolt) switching applicator provide gold plated contacts rated for electronic service.
   ii Relays shall be provided with dust and moisture resistant covers.

d. Options/Accessories Required:
   i Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
   ii Provide mounting rails/holders as required.

e. Manufacturers:
   i Siemens Sirius Act
   ii Eagle Signal Controls
   iii Allen Bradley
   iv Potter & Brumfield

5. Electronic Indicator

a. Type: Electronic; 3-in by 6-in NEMA 4X case.

b. Operation: To accept a standard analog input signal, and display the manually set flow on a vertical indicating scale.

c. Functional:
   i Input - 4-20 mADC.
   ii Accuracy plus or minus 0.5 percent of span for input/output.

d. Physical:
   i Case Size - Nominal 3-in by 6-in face.
   ii NEMA 4X enclosure, with slide tray.
   iii Mounting - Flush panel, suitable for high density mounting arrangements.
   iv Scales – Digital, 0 to 100 percent output.

e. Manufacturers:
   i ABB Instrumentation
   ii Moore Industries

6. Signal Relay Switches (Current Trips)

a. Type: Solid state electronic, dual setpoint.

b. Functional/Performance:
   i Input - 4-20 mA
   ii Output - Isolated contact output, double pole double throw, rated 5 Amps at 120 VAC.
   iii Accuracy - 0.1 percent.
   iv Protection - Provide RFI protection.
   v Deadband - Adjustable between 0.1 and 5.0 percent of span.
   vi Setpoint Adjustment - Provide graduated dial for each alarm set point from 0 to full scale. Alarms shall be adjustable to trip on rising or falling input signal.
   vii Repeatability - Trip point repeatability shall be at least 0.1 percent of span.

c. Physical:
   i Mounting - Suitable for mounting in an enclosure or high density instrument rack.

d. Options/Accessories Required:
   i Mounting rack or general-purpose enclosure as required.

e. Manufacturers:
   i Acromag
   ii Moore Industries
   iii AMETEC Rochester Instrument Systems

PART 3 - EXECUTION

A. Installation

1. The panels shall be installed at locations as shown on the Drawings.

2. Panels shall be factory tested prior to shipment. Field installation shall consist only of setting the panel in place and making necessary electrical and conduit connections.

3. Refer to Section 13300.

B. Tests (General)

Refer to Section 13300.

END OF SECTION

SECTION 15050 PIPING SCHEDULE AND GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

A. Description

This section describes the application of the Piping Schedule shown in the drawings and the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).

3. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

4. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

C. Definitions of Buried and Exposed Piping

1. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure. Where a coating is specified, provide the coating up to the structure wall. Piping encased in concrete is considered to be buried. Do not coat encased pipe.

2. Exposed piping is piping in any of the following conditions or locations:

   a. Above ground.

   b. Inside buildings, vaults, or other structures.

   c. In underground concrete trenches or galleries.

D. Piping Service

Piping service is determined by the fluid conveyed, regardless of the pipe designation. For example, pipes designated "Air Low Pressure," "Air High Pressure," and "Air" is all considered to be in air service.

E. Default Piping Materials

If no material is shown in the drawings or in the Piping Schedule, use the following piping materials:

Service	Size Range (inches)	Material	Specification Section
Buried	3 and smaller	PVC	15290
	4 and larger	DIP	15240
Exposed	3 and smaller	PVC	15290
	4 and larger Air Service	SST	15276
	4 and larger	DIP	15240

PART 2 - MATERIALS

A. Materials Selection and Alternative Materials

1. The Piping Schedule in the drawings lists the material and specification for each piping service in the project. In locations where the piping material referenced on the Piping Schedule is not appropriate, the piping material is indicated in the drawings. Materials called out in the drawings shall govern over materials stated in the Piping Schedule.

2. The Piping Schedule in the drawings may show alternative piping materials for certain services. In such cases, the same pipe material shall be used for all pipe sizes in all locations for the given piping service. Do not intermix piping materials.

B. Thread Forming for Stainless Steel Bolts

Form threads by means of rolling, not cutting or grinding.

C. Bolts and Nuts for Flanges for Ductile-Iron Piping (Specification Section 15240)

1. Bolts and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors and above ground, shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

2. Bolts and nuts for buried or submerged Class 150 flanges and Class 150 flanges located outdoors above ground or in vaults and structures shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

3. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B7.

4. Fit shall be Classes 2A and 2B per ASME B1.1 when connecting to cast-iron valves having body bolt holes.

5. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

6. Provide washers for each nut. Washers shall be of the same material as the nuts.

D. Bolts and Nuts for Flanges for Stainless Steel (Specification Section 15276)

1. Bolts and nuts for flanges shall be Type 304 stainless steel conforming to ASTM A 193, Grade B8 for bolts and ASTM A 194, Grade 8 for nuts.

2. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B8, Class 2.

3. Bolts for flange insulation kits shall conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H.

4. Provide washer for each nut. Washers shall be of the same material as the nuts.

E. Bolts and Nuts for Flanges for PVC and CPVC (Specification Sections 15290, 15291, and 15294)

1. Bolts and nuts for flanges located indoors shall be carbon steel, ASTM A307, Grade B.

2. Bolts and nuts for buried and submerged flanges and flanges located outdoors above ground or in vaults and structures shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts.

3. Bolts for piping in sodium hypochlorite service shall be made of titanium, per ASTM F467, Grade Ti1 or Ti7. Nuts shall conform to ASTM F467, same material as the bolts.

4. Provide a washer under each nut and under each bolt head. Washers shall be of the same material as the nuts.

F. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal.

G. Gaskets for Flanges for Ductile-Iron Piping and Fittings in Water Service (Specification Section 15240)

Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

H. Gaskets for Flanges for PVC and CPVC Piping (Specification Sections 15290, 15291, and 15294)

Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material shall be EPR. Gasket material for sodium hypochlorite service shall be Viton ETP.

I. Insulating Unions

Insulating unions shall consist of a molded nylon sealing sleeve mounted in a three-piece malleable-iron (ASTM A 47 or A 197) body. Ends shall be threaded (ANSI B1.20.1) when connecting to steel piping, and copper solder joint when

connecting to copper piping. Minimum working pressure shall be 150 psi. Unions shall be as manufactured by Central Plastics Company, Capital Insulation, or equal.

J. Dielectric Sealant

Unbacked elastomeric tape 0.125-inch thick, "Moldable Sealant" by Tapecoat Co., "Tac-Tape" by Royston Laboratories, with manufacturer's primer.

PART 3 - EXECUTION

A. Installing Pipe Spools in Concrete

Install pipes in walls and slabs before placing concrete.

B. Raised Face and Flat Face Flanges

Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

C. Installing Aboveground or Exposed Piping

1. Provide pipe hangers and supports as detailed in the drawings and as specified in Section 15064.

2. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

D. Installing Flanged Piping

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing,

lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

8. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried piping.

9. Prior to paint, trim back gasket and caulk joints.

E. Installing Blind Flanges

1. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.

2. Coat the inside face of blind flanges per Section 09900, System No. 7.

F. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

SECTION 15062 WALL PIPES, SEEP RINGS, AND PENETRATIONS

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of steel, cast-iron, and ductile-iron wall pipes and sleeves (including wall collars and seepage rings) and penetrations.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit detail drawings for fabricated steel or cast-iron wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.

3. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.

4. Show grooved-end dimensions and AWWA grooved-end dimensional standard where grooved-end wall pipes or penetrations are used.

5. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.

6. List materials of construction, with ASTM material reference and grade.

7. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.

8. Submit six copies of the results of the leakage test for cast-iron sleeves having shrink-fit steel collars or collar halves bottomed in a groove and steel sleeves having welded steel collars.

PART 2 - MATERIALS

A. General

1. Use cast-iron, ductile-iron, or fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes.

2. Use only cast-iron or ductile-iron wall pipes when connecting to cast-iron and ductile-iron pipe. Use only fabricated steel or stainless steel wall pipes when connecting to steel or stainless steel pipe, respectively.

3. Cast-iron flanges shall conform to ASME B16.1, Class 125 or 250, to match the flange on the connecting pipe.

4. Class 150 steel flanges shall conform to AWWA C207, Class D. Flanges shall be flat face. Flanges shall match the flange on the connecting pipe.

5. See Section 15050 for flange bolts and gaskets.

B. Cast-Iron or Ductile-Iron Wall Pipes and Sleeves

1. Provide cast- or ductile-iron wall pipes with ends as shown in the drawings for connection to adjacent cast-iron and ductile-iron pipe or for containing pipes where they pass through concrete walls, ceilings, and floor slabs. Provide seepage ring on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Locate collars such that the collar is at the center of the wall or floor slab, unless otherwise shown in the drawings.

2. Wall pipes and sleeves shall be of the following types:

   a. Pipe or sleeve with integrally cast seep ring.

   b. Pipe or sleeve with shrink-fit steel collar attached.

   c. Pipe or sleeve with steel collar halves bottomed in a groove provided in the pipe or sleeve.

   d. Pipe or sleeve with 360 degree fillet welds on both sides of the collar.

3. Minimum wall thickness for pipes and sleeves having integrally cast seep rings shall be as shown in the following table:

Pipe or Sleeve Size (inches)	Minimum Wall Thickness (inches)
3	0.48
4	0.52
6	0.55
8	0.60
10	0.68
12	0.75
14	0.66
16	0.70
18	0.75
20	0.80
24	0.89
30	1.03
36	1.15
42	1.28
48	1.42

4. Minimum wall thickness of pipes or sleeves having shrink-fit collars shall be special Class 52. Cut shrink-fit collars from a 1/4-inch-thick steel ring. Attach the collar to a cast-iron or ductile-iron pipe or sleeve by heating the steel collar and allowing it to shrink over the pipe at the necessary location. Provide an epoxy bond (Keysite 740 or 742 or Scotchkote 302) between the pipe and collar. Sandblast the area of the pipe to be epoxy coated per SSPC SP-10.

5. Wall pipes or sleeves having steel collar halves bottomed in a groove shall be ductile iron Special Class 54 minimum unless otherwise shown. Wall flanges shall consist of 1/4-inch-thick steel seep ring halves for pipes through 24-inch and 3/8-inch-thick halves for pipe 30-inches and larger, bottomed in a groove provided on the pipe. The pipe groove shall be machine cut to a depth of 1/16-inch to 5/64-inch to provide a press fit for the seep ring. Seep ring halves shall be welded together after fit into groove but shall not be welded

to pipe. Seep rings shall be sealed completely around the pipe with silicon sealant manufactured by Dow-Corning No. 790, General Electric Silpruf, or equal.

6. The material used in cast- or ductile-iron wall flanges, wall sleeves, and wall penetrations shall conform to ASTM A395, A436, A536, A48 (Class 35), or A126 (Class B).

7. Pressure test at least one of each size of cast-iron pipes or sleeves having shrink-fit steel collars or collar halves installed in a groove in the pipe at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours duration and shall show zero leakage.

C. Fabricated Steel Wall Pipes and Sleeves

1. Provide fabricated steel wall pipes and sleeves with ends as shown in the drawings for connection to adjacent steel pipes, or for containing pipes, where they pass through concrete walls. Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe. Minimum wall thickness for sleeves containing pipes shall be standard weight per ASME B36.10 for sleeves 72-inches and smaller and 1/2-inch for sleeves greater than 72-inches through 96-inches.

2. Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from a 1/4-inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16-inch fillet welds. Welding procedures shall be in accordance with ASME B31.3, Chapter V.

3. Steel pipe used in fabricating wall sleeves containing pipes shall comply with ASTM 53 (Type E or S), Grade B; ASTM A135, Grade B; ASTM A139, Grade B; or API 5L or 5LX. Wall pipes connecting to steel pipe shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A36, A105, A181, or A182.

4. Stainless steel pipe used in fabricating wall pipes shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A240.

5. Pressure test at least one of each size of fabricated steel wall sleeve or penetration and collar assemblies at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours duration and shall show zero leakage.

D. Rubber Annular Hydrostatic Sealing Devices

1. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.

2. Materials of construction shall be as follows:

Compound	Material
Pressure plate	Type 316 stainless steel
Bolts and nuts for links	Type 316 stainless steel
Sealing element	Nitrile rubber

3. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.

4. Provide centering blocks in 25% of the sealing elements on pipelines larger than 12-inches in diameter.

5. The rubber annular hydrostatic sealing devices shall be Link Seal as manufactured by Thunderline Corporation; Innerlynx as manufactured by Advance Products & Systems, Inc.; or equal.

E. Bolts, Nuts, and Gaskets for Flanged-End Wall Pipes

See Section 15050.

F. Polyethylene Foam Filler for Pipe Penetrations

Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/2-inch larger in diameter than the annular space.

G. Polyurethane Sealant for Pipe Penetrations

Sealant shall be multipart, polyurethane sealant, to cure at ambient temperature, for continuous immersion in water. Install as recommended by the manufacturer. Products: SIKA Sikaflex 2C or equal.

H. Painting and Coating

1. Coat penetrations and sleeves exposed, above ground, or in vaults and structures in accordance with Section 09900, System No. 10 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

2. Coat submerged sleeves and penetrations per Section 09900, System No. 7 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

3. Coat buried sleeves and penetrations per Section 09900, System No. 21.

4. Do not coat stainless steel sleeves and penetrations.

PART 3 - EXECUTION

A. Location of Pipes and Sleeves

1. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.

2. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless steel pipe 3-inches and smaller or stainless steel or copper tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.

3. Provide wall sleeves where shown in the drawings and wherever plastic, steel or stainless steel pipe 3-inches and smaller, or stainless steel or copper tubing passes through a wall. Provide a single rubber annular seal when the wall is 8-inches thick or less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8-inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2-inches of elastomeric sealant on both sides of the structure.

4. Where wall sleeves are installed in which water or soil is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).

5. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2-inches of elastomeric sealant on both sides of the structure.

B. Installation in Existing Concrete Walls and Slabs

Core drill holes 1 to 2 inches larger in diameter than the outside diameter of the wall flange or collar. Install wall pipe and collar assembly axially aligned with the piping to which it will be connected or will contain. Pack the void space between the sleeve and concrete with grout. See Section 03600 for grouting specification.

C. Installation in New Concrete Walls and Slabs

Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

D. Installation in Dry Floors and Slabs

Install pipe sleeves and spools in concrete floors and slabs which do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2-inches above the floor or slab unless shown otherwise in the drawings.

E. Installation of Wall Pipes Having Flanged End Connections

1. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.

2. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

3. Lubricate flange bolts with oil and graphite prior to installation.

F. Qualifications of Welders

Welder qualifications shall be in accordance with AWS D1.1.

G. Installation of Rubber Annular Hydrostatic Sealing Devices

Install in accordance with the manufacturer's instructions.

H. Field Testing

Check each wall penetration for leakage at the time the hydraulic structure is tested for leakage; see Section 03800. Penetrations shall show zero leakage.

END OF SECTION

SECTION 15064 PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws, neoprene isolation pads.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.

3. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

PART 2 - MATERIALS

A. Design Criteria

1. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.

2. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.

B. Hanger and Support Systems

1. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, or Superstrut.

2. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced in the drawings. Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable steel clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102
3	Steel double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	Steel pipe clamp (pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
4	Steel pipe clamp (pipes 3 inches and larger)	Anvil Fig. 216, B-Line 3142
5	Pipe hanger	B-Line B6690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable steel band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B5573
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	Steel turnbuckle	Anvil Fig. 230, B-Line B3202
14	Steel clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	Malleable iron socket	Anvil Fig. 110R, B-Line B3222
17	Steel weldless eye nut	B-Line B3200
18	Steel or malleable iron concrete insert	Anvil Fig. 281, Superstrut 452

Type Number	Description	Manufacturer and Model (or Equal)
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134
22	Welded attachment type	Anvil Fig. 66 B-Line B3083
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	Steel I-beam clamp with eye nut	Anvil Fig. 228
29	Steel wide flange	Anvil Fig. 228 clamp with eye nut
30	Malleable iron beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3093/B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165

Type Number	Description	Manufacturer and Model (or Equal)
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B-Line B3114
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B-Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B-Line B3117SL

3. Pipe hangers and supports shall be hot-dipped galvanized per ASTM A 153 carbon steel (ASTM A36, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A47).

4. Pipe hangers and supports in submerged service shall be type 316 stainless steel.

C. Miscellaneous Pipe Supports and Hangers

1. Pipe Anchor Chair: Anvil Figure 198 or equal.

2. One Hole Clamp: Anvil Figure 126 or equal.

3. Roller Chair: Anvil Figure 175 or equal.

D. Pipe Spiders

Superstrut S-794 or equal.

E. Waffle Isolation Pads

Mason Type "W"; Machinery Installation Systems "Unisorb" Type S, SB, F, or FB; or equal. Provide minimum 1/4-inch thickness.

F. Neoprene Isolating Sleeves for Metal Pipe

Unistrut P2600, B-Line "Vibrocushion," or equal.

G. Anchor Bolts and Screws

Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be

Type 316 stainless steel, ASTM A276 or F593. Nuts shall be Type 316 stainless steel, ASTM A194, Grade 8M or ASTM F594, Type 316 stainless steel.

PART 3 - EXECUTION

A. Pipe Hanger and Wall Support Spacing

Install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed in the drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes shown or detailed in the drawings. If no spacing or rod sizes are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe Hanger and Wall Support Spacing for Stainless Steel and Ductile-Iron Pipe (Sections 15240 and 15276):

Pipe Size (inches)	**Maximum Support or Hanger Spacing (feet)**	**Minimum Rod Size (inches)**
3/8 and smaller	4	3/8
1/2 through 1	6	3/8
1-1/4 through 2	8	3/8
2-1/2 and 3	10	1/2
3-1/2 and 4	10	5/8
6	12	3/4
8	12	7/8
10 and 12	14	7/8
14 and 16	16	1
18	15	1
20 through 24	9	1
30	6	1

2. Pipe Hanger or Wall Support Spacing for PVC Pipe (Sections 15290, 15291 and 15294):

Pipe Size (inches)	Maximum Support or Hanger Spacing (feet)	Minimum Rod Size (inches)
3/4	4	3/8
1	4	3/8
1-1/2	5	3/8
2	5	3/8
2-1/2	5	1/2
3	6	1/2
4	6	5/8
6	7	3/4
8	7	7/8

3. Pipe Hanger or Wall Support Spacing for Stainless Steel Tubing (Section 15278):

Tube Outside Diameter (inches)	Maximum Hanger or Support Spacing (feet)	Minimum Rod Size (inches)
1/8 to 1/4	2	3/8
5/16 to 1/2	3	3/8
5/8 to 7/8	4	3/8
1 to 2	6	3/8

B. Pipe Support Spacing for Supports on Top of Slabs or Grade

Install pipe supports on horizontal runs at the spacing shown or detailed in the drawings. Provide supports of the type shown or detailed in the drawings. If no spacings are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe Support Spacing for Steel and Ductile-Iron Pipe (Sections 15240 and 15276):

Pipe Size (inches)	Maximum Support Spacing (feet)
3/8 and smaller	4
1/2 through 1	6
1-1/4 through 2	8
2-1/2 and 3	10
3-1/2 and 4	10
6	12
8	12
10 and 12	14
14 and 16	16
18	16
20 through 24	18
30 through 36	18

2. Pipe support spacing for other pipe materials shall be the same as described above in paragraph entitled “Pipe Hanger and Wall Support Spacing.”

C. Installing Pipe Hangers and Supports

1. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.

2. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.

3. Adjust pipe hangers per MSS SP-89, paragraph 10.6.

4. Install leveling bolts beneath support baseplates. Provide 1-inch thick grout pad beneath each base.

5. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

D. Installing Stainless Steel Channel Frames

Use 1-5/8-inch high channel frames unless 3-1/4-inch is needed to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

E. Installing Neoprene Isolating Sleeves

Install a sleeve around each metal pipe 6-inches and smaller at the point of bearing or contact with the pipe hanger or support.

F. Painting and Coating

1. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.

2. Paint exposed pipe hangers and supports to match the color of the adjacent wall using System No. 10 per Section 09900. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.

3. Do not coat stainless steel pipe supports.

4. Remove heat tint completely from the heat affected zones HAZ of the finished weld on stainless steel pipe supports by grinding or blasting. The maximum depth of grinding or abrasive blasting to remove defects shall not exceed 10% of the support thickness. Do not perform abrasive blasting with steel shot, grit, or sand. Perform a final cleaning then pickle, and passivate the heat affected zones (HAZ) on stainless steel pipe supports.

END OF SECTION

SECTION 15075 PROCESS EQUIPMENT, PIPING, DUCT, AND VALVE IDENTIFICATION

PART 1 - GENERAL

A. Description

This section includes materials and installation of markers, labels, and signs for pipes, ducts, and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.

PART 2 - MATERIALS

A. Labels for Exposed Piping

1. Labels for piping shall bear the full piping system name as shown in the Piping Schedule in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels and flow direction arrows shall be painted on using commercial paint stencils to spell out the pipe name.

2. Provide 1-inch thick molded fiberglass insulation with jacket for each plastic pipe label or marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

B. Labels for Valves

Provide each valve of size 3 inches and larger and all actuated valves regardless of size with an identification tag. Tag shall be 2-inch square or circular aluminum or 1/16-inch thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have

black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings. Tags for actuated valves shall show the power source of the actuator.

C. Hose Bibb Signs--Unsafe Water

Provide a rigid sign labeled "RECLAIMED WATER-DO NOT DRINK—NO BEBER" for each hose bibb as denoted for a reclaimed water source. The size and lettering shall conform to OSHA requirements. Signs shall be Seton Nameplate Company 20-gauge baked enamel, minimum size 7 inches by 3 inches; Brady B-120 Fiber-Shield fiberglass, minimum size 7 inches by 3 inches, 1/8-inch thick; or equal.

D. Labels for Mechanical Equipment

Provide a label for each pump, filter, drive mechanism, blower, compressor, tank, feeder, flocculator, flash mixer, clarifier mechanism, or other piece of mechanical equipment. Label shall show the equipment name. Labels shall be 1-1/2 inches (minimum) by 4 inches (minimum) brass, aluminum, or 1/8-inch thick fiberglass tags: Brady B-120 Fiber-Shield, Seton Style 2065, or equal.

E. Labels for Tanks

Signs shall be weather- and UV-resistant. Labels shall be Brady B-946, Seton Name Plate Corporation PSPL, or equal. Minimum size shall be 7 inches by 10 inches. Provide a sign on each tank bearing the tank tag number and the name of the liquid stored.

F. Wall Signs

Wall signs shall be 1-1/2 inches by 4 inches (minimum dimensions), 1/16-inch thick satin-surfaced material conforming to ASTM D709 (Grades ES-1, ES-2, or ES-3). Lettering shall be 1/2-inch high white letters on black background. Do not provide mounting holes.

G. Labels for Automatic Start/Stop Equipment

Provide a sign reading "CAUTION--EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on each piece of equipment listed below. Signs shall be pressure-sensitive vinyl with adhesive for application to equipment. Signs mounted on adjacent walls are also acceptable. Table does not include all equipment

within the Project to receive signage. Reference the Drawings and provide signage for all equipment within the Project that stops and starts automatically. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

Equipment Type	Location	Tag Number
Electric Actuated Butterfly Valves	Disk Filter Influent	065-V-1A, 065-V-2A, 065-V-3A, 065-V-4A, 065-V-5A, 065-V-6A, 570-V-1A, 570-V-2A, 570-V-3A, 570-V-4A, 570-V-5A
Electric Actuated Backwash & Waste Valves	See Drawings	065-V-1(B-J), 065-V-2(B-J), 065-V-3(B-J), 065-V-4(B-J), 065-V-5(B-J), 065-V-6(B-J) 570-V-1(B-J), 570-V-2(B-J), 570-V-3(B-J), 570-V-4(B-J), 570-V-5(B-J)
Disk Filter Drive Assembly	One per Disk Filter (See Drawings)	065-D-1, 065-D-2, 065-D-3, 065-D-4, 065-D-5, 065-D-6, 570-D-1, 570-D-2, 570-D-3, 570-D-4, 570-D-5

H. Underground Plastic Warning Tape for Metallic Pipe

Provide permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service, not less than 6 inches wide by 3.5 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue

I. Underground Detectable Metallic Pipe Warning Tape for Nonmetallic Pipe

Provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Provide tape with printing which most accurately indicates type of buried service. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue

PART 3 - EXECUTION

A. Installing Pipe Labels

1. Provide label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 10-foot centers on straight

runs of piping. Minimum 1 label per straight run and 10’ after.

2. On piping having external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.

3. On piping having external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers but not narrower than three times letter height (and of required length), fastened by one of the following methods:

   a. Laminated or bonded application of pipe marker to pipe or insulation.

   b. Strapped-to-pipe or insulation application of semirigid type with Type 304 or 305 stainless steel bands.

4. Label destination on pipes entering and leaving buildings.

B. Installing Valve and Equipment Labels

1. Attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains or wires.

2. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

C. Installing Miscellaneous Signs

Attach per sign manufacturer's recommendations and per OSHA requirements.

D. Installing Wall and Door Signs

Attach to walls and doors using epoxy adhesive.

E. Installing Labels for Automatic Start/Stop Equipment and Hazardous Materials Warning Signs for Equipment

1. Attach signs for exposed equipment directly to the equipment.

2. Attach signs for sump pumps on the adjacent wall.

F. Installing Ventilation Ductwork Labels

1. In each space where ductwork is exposed or concealed only by a removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground, or similar concealment) and at 20-foot spacings along exposed runs.

2. Provide markers on each access door in ductwork and housings, indicating purpose of access.

3. Assure that all identification labels are clearly visible.

G. Installing Underground Plastic Warning Tape for Metal Pipe

During backfilling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches above the top of the pipe. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker.

H. Installing Underground Detectable Metallic Pipe Warning Tape

Install tape 12 to 18 inches below finished ground surface, located directly over buried pipelines. Where multiple small pipelines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker tape.

END OF SECTION

SECTION 15100 MANUAL, CHECK, AND PROCESS VALVES

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of manually operated valves, check valves, and process valves including gate, butterfly, ball, hose bibbs, eccentric plug, and check valves.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

3. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

4. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

5. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."

6. For butterfly and eccentric plug valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.

C. Proof of Design Test for Eccentric Plug Valves (Types 500, 510, 520)

1. The Contractor shall require the valve manufacturer to furnish six certified copies of reports covering the design tests for the eccentric plug valves as described in AWWA C517 and the following. One prototype valve of each size and class of a manufacturer's design shall be tested for leakage at the specified design pressure and hydrostatically tested with twice the specified design pressure. The hydrostatic test shall be performed with the plug in the open position. The leakage test shall be performed with the plug in the closed position. The duration of each test shall be 10 minutes minimum. During the leakage test, there shall be no indication of leakage past the valve plug. Valves specified to have bi-directional seats shall be leak tight in both directions. In the case of flanged valves, the valve body shall be bolted to a flanged test head.

2. No part of the valve or plug shall be permanently deformed by the hydrostatic test. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft seal.

3. It is the intent that the valve manufacturer provide evidence of the adequacy of each type offered to perform under design pressures within the applicable rating for a sufficient number of test cycles simulating a full service life. The adequacy is to be proven by tests, made on one or more valves selected to represent each basic type of seat design of a size within each applicable group, in a pressure class or classes equal to or greater than that specified. The required number of test cycles appears in the following table:

TEST CYCLES REQUIRED		
Size Group (inches)	**No. of Cycles**	**Minimum Differential Pressure (psig)**
3 to 20	10,000	150
24 to 42	5,000	150

Every test cycle shall consist of applying the specified differential pressure to the plug in the closed position, then opening the plug (which will relieve the

pressure) to the wide-open position and then closing the plug.

4. The valve shall be leak tight under the specified pressure differential upon completion of the cycle test without having to stop during the test to repair the valve, modify or reinforce the seat, or install shims or wedges around the seat.

5. The plug shall not be rotated past the center position to jam the plug onto the seat during the hydrostatic test, the leakage test, or the cycle test.

PART 2 - MATERIALS

A. General

1. Valves are identified in the drawings by size and type number. For example, a callout in the drawings of 2V310 refers to 2-inch Type 310 valve in these specifications, which is a 2-inch double union PVC ball valve.

2. In addition, valves are further described by a suffix letter on the type number:

Suffix Letter	Description
L	Limit switches at the fully open and/or fully closed positions
M	Motorized actuator per Section 15119

3. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

4. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

5. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

B. Valve Actuators

1. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

2. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

3. Provide 2-inch AWWA operating nuts for buried and submerged valves. Provide 2-inch AWWA operating nuts with the handwheels for manually actuated valves 12 inches and larger for use with a portable electric valve actuator.

4. Provide enclosed gear actuators on butterfly, ball, and plug valves 6 inches and larger, unless electric valve actuators are shown in the drawings. Gear actuators for valves 12 inches and larger shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.

5. Design gear actuators assuming that the differential pressure across the plug or disc is equal to the test pressure of the connecting piping unless otherwise required in the detailed valve specifications.

6. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

7. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

8. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on

the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

9. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

10. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B84, Alloy C86200), accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148, Grade 105-85), with thread ground and polished. Support worm-gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

11. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

12. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

C. Cast-Iron Valve Boxes With Debris Caps for Buried Valves

1. Valve boxes shall be two-piece sliding type, cast iron, with extension shafts. Units shall be as manufactured by Bingham/Taylor Foundry, Russco/Sigma, or Star Pipe Products. Extension pipes shall be cast iron.

2. Debris cap shall be comprised of a hollow member having a cylindrical outer surface, a closure for one end, and three resilient contact pads projecting from the outer surface. Stainless steel springs under each contact pad

shall hold the debris cap in position against the interior of the extension pipe or valve box. Provide handle to allow the contact pads to be extended and retracted. The cap shall have a flexible skirt providing an outward seal preventing debris from passing the cap. The cap shall withstand, without slipping, a minimum vertical force of 50 pounds when the contact pads are extended against the wall of the extension pipe or valve box. The cap shall be made of molded ABS plastic material. Color of handle shall be indicated by the Owner. The cap shall have retaining prongs to retain a copper locating wire coil. Provide locking mechanism to accept a lock furnished by the Owner. Manufacturer: Bingham/Taylor Foundry, Russco/Sigma, or Star Pipe Products.

3. Coat buried cast-iron pieces per Section 09900, System No. 21 or with fusion-bonded epoxy per Section 09961.

D. Extension Stems for Buried and Submerged Valve Actuators

1. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the high water level surface. Extension stems shall be steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

2. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1-1/8
10, 12	1-1/4
14	1-3/8
16, 18	1-1/2
20, 24, 30, 36	1-3/4
42, 48, 54	2

3.

E. Chainwheels and Guides

Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, or Stockham. Chainwheels and guides shall be galvanized iron or steel. Chains shall extend to within 4 feet of the operating floor. Chains shall be Type 316 stainless steel.

F. Valve Tagging and Identification

Provide identifying valve tags per Section 15075.

G. Bolts and Nuts for Flanged Valves

Bolts and nuts for flanged valves shall be as described in Section 15050.

H. Gaskets for Flanges

Gaskets for flanged end valves shall be as described in Section 15050.

I. Limit Switches for Check Valves

Provide oiltight position limit switches for indication of open position of check valves. Provide single-pole double-throw contacts rated for 3 amperes break, minimum, at 120-volt a-c, 35% power factor. Provide an adjustable mounting bracket to permit the actuation point to be field adjustable

at any point of the valve's travel. Switch to be Square D, Allen-Bradley, or equal.

J. Painting and Coating

1. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09900, System No. 10. Apply the specified prime and intermediate coat at the place of manufacture. Finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.

2. Coat buried metal valves at the place of manufacture per Section 09900, System No. 21.

3. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 09900, System No. 7.

4. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09900, System No. 7. Apply lining at the place of manufacture.

5. Coat floor stands per Section 09900, System No. 19.

6. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

7. Measure the thickness of the valve interior linings per Section 09900. Repair areas having insufficient film thickness per Section 09900.

K. Packing, O-Rings, and Gaskets

Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

1. Teflon.

2. Kevlar aramid fiber.

3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

4. Buna-N (nitrile).

L. Rubber Seats

Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/l in the fluid conveyed.

M. Valves

1. Gate Valves:

a. Type 100--Aboveground Bronze Gate Valves 3 Inches and Smaller:

Aboveground threaded end gate valves, 1/4 inch through 3 inches, for water and air service shall be rising stem, screwed bonnet, solid wedge disc type, Class 125, having a minimum working pressure of 200 WOG psi at a temperature of 150°F. Ends shall be female threaded, ASME B1.20.1. Materials of construction shall be as follows:

Component	Material	Specification
Body and bonnet	Bronze	ASTM B61 or B62
Disc	Bronze	ASTM B61, B62, or B584 (Alloy C97600)
Stem	Bronze or copper silicon	B99 (Alloy 651), B584 (Alloy C87600), B371 (Alloy C69400)
Seat rings (Classes 200 and 300 only)	Stainless steel	AISI Type 410

Handwheels shall be aluminum, brass, or malleable iron. Packing shall be Teflon or Kevlar aramid fiber. Valves shall be American Flow Control Series 2500, Clow Series F-6100, or Mueller Series A2360.

b. Type 120—2-Inch and 3-Inch Cast-Iron Buried Gate Valves:

Buried gate valves of sizes 2 inches through 3 inches for water service shall be iron body, bronze mounted, nonrising stem type, double disc, parallel seat, and shall have a working pressure of at least 200 psi. Valves shall have flanged, PVC, or threaded ends to match the pipe ends. Valves shall have a 2-inch AWWA operating nut. Materials of construction shall be as follows:

Component	Material	Specification
Body, bonnet, operating nut, and stuffing box	Cast iron	ASTM A126, Class B or C
Bonnet bolts and stuffing box bolts	Stainless steel	ASTM A193, Grade B8M
Discs and seat ring	Bronze or cast iron	ASTM B62 or ASTM A126, Class B or C
Disc nut and disc ring	Bronze or copper alloy	ASTM B62 or ASTM B584
O-ring	Synthetic rubber	
Stem	Copper silicon	ASTM B584, Alloy C87600,

Valves shall be Clow Series F-5070, Mueller Model 71 or equal.

c. Type 130--Cast-Iron Gate Valves 4 Inches and Larger:

Valves shall conform to AWWA C500 and the following. Valves shall be iron bodied, bolted bonnet, nonrising stem, solid bronze internal working parts, parallel faced, bottom wedging double-discs, and O-ring seals. Discs shall be solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 (85-5-5-5) or ASTM B584 (Alloy C83600), except that stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum

of 10% elongation in 2 inches (ASTM B584, Alloy C87600). Body bolts shall be Type 316 stainless steel, ASTM A276. End connections for exposed valves shall be flanged. End connections for buried valves shall be push-on type to match the connecting pipe material. Valves shall be Mueller Series A-2361, American Flow Control Series 2500, or Clow Series F-6100.

d. Type 137--Ductile-Iron Resilient Wedge Tapping Gate Valves 4 Inches Through 48 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. Ends shall be flanged, Class 125, ASME B16.1. One end shall have slotted bolt holes per AWWA C515, paragraph 4.4.1.3.4 to fit tapping machines.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Mueller, or Kennedy.

e. Type 185—Ductile-Iron Resilient Wedge Gate Valves 2 Inches Through 36 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint or push-on type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Mueller, or Kennedy.

2. Butterfly Valves:

   a. Thrust Bearings for Butterfly Valves (Types 200, 205 and 210):

      Provide thrust bearings to hold the valve disc in the center of the valve seat. No bearings shall be mounted inside the valve body within the waterway. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

   b. Bronze Components in Butterfly Valves (Types 200, 205 and 210):

Bronze components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

c. Actuator Sizing for Butterfly Valves (Types 200, 205 and 210):

Actuators shall be sized to produce valve shaft output torques equivalent to at least 75% of the torsional shear stress of the minimum required shaft diameters.

d. Port Sizes for Butterfly Valves (Types 200, 205 and 210):

For valves 24 inches and smaller, the actual port diameter shall be at least 93% of the nominal valve size. For valves larger than 24 inches, the port diameter shall not be more than 1.25 inches smaller than the nominal valve size. The dimension of the port diameter shall be the clear waterway diameter plus the thickness of the rubber seat.

e. Corrosion-Resistant Materials in Butterfly Valves (Types 200, 205 and 210):

Where AWWA C504 requires “corrosion resistant” material, such material shall be one of the following:

(1) Bronze as described above.

(2) Type 304 or 316 stainless steel.

(3) Monel (UNS N04400).

(4) Synthetic nonmetallic material.

f. Seating Surfaces in Butterfly Valves (Types 200, 205 and 210):

Seating surfaces in valves having motorized actuators shall be stainless steel or nickel-copper per AWWA C504 or nickel-chromium alloy containing a minimum of 72% nickel and a minimum of 14% chromium.

g. Factory Leakage Testing (Types 200, 205 and 210):

Perform factory leakage tests per AWWA C504 on both sides of the seat.

h. Type 200—Flanged and Mechanical Joint, Rubber-Seated Butterfly Valves 4 Through 72 Inches, Class 150B:

Butterfly valves shall be short body, flanged type for exposed valves and valves in vaults or structures, and either flanged or mechanical joint for buried valves. Valve shall conform to AWWA C504, Class 150B. Minimum working differential pressure across the valve disc shall be 150 psi. Flanged ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron or ductile iron	AWWA C504
Exposed body capscrews and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Discs	Cast iron, ductile iron, or Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N rated to 250°F	--

Where the rubber seat is applied to the disc, it shall be bonded to a stainless steel seat retaining ring which is clamped to the disc by Type 304 or 316 stainless steel screw fasteners or secured to a

stainless steel seat by a combination of cap screws, a serrated disc retaining ring, and molded shoulders in the seat mating with machined registers in the disc. The rubber valve seat shall be secured to or retained in the valve body. Valves shall be Clow Series 4500, DeZurik Series BAW, Henry Pratt, or M&H Series 4500.

i. Type 210--Flanged, Rubber-Seated Butterfly Valves 4 Through 72 Inches, Class 75A:

Butterfly valves shall be short body, flanged type, conforming to AWWA C504, Class 75A or 75B. Minimum working differential pressure across the valve disc shall be 75 psi. Flanged ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron or ductile iron	AWWA C504
Exposed body capscrews and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Discs	Cast iron, ductile iron, or Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N rated to 250°F	--

The rubber valve seat shall be secured to or retained in the valve body. Valves shall be Henry Pratt, Clow Series 4500, DeZurik Series BAW, or M&H Series 4500.

j. Type 310--Double Union PVC Ball Valves 3 Inches and Smaller:

Thermoplastic ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, or Plast-O-Matic.

k. Type 316--Double Union PVC Ball Valves 3 Inches and Smaller with Vented Ball:

Vented PVC ball valves, 3 inches and smaller, for chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 85 psi at a temperature of 140°F. Provide machined vent hole, deburred, in the ball to allow gases to vent. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be Plast-O-Matic “Z-MBV-Vent,” Asahi/America Type 21, or equal.

l. Type 320--Regular Port Threaded Stainless Steel Ball Valves 3 Inches and Smaller:

Stainless steel ball valves, 3 inches and smaller, for water service shall be rated at a minimum pressure of 1,500 psi WOG at a temperature of 100°F. Valve body, ball, and stem shall be Type 316 stainless steel, ASTM A276 or A351. Seat and seals shall be reinforced Teflon. Valves shall have lever actuators, plastic coated. Valves shall have screwed ends (ASME B1.20.1) and nonblowout stems. Valves shall be McCanna Figure M402, Worcester Series 48, Stockham Figure SD 2120-SSMO-R-T, or Apollo 76-100 Series.

3. Angle Hose Valves& Hose Bibbs:

a. Type 410--Bronze Angle Hose Valves:

Angle-type hose valves of sizes 1-1/2 inches and 2-1/2 inches shall be brass or bronze (ASTM B62 or ASTM B584, Alloy C83600) body with rising or nonrising stem, composition disc, and bronze or malleable iron handwheel. Stem shall be bronze, ASTM B62, ASTM B584 (Alloy C83600), or ASTM B198 (Alloy C87600). Valves shall have a cold-water service pressure rating of at least 150 psi. Provide cap and chain with valve. Threads on the valve outlet shall be American National Standard fire hose coupling screw thread. Valves shall be Nibco T-301-HC, Powell Figure 151 with Figure 527 nipple adapter, or Crane 17TF with hose nipple adapter.

b. Type 420--Bronze Hose Bibbs:

Hose bibbs of size 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or nonrising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be Teflon or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlet shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Provide atmospheric vacuum breaker conforming to the state of Florida health department on each hose bibb. Valves shall be Jenkins Figure 112, 113, or 372, Nibco Figure T-113-HC, or Powell Figure 503H.

4. Plug Valves:

a. Plug and Seating Design for Eccentric Plug Valves (Types 500, 510, and 520):

Eccentric plug valves shall comply with AWWA C517 and the following. Provide a rectangular or circular plug design, with an associated rectangular or round seat. Provide bidirectional seating design. The valve shall seat with the rated pressure both

upstream and downstream of the closed plug. Provide geared actuators sized for bidirectional operation.

b. For Types 500, 510 and 520 eccentric plug valves, the metallic portion of the plug shall be one-piece design and shall be without external reinforcing ribs which result in there being a space between the rib and the main body of the plug through which water can pass. Valves shall be repackable without any disassembly of valve or actuator. The valve shall be capable of being repacked while under the design pressure in the open position. Nowhere in the valve or actuators shall the valve shaft be exposed to iron on iron contact. Sleeve bearings shall be stainless steel in valve sizes 20 inches and smaller and bronze or stainless steel in valve sizes 24 inches and larger. Provide enclosed worm-gear actuators for valves 6 inches and larger.

c. Rubber compounds shall have less than 2% volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at a temperature of 73.4°F ±2°F for 70 hours.

d. Type 510--Eccentric Plug Valves 4 Inches Through 12 Inches:

Eccentric plug valves, 4 inches through 12 inches, shall be nonlubricated type. Minimum pressure rating shall be 175 psi. Bodies shall be cast iron per ASTM A126, Class B. Ends shall be flanged, Class 125 per ASME B16.1 or mechanical joint per ANSI/AWWA C111/A21.11. Plugs shall be cast iron (ASTM A126, Class B), or ductile iron (ASTM A536, Grade 65-45-12) with neoprene facing. Design plugs to seat over a pressure range of 0 to 5 psi. Valve body seats shall be Type 304 or 316 stainless steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Body capscrews and bolts and nuts shall be Type 316 stainless steel. Packing shall be butadiene-filled Teflon. Alternatively, U-cup seals may be provided. Valves shall be Valves shall be DeZurik Series –PEC, Val-Matic Series 5600R or Series 5700R, or Milliken Series 601.

5. Check Valves:

a. Type 720--Cast-Iron Swing Check Valves 3 Inches and Larger, Class 125:

Swing check valves, 3 inches and larger, shall be iron body, bronze mounted with the following materials of construction:

Description	Material	Specification
Disc or clapper seat ring and valve body seat ring	Bronze or brass	ASTM B62 or B584 (Alloy C84400 or C87600)
Body and cap (bonnet)	Cast iron	ASTM A126, Class B
Disc and hinge or arm (valves 4 inches and smaller)	Bronze	ASTM B62 or ASTM B584 (Alloy C84400)
Disc and hinge or arm (valves larger than 4 inches)	Cast iron or bronze	ASTM A126, Class B; ASTM B62.
Hinge pin	Stainless steel	Type 303, 304, or 410 stainless
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Internal fasteners and accessories	Bronze or Type 304 or 316 stainless steel	

Bronze or brass components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

Ends shall be flanged, Class 125, ASME B16.1. Minimum valve working pressure shall be 150 psi. Provide check valves with outside lever and spring.

The shop drawing submittal shall include a detail showing how the hinge pin extends through the valve body. Show packing gland, hinge pin gland, cap, and other pieces utilized.

Valves shall be Milliken 800, Kennedy 106, M&H Style 159, Mueller Series 2600, Clow 106, Empire 220, American Flow Control Series 600, Val-Matic Series 9800, ARI NR-040, DeZurik, or acceptable equal.

b. Type 730—PVC Ball Check Valves, 3 Inches and Smaller:

PVC check valves, 3 inches and smaller, shall be constructed of PVC per ASTM D1784, Type I, Grade 1. Ends shall be double union, socket welded. Seats and seals shall be Viton. Valve shall have a pressure rating of 150 psi at a temperature of 73°F.

c. Type 760—Double Door Check Valves, 2 to 36 Inches:

Double door check valves shall conform to API 594. Valves shall be equipped with a Type 316 stainless steel spring mechanism to provide for nonslam closure of the valve without backflow, in any position, and shall not be dependent on gravity or backflow for closure. Sealing members shall be Viton suitable for a maximum pressure of 35 psi and a maximum temperature of 250°F. Bodies shall be cast iron, ASTM A 48 or A 126. Internal assemblies shall be aluminum. Ends shall be flanged, Class 125, ANSI B16.1. Valves shall be APCO Series 9000 or equal.

6. Spare Parts:

1. Provide five (5) T-handle wrenches for 2-inch nuts, as follows:

a. Two (2) 4-foot T-handle wrenches

b. Two (2) 5-foot T-handle wrenches

c. One (1) 6-foot T-handle wrench

2. Provide two (2) adjustable 4-foot to 10-foot valve wrenches for 2-inch nuts.

PART 3 - EXECUTION

A. Joints

1. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

4. Install grooved-end couplings for valves in accordance with Section 15050.

B. Installing Exposed Valves

1. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

2. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

C. Installing Buried Valves

1. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement, and place and compact the backfill to the height of the valve stem.

2. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.

3. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.

4. In streets without concrete curbs and in open areas, install the valve box as for a paved area with concrete curb except include a marker post. Cut the marker post from 4-inch by 4-inch dense structural grade Douglas fir No. 2 surfaced on four sides to a length of 5 feet. Chamfer the top. Set the post in concrete, 2 feet into the ground, away from traffic, and to the side of the pipeline. Coat with a seal and finish coat of white alkyd exterior paint. On the side facing the valve, letter in black the word "VALVE" and the distance in feet from the marker post to the valve box cap.

5. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior or the extension pipe. Install Owner-furnished locks.

D. Field Coating Buried Valves

1. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 09900, System No. 24.

E. Installing Eccentric Plug Valves

1. Install such that the rotation of the plug is about a horizontal axis.

2. Install such that the plug stores in the top when the valve is open.

3. Orient the valve such that the seat is opposite the high-pressure side.

F. Installing Extension Stem Guide Brackets

Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

G. Mounting Gear Actuators

The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

H. Field Installation of Gear Actuator

Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

I. Valve Leakage Testing

Test both sides of valves for leakage at the same time that the connecting pipelines are tested. See Section 15144 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

J. Valve Field Testing

1. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

2. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in

accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

SECTION 15108 AIR-RELEASE AND VACUUM-RELIEF VALVES

PART 1 - GENERAL

A. Description

This section includes materials and installation of air and vacuum valves, air-release valves, combination air-release valves, water service and sewage service. These valves are designated in the drawings as Types 1200 through 1240. Two types of valves are allowed:

1. Type A: A body containing a stainless steel float with associated stainless steel lever or linkage mechanism.

2. Type B: A cylindrical body containing a series of HDPE floats having air release orifices within them.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and detail drawings showing all valve parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings. Identify each valve by tag number to which the catalog data and detail sheets pertain.

PART 2 - MATERIALS

A. Valve Identification

Valves are identified in the drawings by size and type number. For example, a callout in the drawings of a 1-V1201 refers to a 1-inch Type 1201 valve in these specifications, which is a 1-inch 150-psi air-release valve.

B. Valve Tagging and Identification

Provide identifying valve tags per Section 15075.

C. Bolts, Nuts, and Gaskets for Flanged Valves

See Section 15050 and specification for the pipe to which the valve is attached.

D. Type A: Valve Design and Operation

1. Valve design shall comply with AWWA C512, except as modified herein. Class 150 valves shall have a maximum working pressure of at least 150 psi. Class 300 valves shall have a maximum working pressure of at least 300 psi. Class 500 valves shall have a maximum working pressure of at least 500 psi.

2. Air-Release Valves for Water Service:

   a. Air-release valves for water service 3/4 inch and smaller shall be of the direct-acting type or lever type. Valves larger than 3/4 inch shall have a float-actuated compound lever with linkage mechanism to release air.

   b. Air-release valves of sizes 1 and 2 inches shall incorporate a body with flanged top cover and replaceable orifice and a synthetic rubber needle or disc actuated by the float and linkage mechanism. Top cover shall include a 1/2-inch threaded port with bronze plug. Body shall include a 1/2-inch threaded drain port near the bottom with a bronze plug.

3. Air and Vacuum Valves for Water Service:

   a. Air and vacuum valves for water service shall have a body with a flanged top containing the air-release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat.

   b. Air and vacuum valves 3 inches and smaller shall have 1/2-inch threaded ports with bronze plugs in the top cover and near the bottom of the valve body. Air and vacuum valves larger than 3 inches shall have a 1-inch threaded drain outlet with bronze plug near the bottom of the valve body and a 1-inch threaded port with bronze plug on the side of the valve body above the minimum water level in the valve which forces the float against the valve seat.

4. Combination air valves 3 inches and smaller shall have a float with lever arm to actuate a poppet valve. A needle shall be attached to the float arm. The poppet valve shall serve to admit large quantities of air when the pipeline drains. The needle shall serve to release small

quantities of air as the pipeline fills or as air accumulates in the pipeline.

5. Air and vacuum valves for vertical turbine pump service (3 inches and smaller) shall have a float assembly. The discharge orifice shall have a double-acting throttling device to restrict air venting; it shall fully open to allow unrestricted air entry when the pump is shut down. Valve shall have a body with flanged top containing the air-release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat.

    a. Valves 3 inches and smaller shall include the following features:

        (1) Water diffuser around the float to break up the incoming water column before contacting the float.

        (2) Double-acting throttling device that restricts airflow when the pump is started and opens fully when the pump is stopped.

E. Type B: Valve Design and Operation

1. The air-release and vacuum-relief valve shall be of a single chamber design with solid cylindrical HDPE control floats housed in a tubular stainless steel body with epoxy powder-coated cast iron, steel, or stainless steel ends secured by means of stainless steel tie rods or by a flanged connection. The valve shall have an integral orifice mechanism that shall operate automatically to limit transient pressure rise or shock induced by closure to twice valve rated working pressure. Provide a double (small and large) orifice design.

2. The intake orifice area shall be equal to the nominal size of the valve. The large orifice sealing shall be affected by the flat face of the control float seating against a nitrile rubber O-ring housed in dovetail groove circumferentially surrounding the orifice. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control float. The nozzle shall have a flat seating land surrounding the orifice.

3. Provide a 1/4-inch NPT test/bleed cock.

4. Prior to the ingress of liquid into the valve chamber, as when the pipeline is being filled, valves shall vent through the large orifice. At higher water approach velocities, the valve shall automatically discharge air through the orifice mechanism and reduce water approach velocity.

5. Valve shall not exhibit leaks or weeping of liquid past the large orifice seal at operating pressures of 7 psi to twice rated working pressure.

6. Valves shall respond to the presence of air by discharging it through the small orifice at any pressures within the specified design range and shall remain leak tight in the absence of air.

7. Valves shall react immediately to pipeline drainage or water column separation by the full opening of the large orifice so as to allow unobstructed air intake at the lowest possible negative internal pipeline pressure.

F. Type A: Materials of Construction

1. Materials of construction for air-release, air and vacuum, and combination air valves for water service shall be as follows:

Item	Material	Specification
Body and cover	Cast iron	ASTM A48, Class 35; or ASTM A126, Class B
Float, lever or linkage, air-release mechanism, poppet, guide rod, guide bushings, fasteners, other internal metal parts	Stainless steel	AISI Type 316
Plugs	Bronze	-
Seat, plunger, needle	Buna-N	–

2. Rubber seats shall be made of a rubber compound that is resistant to free chlorine concentrations up to 10 mg/L in the fluid conveyed.

3. Body and cover bolts, nuts, and cap screws shall be Type 316 stainless steel.

G. Type B: Materials of Construction

1. Materials of construction for air-release valves/air and vacuum-relief valves for sewage service shall be as follows:

Item	Material	Specification
Top flange, lower flange, screen mesh, bolts, nuts, connecting screws, float screw, and assembly screws	Stainless steel	AISI Type 304
Top cover	ABS plastic	–
Barrel	Stainless steel	AISI Type 304L
Floats	HDPE	–
Air-release nozzle or orifice mechanism	Stainless steel	AISI Type 304
Nozzle seal and seat	Natural rubber	–
Nozzle seal retaining plate	Stainless steel	AISI Type 304
Tie rod assembly and support fasteners	Stainless steel	AISI Type 304
Float O-ring seals	Nitrile rubber	–

H. Seating

Valves shall seat drip tight at a pressure of 1 psi.

I. Valve End Connections

1. Valves 2 inches and smaller shall have threaded ends. Valves 3 inches and larger shall have flanged ends.

2. Flanges for Class 150 valves shall comply with ASME B16.1, Class 125. Flanges for Class 300 valves shall comply with ASME B16.1, Class 250.

3. Threaded ends shall comply with ASME B1.20.1.

J. Valves

1. Type 1201--Air-Release Valves, 1 and 2 Inches, Class 150: Valves shall have a maximum working pressure of 150 psi. Orifice size shall be 1/4 or 3/16 inch. Valves shall be APCO 200, Crispin PL10, Val-Matic VM-38/VM-45.

2. Type 1204--Air-Release Valves, 2 Inches, Class 500: Orifice size shall be 3/16 or 7/32 inch. Valves shall be APCO 205, Val-Matic Model 50, or equal.

3. Type 1207--Air and Vacuum Valves for Vertical Turbine Pump Service, 6 Inches and Smaller: Valves shall be APCO Series 140DAT or Series 1900, Val-Matic Series 100SS, Crispin Series DL-D/DBL, or equal. Valve shall incorporate an air-release valve, Type 1201. If necessary, modify valve size from that shown in the drawings for 200% of the vertical turbine pump design point flow shown in Section 11214.

4. Type 1225--Sewage Air-Release Valves, 2 Through 4 Inches, Class 150: After entraining air escapes through the orifice, the orifice shall be closed by a needle on a compound lever mechanism or by a float which buoys to close the orifice by seating against the top cover to prevent the escape of sewage. The orifice shall remain closed until more gas accumulates and the cycle automatically repeats. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall have an operating pressure of at least 175 psi. Venting capacity shall be at least 100 scfm. Valves shall be Vent-O-Mat Series RGX, Model 050RGX1621.

5. Type 1230--Combination Air Valves, 1 Through 3 Inches, Class 300: Valves shall have a maximum working pressure of 300 psi. Combination Air Valves shall be APCO Series 140C, Val-Matic VM-201C-M or equal.

PART 3 - EXECUTION

A. Lining and Coating

1. Coat cast-iron valves the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 09900, System No. 10. Apply the specified prime and intermediate coats at the place of manufacture. Apply finish coats in field. Finish coat shall match the color of the adjacent piping.

2. Coat interior surfaces of cast-iron valves at the place of manufacture per Section 09900, System No. 7. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.

B. Installation

1. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon® joint compound or Teflon® tape to pipe threads before installing threaded valves. Joints shall be watertight.

3. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the valves.

4. Do not spring flanges of connecting piping into position. Separately work connecting piping systems into position to bring the piping flanges into alignment with the matching valve flanges. Do not move valves to achieve piping alignment. Do not use electrical heating stress relieving to achieve piping alignment.

5. Line up pipe flange bolt holes with valve nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

6. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

C. Valve Pressure Testing

Test valves at the same time that the connecting pipelines are pressure tested. See Section 15144 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

END OF SECTIO

SECTION 15112 BACKFLOW PREVENTERS

PART 1 - GENERAL

A. Description

This section includes materials and installation of reduced pressure backflow preventers.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's certificate of compliance with AWWA C511 for backflow preventers.

3. Provide manufacturer's certification that materials are lead free.

4. Submit dimensional drawings for each size and type of backflow preventer.

5. Submit manufacturer’s catalog data and detail drawings showing backflow preventer parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show manufacturer’s recommended maximum operating pressure and maximum recommended flow. Show linings and coatings.

6. Submit certificate of approval of backflow preventer device by Orange County Utilities Water Division.

7. Submit certificate of backflow preventer installation by a certified installer. Installer shall be certified by the Orange County Utilities Water Division.

PART 2 - MATERIALS

A. Backflow Preventers

1. Backflow preventers shall be of the reduced pressure type, complying with AWWA C511. Provide two independently operating check valves, two shutoff valves, an automatic pressure differential relief valve,

and test cocks so that a test of each check valve can be made.

2. Backflow preventers of sizes 2 inches and smaller shall have bronze (ASTM B61 or B62) check valves. Check valves shall be of the poppet type and have replaceable seats.

3. Backflow preventers 2 inches and larger shall have check valves of either the poppet or the toggle lever type. Check valves larger than 2 inches shall have cast-iron (ASTM A126, Class B) body and cover.

4. Differential relief valve shall be bronze (ASTM B61 or B62) with Type 304 or 316 stainless steel trim.

5. Isolation valves shall be Type 100 gate or Type 300 ball per Section 15100 for backflow preventers smaller than 3 inches.

6. Service conditions shall be as follows:

Unit Tag Number	Service Conditions
500-BFP-1	Cold Water

7. Backflow preventers shall be Clayton Model RP, Mueller Model FRP-II or 6CM, or equal.

B. Bronze Components

Bronze in contact with water shall have the following chemical constituents:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

PART 3 - EXECUTION

A. Painting and Coating

1. Coat backflow preventers including isolation valves the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 09900, System No. 15.

Apply the specified prime at the place of manufacture. Apply intermediate and finish coats in field. Do not coat bronze or stainless steel items. Finish coat shall match the color of the adjacent piping.

B. Shipment and Storage

1. Identify the equipment with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

2. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

3. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

4. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

C. Installation of Backflow Preventers

1. Installation shall be done by an installer certified by the Orange County Utilities Division.

2. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the equipment.

3. Do not spring flanges of connecting piping into position. Separately work inlet and outlet piping systems into position to bring the piping flanges into alignment with the matching equipment flanges. Do not move equipment to achieve piping alignment. Do not use

electrical heating stress relieving to achieve piping alignment.

4. Line up pipe flange bolt holes with machinery nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

5. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

D. Field Testing

Pressure test the backflow preventers along with the connecting piping per Section 15144. There shall be no visible leaks in the backflow preventer assembly, valves, or joints of the interconnecting piping.

END OF SECTION

SECTION 15119 ELECTRIC MOTOR ACTUATORS FOR VALVES AND GATES

PART 1 - GENERAL

A. Description

This section includes materials and installation of electric motor actuators for valves and gates.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data showing motor actuator parts and materials of construction, referenced by AISI, ASTM, SAE, or CDA specification and grade. Show motor actuator dimensions and weights. Show coatings.

3. Show the maximum torque required to open and close each motor-actuated valve.

4. Submit certified factory performance test records.

5. Submit motor data including nameplate data, insulation type, duty rating, and torque output at duty rating.

6. Submit electrical schematic drawings and wiring diagrams showing physical locations of components.

7. The manufacturer’s inspection, field testing and evaluation of the existing valves where actuators are to be installed.

C. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One (1) eight hour labor day for both the EWRF actuators and NWRF actuators to check the installation and advise during start-up, testing, and adjustment of the equipment.

2. Two (2) labor days (one (1) day for each shift) to instruct the County's personnel in the operation and maintenance of the equipment. If there are difficulties

in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

PART 2 - MATERIALS

A. Manufacturers

1. Electric motor actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter-turn type and shall be Limitorque “QX” Series or Rotork “IQT” Series.

2. Other electric motor actuators for open-close service shall be multi-turn type and shall be Limitorque “MX” Series or Rotork “IQ” Series.

3. Intelligent electric motor actuators for modulating service shall be Limitorque “MX” Series or Rotork “IQ” Series.

4. Electric motor actuators for explosion proof service shall be Limitorque “MX” Series or Rotork “IQ” Series.

5. All actuators on the project shall be of one manufacturer.

6. All actuators on the project shall be compatible with Profibus DP communications.

B. Actuator Identification

1. Motorized valves are identified in the drawings by size, type number, and suffix letter "M." For example, a callout in the drawings of 24" V-200M refers to Type 200 valve in Section 15100, which is a Class 150 butterfly valve with an electric motor actuator.

2. Motor actuators shall have the name of the manufacturer cast or molded onto the actuator body or shown on a permanently attached plate in raised letters.

C. Actuator Tagging

Provide identifying tags for electric motor-actuated valves per Section 15075. Show valve actuator tag number, name or designation as shown in the drawings, and valve size. Attach tags to actuators by means of stainless steel wire.

D. Motors for Electric Actuators

1. Motors shall be 480 volt, 3 phase and specifically designed for high torque, low inertia duty. Motors for on/off, open/close actuators shall be designed and rated for 15-minute duty or 60 starts per hour at 104°F. Motors and starters for modulating actuators shall be designed for 30-minute duty or 600 starts per hour at 104°F.

2. Output capacity shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Motors shall have Class F insulation. Provide motor with torque output (at duty rating) that exceeds the requirements of paragraph E below including safety factor.

3. Provide an electrical and mechanical disconnection of the motor without draining the lubricant from the actuator gearcase.

E. Actuator Torque Requirements

1. Actuators being installed on existing valves shall include the manufacturer’s inspection, field testing and evaluation of the existing valve in order to apply the applicable torque requirements in order to properly actuate the existing valves.

2. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

3. Maximum torque shall include seating or unseating torque, bearing torque, dynamic torque, and hydrostatic torque. Assume that the differential pressure across the valve is equal to the pressure or head rating of the valve.

4. Assume a maximum pipeline fluid velocity of 16 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

F. Design of Electric Motor Actuators

1. Actuators shall comply with AWWA C542, except as modified herein. Output capacity of motors shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Provide motor with torque output (at duty rating) that exceeds the requirements of the following paragraphs including safety factor.

2. Provide a reversing starter, three overloads (one in each ungrounded leg) or two motor thermal cutouts, 120-volt control power transformer, local-off-remote selector switch, stop-open-close push buttons, and open and closed indicator lights. Provide magnetic starters in actuators for open/close operation and for modulating operation. Provide dry contact for remote indication of the actuator mode of operation. The contact shall be closed when the local-off-remote selector switch is in the remote position and the internal control power exists.

3. Provide a separate (remote) 316 Stainless Steel NEMA 4X (unless otherwise noted) enclosure with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6 feet 6 inches above floor or deck in lieu of integral controls.

4. Do not use external conduit for wiring any components within the actuator.

5. Gear actuators shall be totally enclosed and factory-grease packed or oil-bath lubricated. The power gearing shall consist of helical gears of heat-treated steel. Worm gears shall be alloy bronze accurately cut with a hobbing machine. Worm shall be hardened steel alloy. Design gears for 24-hour continuous service with an AGMA rating of 1.50.

6. Position switches shall be adjustable and capable of actuation at any point between fully opened and fully closed positions. The position switches shall operate

while the actuator is either in manual or in motor operation. Provide motor actuators with position switches capable of being separately used to provide remote indication of end of travel in each direction and to stop motion at the end of travel in each direction.

7. Provide two individually adjustable torque switches to protect the valve and motor against overload in the opening and closing directions. To prevent hammering, the torque switch shall not reclose until the valve is made to travel in the opposite direction.

8. Provide a manually operated handwheel that shall not rotate during electrical operation. In the event electrical power is interrupted, handwheel operation shall be activated by a hand lever attached to the mechanism. While the valve is being operated manually, the motor shall not rotate. Upon restoration of electrical power, the handwheel shall automatically disengage. Design the handwheel diameter such that hand operation will not damage the valve.

9. The position switch and torque switch contacts shall be capable of interrupting at least 0.2-ampere inductive load at 125-volt dc or 6-ampere inductive load at 120-volt ac.

10. Provide a lost motion device for open/close operation to permit the motor to reach full speed before the load is applied. Provide lost motion action for manual operation also. Do not provide lost motion device for modulating applications.

11. “Latching” shall be provided to inhibit high torque during unseating or starting in mid-travel against high inertia loads. The actuator electrical diagram shall be identical, regardless of whether the valve is to operate on torque or position limit. Provide the actuator with means to non-intrusively calibrate torque or position and interrogate the status and performance of the actuator.

12. Motor shall de-energize in the event of a stall when attempting to unseat a jammed valve.

13. Provide a time delay to prevent instant reversal of the actuator motor.

14. Provide terminal connections for external remote controls fed from an internal 24-volt or 120-volt supply.

15. Provide two separate 3/4-inch conduit connections for control and power wiring.

G. Local Actuator Control

1. Integral to the actuator shall be local controls for Open, Close, and Stop, and a local/remote selector Switch:

   a. Local Control Only

   b. Off (No Electrical Operation)

   c. Remote Control plus Local Stop Only.

2. Provide a separate NEMA 4X enclosure with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6’-6” above or below the floor or deck in lieu of integral controls. Mount in an accessible location closest to the valve.

3. All the necessary wiring, indication relays and terminals shall be provided in the actuator to accommodate the remote mounted push button control functions. Provide terminal connections for external remote controls fed from an internal 120-volt AC supply.

4. The following Control, Status and Alarm indication shall be available locally at the actuator:

Controls:	Status:	Alarms:
1. Open/Stop/Close	1. Motor Running Open Direction	1. Communications Failure
2. Desired Valve Position Control	2. Motor Running Closed Direction	2. Actuator Alarm
	3. Fully Open	3. Valve Alarm
	4. Fully Closed	4. Battery Low Alarm, if required
	5. Percentage Open	

5. The actuator must provide a local display of the position of the valve, even when the power supply is not present. The display shall be able to be rotated in 90 degree increments so as to provide easy viewing regardless of mounting position.

6. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments with +/- ½% accuracy. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the power to the actuator is isolated.

7. The local display should be large enough to be viewed from a distance of six feet (6’) when the actuator is powered up.

8. Provide a diagnostic module, which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. A software tool for a PDA or laptop shall be provided to allow configuration and diagnostic information to be reviewed, analyzed and reconfigured.

9. Diagnostic status screens must be provided to show multiple functions. Emergency Shut Down shall be selectable; Last-position, Full Open, Full Closed.

H. Actuator Communication Board

1. General: Communication board shall support Profibus DP communication or hardwired analog and discrete signals, as required between the electric-motor valve actuator and the protocol gateway.

2. Profibus DP:

   a. The communication board shall support Profibus DP data transmission with the plant SCADA system.

   b. The communication boards shall support assigning individual addresses, unique to the Profibus DP network.

   c. The communication board shall be powered by the actuator assembly. No external power source shall be required.

   d. The communication board shall supply the following for transmission to the host system(s)

      (1) Status: Open, Closed, Moving, Stopped mid travel, valve position.

      (2) Alarms: Local Control, High Temperature, Valve Obstructed, and Valve Jammed.

   e. The communication board shall accept and act upon the following commands transmitted by the host system(s) via the protocol gateway: Open, Close, Stop mid travel, Emergency Shut Down.

   f. Features:

      (1) Communication boards shall be plug-in type, easily installed in the electric-motor valve actuator housing. Externally-mounted communication devices will not be accepted.

3. Hardwired

   a. Capabilities shall be provided to position the valve (or gate) locally via the Local/Off/Remote selector switch and Open/Stop/Close push buttons.

   b. For on/off service, when in remote, the actuator shall accept one remote signal to open the valve or gate and a second remote signal to close the valve or gate.

   c. For modulating service, when in remote the actuator shall accept a 4-20mADC position control signal, and shall position the valve 0-90 degrees or gate 0-100% of travel in proportion to the control signal.

d. Valve position shall be sensed by an 18-bit, optical, absolute position encoder with redundant position sensing circuits designed for Built-In-Self-Test [BIST]. Each of the position sensing circuits shall be redundant permitting up to 50% fault tolerance before the position is incorrectly reported. The BIST feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions shall be stored in permanent, nonvolatile memory. The encoder shall measure valve position at all times, including both motor and handwheel operation and with or without power present. The absolute encoder will be capable of resolving ±7 degrees of output shaft position over 10,000 output drive rotations.

e. Discrete outputs to SCADA shall be provided for all limit and torque switches, and for Local/Off/Remote switch in Remote position, as required by the Drawings.

I. Wiring and Terminals

1. Internal wiring shall be tropical grade insulated stranded cable of appropriate size for the control and three-phase power. Each wire shall be clearly identified at each end. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

2. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with a minimum of four threaded cable entries.

3. Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards.

4. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

a. Serial Number

b. External Voltage Values

c. Wiring Diagram Number

d. Terminal Layout

This must be suitable for the contractor to inscribe cable core identification beside terminal numbers.

J. NFPA Hazardous Area Classification:

1. Reference the Construction Drawings for the respective NFPA Hazardous Area Classifications where the new electric motor actuators are identified.

The General Contractor and Actuator Manufacturer shall be responsible for providing the Actuators, Local Actuator Control Panels and other respective appurtenances in compliance with the requirements to meet the NFPA Hazardous Area Classification criteria designed within the Drawings.

PART 3 - EXECUTION

A. Service Conditions

Valve Tag	Application	Fluid	Open/Close or Modulating	Fail Position on LOS
065-V-1A	BFV	Secondary Effluent	Modulating	Last
065-V-2A	BFV	Secondary Effluent	Modulating	Last
065-V-3A	BFV	Secondary Effluent	Modulating	Last
065-V-4A	BFV	Secondary Effluent	Modulating	Last
065-V-5A	BFV	Secondary Effluent	Modulating	Last
065-V-6A	BFV	Secondary Effluent	Modulating	Last
065-V-1B*	BFV**	Filter Backwash	Open/Close	Last
570-V-1A	BFV	Secondary Effluent	Modulating	Last
570-V-2A	BFV	Secondary Effluent	Modulating	Last
570-V-3A	BFV	Secondary Effluent	Modulating	Last
570-V-4A	BFV	Secondary Effluent	Modulating	Last
570-V-5A	BFV	Secondary Effluent	Modulating	Last
570-V-6A	BFV	Secondary Effluent	Modulating	Last
570-V-1B*	BFV**	Filter Backwash	Open/Close	Last

* Typical of all Backwash & Waste valves, see tag list for quantity of valves.

** BFV for Manufacturers B & C. Ball Valves for Manufacturer A.

B. Factory Performance Testing of Motor Actuator

Test each actuator prior to shipment in accordance with C542, Section 5.3. The application torque shall be maximum torque required to open or close the valve at position including seating and unseating conditions.

C. Storage and Temporary Installation Before Start-Up

If actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer’s recommended procedures for extended storage. Provide temporary covers over the actuator electrical components. Exercise each actuator from its fully open to fully closed position at least once every seven days. Inspect electrical contacts before start-up.

D. Floor Stands and Extension Stems

Where shown in the drawings, mount the electric motor actuators on floor stands with extension stems as specified in Section 15100.

E. Attaching Electric Actuators

The valve manufacturer shall mount the electric motor actuator and accessories on each valve and stroke the valve prior to shipment. Adjust limit switch positions and torque switches.

F. Painting and Coating

Provide factory applied powder coating for electric motor actuators. The coating system shall be suitable for an ASTM B117 salt spray test for a minimum of 1,500 hours.

G. Field Installation

Install the valve and actuator as indicated in the drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

H. Attaching Electric Actuators – Slide Gates

The slide gate manufacturer shall mount the electric motor actuator and accessories on each slide gate and stroke the slide gate prior to shipment. Adjust limit switch positions and torque switches.

I. Field Testing of Motor Actuators

1. Test motor actuators as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions. The measured current shall not exceed the current measurement recorded during the factory performance test.

2. If the measured current drawn exceeds the above value, provide a larger motor or gear drive or adjust the actuator so that the measured amperage does not exceed the value.

3. Assure that limit switches are placed at their correct settings. Open and close valves twice and assure that limit switches function.

J. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

K. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

L. Certification

Provide a written certification from the equipment manufacturer that the equipment has been properly installed according to the plans, specifications and manufacturer's specifications, and that the equipment is operating normally. Make all necessary corrections and adjustments at no additional cost to the County.

END OF SECTION

SECTION 15121 MISCELLANEOUS PIPE FITTINGS AND ACCESSORIES

PART 1 - GENERAL

A. Description

This section includes materials and installation of quick-connect couplings.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's catalog data and descriptive literature showing dimensions and materials of construction by ASTM reference and grade. Show coatings.

PART 2 - MATERIALS

A. Flange Insulation Kits

See Section 15050.

B. Insulating Unions

See Section 15050.

C. Metallic Quick-Connect Couplings

Type 2: Quick-connect couplings shall be male adapter/ASME B16.1 Class 125 flange. Bodies shall be Type 316 stainless steel. Provide quick- connect plug or cap for each coupling. Couplings shall be Ever-Tite Model FLA, CIVACON Model 633-LAS, or equal.

D. Nonmetallic Quick-Connect Couplings

1. Type 6A: Quick-connect couplers shall be female coupler/female thread type with locking handles. Provide dust plug and security chain with each coupler. Bodies shall be glass fiber reinforced polypropylene. Locking handles shall be Type 302 or 304 stainless steel. Gasket shall be Viton. Couplers shall be Murray Equipment Inc. 663D, Pacific Mechanical 561 Series, or equal.

2. Type 8A: Quick-connect adapters shall be male adapter/ female thread type. Provide adapter cap with locking handles. Bodies shall be glass fiber reinforced polypropylene. Locking handles shall be stainless steel. Gasket shall be Teflon. Adapters shall be Evertite Part A/DC, Banjo Corporation Male Adapter/Female Thread and Dust Cap, Murray Equipment Inc. Style A/DC, or equal.

PART 3 - EXECUTION

A. Installing Quick-Connect Couplings

Attach to piping per the relevant piping specification.

END OF SECTION

SECTION 15122 FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of flexible gasketed sleeve-type compression pipe couplings for ductile-iron pipe; flexible expansion joints; expansion loops; and couplings for connecting different pipe materials.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following;

2. Submit manufacturer's catalog data on flexible pipe couplings and expansion joints. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.

3. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.

4. Show materials of construction by ASTM reference and grade. Show dimensions.

5. Show number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

PART 2 - MATERIALS

A. Coupling System Design and Component Unit Responsibility

The coupling manufacturer shall furnish the gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types and shall design these components as an integral system. Design the gaskets for the coupling and appropriately size to provide a watertight seal at the design pressure and temperature. Ship gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings with the pipe coupling and clearly label indicating the origin of the material, including place and date of manufacture. Package

the manufacturer's printed installation instructions with each pipe coupling.

B. Ductile-Iron Flexible Pipe Couplings

1. Couplings shall have center sleeves and end rings made of ductile iron conforming to AWWA C219, Section 4.

2. Sleeve bolts in exposed service shall be Type 304 stainless steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.

3. Couplings in air service shall have Viton gaskets rated to 250 degrees F.

C. Joint Harnesses

1. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall be Type 304 stainless steel conforming to ASTM A193, Grade B8. Nuts shall be Type 304 stainless steel conforming to ASTM A194, Grade B8. Lug material shall be Type 304 stainless steel conforming to ASTM A 240 Type 304. Lug dimensions for steel pipe shall be as shown in AWWA Manual M11 (2004 edition), Figure 13-20, using the number and size of lugs as tabulated below.

2. Lug or ear dimensions for ductile-iron pipe shall be as shown in the drawings.

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR DUCTILE IRON PIPE

	Tie Bolt or Stud Minimum Requirements					
	150 psi(1)			**300 psi(2) Pipe**		
Nominal Pipe Size (inches)	**No. Bolts or Studs**	**Size (inch)**	**Ear(3) Type**	**No. Bolts or Studs**	**Size (inch)**	**Ear(3) Type**
4	2	5/8	A	2	5/8	A
6	2	5/8	A	2	5/8	A
8	2	5/8	A	2	5/8	A
10	2	5/8	A	4	5/8	A
12	2	5/8	A	4	5/8	A
14	4	5/8	A	5	3/4	A
16	4	5/8	A	5	3/4	B
18	4	3/4	B	8	3/4	B

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR DUCTILE IRON PIPE						
	Tie Bolt or Stud Minimum Requirements					
	150 psi(1)			300 psi(2) Pipe		
Nominal Pipe Size (inches)	No. Bolts or Studs	Size (inch)	Ear(3) Type	No. Bolts or Studs	Size (inch)	Ear(3) Type
20	4	3/4	B	8	3/4	B
24	5	7/8	B	8	7/8	B
30	4	1-1/8	B	14	7/8	B
36	8	1	B	16	1	B
42	9	1	B	--	--	--
48	14	1	B	--	--	--
54	16	1	B	--	--	--
(1) Use ANSI B61.1 Class 125 flanges. (2) Use ANSI B16.1 Class 250 flanges. (3) Ear type as shown in the detail on the last page of Section 15122.						

3. Select number and size of bolts based on the test pressure shown in the Piping Schedule in the drawings Section 15144. Stagger bolts equally around pipe circumference. Where odd number is tabulated, place odd bolt at top. For test pressures less than or equal to 150 psi, use the 150-psi design in the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.

4. Provide washer for each nut. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8-inch.

D. Flexible Pipe Couplings for Plain-End Ductile-Iron Pipe

1. Couplings for pipe 12 inches and smaller shall be cast iron, Dresser Style 153, Smith-Blair Type 441, Baker Series 228, or equal.

2. Couplings for pipe larger than 12 inches shall be cast iron or steel, Dresser Style 38 or 153, Smith-Blair Style 411, Baker Series 228, or equal.

3. Couplings in air service shall have Viton gaskets.

E. Transition Couplings

Couplings for connecting different pipes having different outside diameters shall be steel: Dresser Style 62 or 162, Smith-Blair Series 413, Baker Series 212 or 220, or equal. Couplings shall have an internal full circumference ring pipe stop at the midpoint of the coupling. Inside diameter of coupling pipe stop shall equal inside diameter of smaller diameter pipe.

F. Flanged Coupling Adapters for Cast- and Ductile-Iron Pipe

1. Adapters for cast- and ductile-iron pipe 12 inches and smaller shall be cast iron: Dresser Style 127, Smith-Blair Series 912, or equal.

2. Adapters for cast- and ductile-iron pipe larger than 12 inches shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal.

3. Flange ends shall match the flange of the connecting pipe; see detail piping specifications.

4. Couplings in air service shall have Viton gaskets.

G. Type 4 Expansion Joints: Spherical Expansion Joints

1. Spherical design expansion joints shall be chlorobutyl with polyester fiber reinforcing and be provided with steel retaining rings and Type 304 stainless steel gusset plates and control rods. Expansion joints shall have flat-face flanges integral with the body to match 125/150-pound flanges. Expansion joints for hot water service shall be rated at a minimum of 150 psig at 212°F.

Joint Size	**Flange-to-Flange Length (inches)**	**Minimum Pressure Rating (150°F) (psi)**
4-8	6	225
10-12	8	225
14-20	10-12	125

2. Expansion joints shall be manufactured by Metraflex Metrasphere, Proco Series 240, or equal.

H. Type 5 Expansion Joints: Single Arch Rubber Type (24 Inches and Smaller)

1. Expansion joints shall be rubber, single arch type, with integral flat-face ANSI Class 125/150 flanges. Minimum working pressure shall be 150 psi for joints 12 inches and smaller, 120 psi for 14- and 16-inch joints, 110 psi for 18- and 20-inch joints, and 100 psi for 24-inch joints. Provide steel thrust plates, retaining rings, and control rods. Products: Proco Style 220, General Rubber Style 1075, or equal.

I. Type 12 Expansion Joints: Metal Bellows Pump Connection Joints 1-1/2 Through 36 Inches

1. Provide multiple bellows, annular, flanged expansion joint constructed from single or multiple metal laminations. Provide flow liner. Provide thrust restraining rod system. Minimum pressure rating shall be 275 psi at a temperature of 200°F. Flanges shall be Class 150 per ANSI B16.5. Provide fixed, flat-face flanges. Materials of construction shall be as follows:

Item	Material	Specification
Bellows	Stainless steel	ASTM A240 or A666, Type 304 or 321
Flanges	Steel	ASTM A285, Grade C

2. Products: Hyspan Model 2504-092-3.0, Keflex Type 151-TR, or equal.

J. Expansion Joints in Air Service

Refer to Section 11373.

K. Depend-O-Lok Expansion Couplings

Provide Depend-O-Lok expansion couplings type FxE or type FxF (restrained) where shown in the drawings.

1. FxE couplings shall allow one pipe end to move freely while the other pipe end has restraining rings attached to secure the coupling. Maximum allowable expansion/contraction shall be 4-inches. Couplings shall be Type 316 stainless steel arched band type couplings in either one piece or two piece housings that provide full circumferential bearing against

welded end-rings on the pipe. Coupling o-rings shall be suitable for an air pressure of 50 psi at a temperature of 250°F. Coupling sealing plates, bolts, nuts, washers, and restraining ring shall be type 316 stainless steel. Couplings shall be secured to one pipe end with stainless steel retaining rings shop welded by the pipe fabricator to the pipe end for the fixed side of the coupling.

2. FxF couplings shall Type 316 stainless steel arched band type couplings in either one piece or two piece housings that provide full circumferential bearing against welded end-rings on the pipe. Coupling gaskets shall be suitable for an air pressure of 50 psi at a temperature of 250°F. Coupling sealing plates, bolts, nuts, washers, and restraining ring shall be type 316 stainless steel. Couplings shall be secured to one pipe end with stainless steel retaining rings shop welded by the pipe fabricator to the pipe end for the fixed side of the coupling.

L. Dismantling Joints: Restrained (3 inches and Larger)

1. Romac "DJ400"; Dresser "Style 131 Dismantling Joint" or Viking Johnson.

2. For use in potable water systems, coating to be in accordance with NSF-61.

3. Bolts, nuts, and tie rods for above ground dismantling joints shall be stainless steel ASTM A304 or A316. Bolts, and tie rods for buried dismantling joints shall be ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H). Buried dismantling joints shall be wrapped in cold applied wax tape, Trenton Wax-Tape #1, Denso Densyl Tape, or equal.

4. All dismantling joints shall be restrained, either integrally, or with an external joint harness assembly per Part 2.C.

M. Bolts and Nuts for Flanges

See Section 15050.

N. Threaded Caps for Protection of Nuts and Bolt Threads

See Section 15050.

PART 3 - EXECUTION

A. Installation of Flexible Pipe Couplings, Segmented Sleeve Couplings, and Expansion Joints

1. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installing.

2. Install expansion joints per manufacturer's recommendations, so that 50% of total travel is available for expansion and 50% is available for contraction.

3. Lubricate bolt threads with graphite and oil prior to installation.

B. Painting and Coating

1. Coat buried flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters per Section 09900, System No. 21. Coat buried bolt threads, tie bolt threads, and nuts per Section 09900, System No. 24.

2. Coat flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. Apply prime coat at factory.

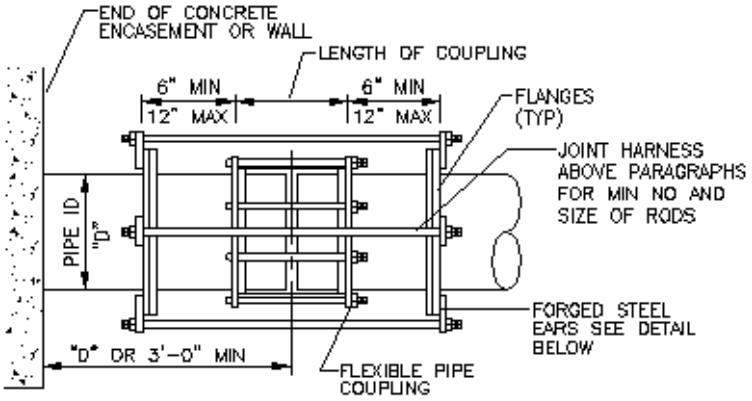
3. Line carbon steel and iron flexible pipe couplings and segmented sleeve couplings per Section 09900, System No. 7.

4. Alternatively, line and coat carbon steel and iron flexible pipe couplings and segmented sleeve couplings with fusion-bonded epoxy per Section 09961.

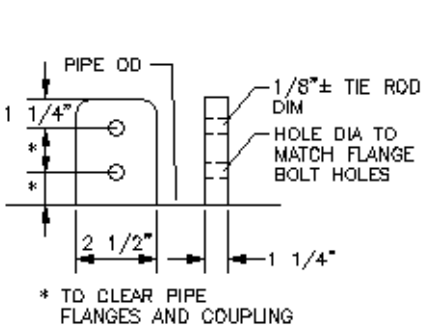
5. Coat couplings, expansion joints, expansion compensators, and alignment guides located above ground or in vaults and structures with the same coating system as specified for the adjacent pipe.

C. Hydrostatic Testing

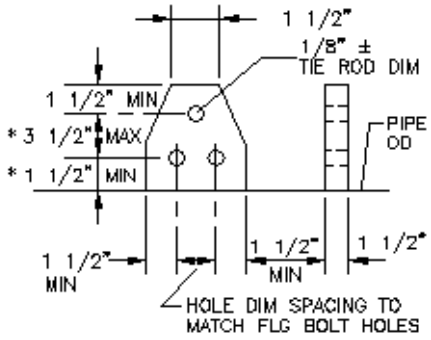
Hydrostatically test flexible pipe couplings, expansion joints, segmented sleeve couplings, and expansion compensators in place with the pipe being tested. Test in accordance with Section 15144.



FLEXIBLE PIPE COUPLING



FORGED STEEL EAR – TYPE "A"



FORGED STEEL EAR – TYPE "B"

FLEXIBLE PIPE COUPLING TIE RODS – DUCTILE IRON PIPE DETAIL

SCALE: NONE

END OF SECTION

SECTION 15141 DISINFECTION OF PIPING

PART 1 - GENERAL

A. Description

This section includes materials and procedures for disinfection of water mains by the continuous feed method. Disinfect piping in accordance with AWWA C651, except as modified below.

B. Job Conditions

1. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility.

2. Use potable water for chlorination.

3. Submit request for use of water from waterlines of Owner 48 hours in advance.

4. Chemicals for use in disinfection of potable water lines shall be certified as conforming to NSF 60.

PART 2 - MATERIALS

A. Liquid Chlorine

Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.

B. Calcium Hypochlorite (Dry)

Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate.

C. Sodium Hypochlorite (Solution)

Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

D. Chlorine Residual Test Kit

For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per AWWA C651, Appendix A. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

A. Continuous Feed Method for Pipelines

Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

B. Disinfection of Valves, Blind Flanges, and Appurtenances

During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1% sodium hypochlorite solution.

C. Disinfection of Connections to Existing Pipelines

Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1% sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

D. Disinfection of Tapping Sleeves and Line Stopping

Flush exterior of pipe with potable water after removal of existing coating. Swab exterior of pipe with a 1% sodium hypochlorite solution. Disinfect per AWWA C651, Section 4.8. After completion of tapping and line stopping, swab interior of pipe, valves, and faces of flanges to be connected to bypass piping with a 1% sodium hypochlorite solution.

E. Confirmation of Residual

1. After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, confirm that a chlorine residual of 50 mg/L minimum exists along the pipeline by sampling at air valves and other points of access, such as tapping valves.

F. Pipeline Flushing

After confirming the chlorine residual, flush the excess chlorine solution from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water. Contractor is responsible for method of removing excess chlorine residual to 0.5 mg/L of the replacement water.

G. Bacteriologic Tests

Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline after chlorination and refilling. Collect at least one set of samples from every 1,200 feet of the new water main and line stopping insertion point, plus one set from the end of the line and at least one set from each branch. At each connection to an existing pipeline, take two additional samples.

H. Repetition of Procedure

If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

I. Test Facility Removal

After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

J. Piping to be Disinfected

1. Disinfect all potable water piping.

END OF SECTION

SECTION 15144 PRESSURE TESTING OF PIPING

PART 1 - GENERAL

A. Description

This section specifies the hydrostatic, pneumatic, and leakage testing of pressure piping for wastewater treatment plants.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

3. Submit six copies of the test records to the Owner's Representative upon completion of the testing.

C. Test Pressures

Test pressures for the various services and types of piping are shown in the Piping Schedule in the drawings.

D. Testing Records

Provide records of each piping installation during the testing. These records shall include:

1. Date and times of test.

2. Identification of process, pipeline, or pipeline section tested or retested.

3. Identification of pipeline material.

4. Identification of pipe specification.

5. Test fluid.

6. Test pressure at low point in process, pipeline, or pipeline section.

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.

PART 2 - MATERIALS

A. Vents and Drains for Aboveground Piping

Install vents on the high points of aboveground piping, whether shown in the drawings or not. Install drains on low points of aboveground piping, whether shown in the drawings or not. Provide a valve at each vent or drain point. Valves shall be 3/4-inch for piping 3 inches and larger and 1/2-inch for piping smaller than 3 inches. Valves shall be as specified in Section 15100, Type 100, unless otherwise shown in the drawings.

B. Manual Air-Release Valves for Buried Piping

Provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

C. Test Bulkheads

Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

D. Testing Fluid

1. Testing fluid shall be reclaimed water, unless otherwise noted, or a pneumatic test is indicated on the Piping Schedule.

2. For potable water pipelines, obtain and use only potable water for hydrostatic testing.

3. Submit request for use of water from waterlines of Owner 48 hours in advance.

4. The Contractor may obtain potable and reclaimed water from the Owner at no charge.

E. Testing Equipment

Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic and pneumatic testing. The Contractor shall supply all temporary plugs, blocking, taps and testing equipment as required to test all the sections of piping installed.

PART 3 - EXECUTION

A. Testing Preparation

1. Pipes shall be in place, backfilled, and anchored before commencing pressure testing.

2. Conduct pressure 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.

3. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. Perform the final pressure test, however, after completely backfilling and compacting the trench.

4. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.

5. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Pipes shall remain full after testing.

6. Prior to starting the test, the Contractor shall notify the County's Representative.

B. Cleaning

1. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes. Maintain a flushing velocity of at least 3 fps for water testing and at least 2,000 fpm for pneumatic testing. Flush pipes for time period as given by the formula

$$T = \frac{2L}{3}$$

in which:

T = flushing time (seconds)

L = pipe length (feet).

2. For pipelines 24 inches or larger in diameter, acceptable alternatives to flushing are use of high-pressure water jet, sweeping, or scrubbing. Water, sediment, dirt, and foreign material accumulated during this cleaning operation shall be discharged, vacuumed, or otherwise removed from the pipe.

C. Testing and Disinfection Sequence for Potable Water Piping

1. Perform required disinfection after hydrostatic testing, except when pipeline being tested is connected to a potable waterline.

2. Locate and install test bulkheads, valves, connections to existing pipelines, and other appurtenances in a manner to provide an air gap separation between existing potable water pipelines and the pipeline being tested. Disinfect water and pipeline being tested before hydrostatic testing when connected to a potable waterline.

D. Length of Test Section for Buried Piping

The maximum length of test section for buried pipe is 1,000 feet. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

E. Initial Pipeline Filling for Hydrostatic Testing

Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

F. Testing New Pipe Which Connects to Existing Pipe

Prior to testing new pipelines that are to be connected to existing pipelines, isolate the new line from the existing line by means of test bulkheads, spectacle flanges, or blind flanges. After the new line has been successfully tested, remove test bulkheads or flanges and connect to the existing piping.

G. Hydrostatic Testing of Aboveground or Exposed Piping

1. Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.

2. Subject the piping system to the test pressure indicated on the Piping Schedule in the drawings. Maintain the test pressure for a minimum of four hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

H. Hydrostatic Testing of Buried Piping

1. 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 placed. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

2. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.

3. Maintain the test pressure for the following duration by restoring it whenever it falls an amount of 5 psi:

Pipe Diameter (inches)	Hours
18 and less	4
20 to 36	8
Greater than 36	24

4. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula

$$L = \frac{HND(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons)
H = specified test period (hours)
N = number of rubber-gasketed joints in the pipe tested
D = diameter of the pipe (inches)
P = specified test pressure (psig)
C = 7,400

5. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

6. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

7. Test piping subject to the National Fire Code requirements per NFPA 24. Test such piping hydrostatically at not less than 200-psi pressure for two hours or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints irrespective of pipe diameter. The piping subject to this testing requirement is shown in the Piping Schedule in the drawings.

8. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

9. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

I. Repetition of Test

If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

J. Bulkhead and Test Facility Removal

After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

END OF SECTION

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SECTION 15225 RUBBER AND PLASTIC HOSE AND TUBING

PART 1 - GENERAL

A. Description

This section includes materials and accessories for rubber and plastic hoses and tubing:

1. SBR hose for water service (Type 5).

2. Flexible white translucent or color-coded polyethylene tubing (Type 13).

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and descriptive literature for hoses, tubing, and couplings. Show pressure rating and materials of construction for tube, carcass, and cover. Show design of hose and tubing ends.

3. Submit procedures for making up insert fittings and joints and compression fittings and joints.

PART 2 - MATERIALS

A. Hose and Tubing Identification

Hoses and tubing are identified in the drawings by size, type number, and in some cases (Types 1 through 5 hoses) by a suffix letter denoting the type of end connection. For example, a callout of 2" Type 1A means a 2-inch, abrasive slurry service hose, with grooved-end nipples at both ends.

B. Hose Design (Type 5)

Design hose for the material conveyed as described in the subsection on "Service Conditions." Provide hose design consisting of cover, carcass, and tube. Design carcass reinforcement to provide a minimum 4:1 safety factor for the working pressure specified in the subsection on "Service Conditions."

C. Type 5: SBR Hose for Potable Water Service

1. Cover: SBR.

2. Reinforcement: Minimum of two horizontal braids or two plies of synthetic fabric.

3. Tube: SBR.

4. Minimum Pressure Rating: 150 psi.

5. Products: Uniroyal H-3400, Goodall N-320, Goodyear, Gates “Steel Head,” or equal.

D. Type 13: Flexible White Translucent or Color-Coded Polyethylene Tubing (1/4 Through 5/8 Inch)

1. Provide odorless and tasteless flexible orange and yellow polyethylene tubing extruded from high molecular weight resin with smooth inside bore and smooth outside. Use the following color codes for the various service conditions in the project:

Tubing Service	Color Code
Sodium Hypochlorite	Yellow
Polymer	Orange

2. Minimum operating pressures shall be 120 psi for 1/4 through 3/8 inch, 90 psi for 1/2 inch, and 70 psi for 5/8 inch. Minimum operating pressure shall be 1/4 of the burst pressure of the tubing. Minimum bending radius shall be 2 inches. Joints and fittings shall be of the compression type utilizing a ferrule nut. Tubing shall comply with ASTM D1248, Type I, Class A, Category 4, Grade E.

3. Products: Parker “Parflex Polyethylene Tubing” with Parker “Fast & Tite” joints and fittings or equal.

4. Provide fitting material that are compatible with the chemical usage.

E. End Connections for Type 5 Hose

1. Type A: Schedule 80S, Type 316 stainless steel grooved-end nipples built into the hose. Grooved-end nipples

shall be flexible, square cut grooved, per AWWA C606, Table 3. Connect hoses to each other with grooved-end couplings.

2. Type B: Schedule 80S, Type 316 stainless steel nipples built into the hose. Ends shall be male threaded, per ASME B1.20.1. Connect hose sections to each other with unions.

3. Type C: Hose shank couplings of the quick-connect type. Fasten couplers and adapters to the hose with clamps. The couplers, adapters, and clamps shall be Type 316 stainless steel. Couplers shall be Evertite Part C, Civicon 633-C, Parker-Hannifin Style C, or equal. Adapters shall be Evertite Part E, Civicon 633-E, Parker-Hannifin Style E, or equal. Where hoses connect to piping, fasten hose shank adapters to the hose end and female couplers to the pipe end. Where hoses are connected in series, fasten one female coupler and one male adaptor to each hose. Fasten male adapters to both ends of a hose only where necessary to accommodate connections with pipes. Do not fasten female couplers to both ends of any hose.

4. Type D: Shaped to the dimensions of Class 125, ASME B16.1, flanges. Construct as an integral part of the hose utilizing the same tube, cover, and carcass material as the hose. Provide Type 316 stainless steel retaining ring for each flange. Bolts and nuts: ASTM A193 (Grade B8M) for bolts and ASTM A194 (Grade 8M) for nuts. Provide washer under each nut and bolthead. Washers shall be of the same material as the nuts.

5. Type E: Hose shank couplings shall be of the quick-connect type. Fasten couplers and hose adapters to the hose with clamps. Coupler and adapters shall be polypropylene: Dixon or equal. Clamps shall be Type 316 stainless steel. Where hoses connect to piping, fasten hose shank adapters to the hose end and female couplers to the pipe end. Where hoses are connected in series, fasten one female coupler by hose shank on one end and one male adapter by hose shank on the other end. Fasten male adapters to both ends of hose only where necessary to accommodate connections with pipes. Do not fasten female couplers to both ends of any hose.

F. Unions for Type 5 Hose

Unions shall be 3,000-pound WOG forged stainless steel, with dimensions conforming to MSS SP-83. Material shall conform to ASTM A182, Grade F316. Ends shall be threaded per ASME B1.20.1.

G. Insert Fittings for Tubing

1. When insert fittings are specified, they shall be of the single-barb type. The completed tubing and fitting system shall have the same operating pressure ratings as specified for the tubing.

2. Rigid PVC pipe to PVC tubing transition fittings shall be solvent cement socket by single barb fittings with stainless steel clamps.

H. Quantities

1. See drawings for total hose lengths or quantities. Provide hoses in maximum 50-foot-long sections.

2. See drawings for total tubing lengths or quantities for the sodium hypochlorite service provides tubing in minimum 300-foot lengths or sections.

PART 3 - EXECUTION

A. Storage

Store hoses in a protected room or building at a temperature range of 50°F to 70°F. Do not store hoses near sources of heat such as radiators or base heaters. Do not store hoses so that they are exposed to sunlight; provide covers to protect hoses from sunlight and from fluorescent or mercury lamps. Storage areas shall be cool and dark, free of dampness and mildew. Protect hoses from rodents and insects. Store hose that is shipped in coils so that the coils are in a horizontal plane.

B. Hose Installation

Prior to assembling hose and components such as fittings and connectors, carefully examine components for correct material, style, size, catalog number, and length. Examine hoses for cleanliness, obstructions, blisters, cover looseness or damage, kinks, cracks, cuts, or any other

visible defects. Inspect the fitting and sealing surfaces for burrs, nicks, corrosion, or other imperfections. Do not use any components that display such signs of nonconformance.

C. Service Conditions

1. Service and design conditions for hoses and tubing shall be as follows:

a. Type: 5

b. Minimum Working Pressure: 100 psig.

c. Material Conveyed: Reclaimed Water

d. Hose or Tubing Size: See drawings inches.

e. Type: 13

f. Minimum Working Pressure: 30 psig.

g. Material Conveyed: Sodium Hypochlorite (10% to 15%)

h. Hose or Tubing Size: See drawings inches.

i. Type: 13

j. Minimum Working Pressure: 30 psig.

k. Material Conveyed: Polymer

l. Hose or Tubing Size: See drawings inches.

D. Field Testing

1. Hydrostatically test hose for leakage in accordance with Section 15144. Leakage shall be zero. Perform pressure testing using water. Fill hoses with water with the outlet ends raised and any outlet valves open to allow the complete removal of air. When the air has been expelled, close outlet valves or install blind flanges or plugs on the outlets and lower the raised ends. Raise the pressure to the specified test pressure. Examine hose for leaks at couplings, fitting slippage, or any indication of weakness in the hose structure. Remove and replace the hose or couplings or fittings if there are any signs of leakage, fitting slippage, or weakness in the hose. Drain the water from the hoses after

completion of the pressure tests. See the Piping Schedule in the drawings for test pressures. Some chemicals, such as concentrated acids, may react with water and become even more corrosive than the standard acid. An example is sulfuric acid. Check the compatibility of the hose material you are specifying and describe the required cleaning procedure accordingly. Identify exactly which hose services need to be purged of moisture. If there is no problem adding the anticipated chemicals to the hoses containing moisture, then delete paragraph below.

2. After completing the pressure testing and draining the water out of the hoses and before filling the hoses with the specified chemicals, flush the following hoses with alcohol to remove moisture. Then blow clean, dry, oil-free air having a dew point of at least 40°F through the hoses. Circulate the air through the hoses until the exiting air has the same dew point as the applied air. Dispose of the effluent from the hoses in accordance with local water quality requirements.

END OF SECTION

SECTION 15240 DUCTILE-IRON PIPE

PART 1 - GENERAL

A. Description

This section describes materials, testing, and installation of ductile-iron pipe and fittings 64 inches and smaller.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Provide an affidavit of compliance with standards referenced in this specification, e.g., AWWA C151. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate that the minimum safety factor described in AWWA C153, Section 5.5 is met.

3. Provide the following information:

   a. Mortar lining thickness.

   b. Wall thickness.

   c. Material test data for this project.

   d. Show deflections at push-on and mechanical joints.

   e. Submit joint and fitting details and manufacturer’s data sheets.

4. Submit calculations and test data proving that the proposed restrained joint arrangement can transmit the required forces with a minimum safety factor of 1.5.

5. Submit certificate that cement for mortar lining complies with ASTM C150, designating type and AWWA C104.

6. Submit test report on physical properties of rubber compound used in the gaskets.

7. Submit drawing or manufacturer's data sheet showing flange facing, including design of facing serrations.

8. Submit weld procedure specification, procedure qualification record, and welder's qualifications prior to any welding to ductile-iron pipe.

9. Submit leak free results of factory air tests for all fittings with welded bosses or outlets.

PART 2 - MATERIALS

A. Pipe

Pipe shall be cast ductile (nodular) iron, conforming to AWWA C151.

B. Pipe Wall Thickness

1. Minimum wall thickness for pipe having push-on or mechanical joints, restrained joints, plain ends, or cast flange ends shall be Class 150, unless otherwise shown in the drawings.

2. Minimum wall thickness for pipe having threaded flanges shall be Special Class 53.

3. Minimum pipe wall thickness required for corporation stops and tapped outlets shall be in accordance with Table A.1 of AWWA C151 for three full threads for design pressures up to 250 psi and four full threads for design pressures over 250 to 350 psi.

C. Fittings

1. Fittings 48 inches and smaller shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Material shall be ductile iron. Flanges shall be flat faced.

2. Mechanical joint fittings conforming to AWWA C153 may be used in lieu of AWWA C110 fittings.

3. Material for fittings with welded-on bosses shall have a Charpy notch impact value of minimum 10 ft-lbs under the conditions defined in AWWA C151. Manufacturer shall submit leak free results of factory air tests for all such welded bosses or outlets.

4. Fittings in Air-1 service shall be unlined.

D. Flanges

1. Flanges shall be solid back, Class 125 per AWWA C115. Flanges on pipe shall be either cast or threaded. Material shall be ductile iron.

2. Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C115. Flanges shall be individually fitted and machine tightened in the shop, then machined flat and perpendicular to the pipe barrel. Flanges shall be backfaced parallel to the face of flange. Prior to assembly of the flange onto the pipe, apply a thread compound to the threads to provide a leak-free connection. There shall be zero leakage through the threads at a hydrostatic test pressure of 250 psi.

E. Pipe Lining-Cement Mortar

1. Ductile iron pipe associated with the disk filters shall be cement mortar lined. Line the pipe interior and fittings with cement-mortar per AWWA C104. Lining thickness shall be the double thickness listed in AWWA C104, Section 4.8. Lining material shall conform to ASTM C 150, Type V. This shall include the following pipes: Line the interior of the pipes as identified in the Flow Stream Identification chart in the drawings.

2. Line blind flanges per with a fusion bonded epoxy. Apply the manufacturer’s recommended number of coats to attain the specified minimum coating thickness. Products: Carboline Carboguard 891HS, Tnemec N140, Sherwin-Williams Tank Clad HS B62-W80/B60-V80, 16 mils total. Color of topcoat: white. Each coat shall be different color than the one preceding it.

3. Remove and reconstruct lining in areas where quality is defective per AWWA C104.

F. Gaskets for Flanges

Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

G. Bolts and Nuts for Flanges

1. Bolts and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors and above ground, shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

2. Bolts and nuts for buried or submerged Class 150 flanges and Class 150 flanges located outdoors above ground or in vaults and structures shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

3. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B7.

4. Fit shall be Classes 2A and 2B per ASME B1.1 when connecting to cast-iron valves having body bolt holes.

5. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

6. Provide washers for each nut. Washers shall be of the same material as the nuts.

H. Outlets and Nozzles

1. Provide outlets 2 inches and smaller by using a threaded welded-on boss.

2. For outlets larger than 2 inches use a tee with a flanged outlet.

I. Joints

1. Joints in aboveground or submerged piping or piping located in vaults and structures shall be flanged.

2. Joints in buried piping shall be of the restrained type per AWWA C111 except where flanged joints are required to connect to valves, meters, and other equipment.

3. All buried joints shall be restrained.

4. Restrained joint devices shall be accordance with the Orange County Utilities Standards and Construction

Specifications Manual List of Approved Products in Appendix A.

5. Restrained joints for piping 4 to 36 inches shall be American Cast Iron Pipe “Fast Grip Gaskets”, U.S. Pipe “Field Loc Gaskets” or equal. Joint restraint shall be certified to a rated pressure of 250 psi. Restrained joints for piping 42 ~~36~~ inches to 64 inches shall be American Cast Iron Pipe “Flex-Ring”, or “Lok-Ring”, U.S. Pipe “TR Flex” or “HP Lok”, or equal.

6. Where thrust restraint is called for in the drawings, provide pipe with restrained joints capable of transmitting 1.5 times the thrust, as calculated by the following equation:

$$T = 1.5 * (0.785 * P * D^2)$$

where:

P = Pressure class of pipe in psi.
D = Outside diameter of pipe in inches.
T = Thrust in pounds.

7. Existing unrestrained bell & spigot joints are to be restrained using Series 1100HD restraint devices by EBBA Iron, Inc. Restraint may also be provided by a thrust collar constructed in accordance with the Orange County Utilities Standards and Construction Specifications, Figure A105-1 & -2. Existing unrestrained fittings and appurtenances are to be restrained using Series 1100SD by EBBA Iron, Inc.

J. Mechanical Joint Restraint System Using Follower Ring and Wedges

The restraining mechanism shall consist of a follower gland having a seal gasket and individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The system manufacturer shall provide all the components (follower ring, wedges, and gaskets) for the restraining device. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be constructed of ductile iron conforming to ASTM A 536, Grade 60-42-10. The wedges shall be ductile iron, heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall

be such that it can be used with mechanical joint bells conforming to AWWA C111 and AWWA C153. The design shall use torque limiting twist-off nuts to provide actuation of the restraining wedges. The mechanical joint restraint shall be available in the size range of 3 through 48 inches. Minimum rated pressure shall be 350 psi for sizes 16 inches and smaller and 250 psi in sizes 18 inches and larger. Products: Megalug Series 1100 as manufactured by EBAA Iron, Inc., or equal.

K. Ductile-Iron Pipe Weldments

1. All welding to ductile-iron pipe, such as for bosses, joint restraint, and joint bond cables, shall be done at the place of manufacture of the pipe. Perform welding by skilled welders experienced in the method and materials to be used. The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedures specification, procedure qualification, and welder performance qualification test records.

2. Welds shall be of uniform composition, neat, smooth, full strength, and ductile. Completely grind out porosity and cracks, trapped welding flux, and other defects in the welds in such a manner that will permit proper and complete repair by welding.

3. Prior to the application of any coating or lining in the outlet area all weldments for branch outlets shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer’s written procedures.

PART 3 - EXECUTION

A. Delivery, Unloading, and Temporary Storage of Pipe at Site

1. Use unloading and installation procedures that avoid cracking of the lining.

2. Do not move pipe by inserting any devices or pieces of equipment into the pipe barrel. Field repair linings damaged by unloading or installation procedures.

B. Sanitation of Pipe Interior

1. During laying operations, do not place tools, clothing, or other materials in the pipe.

2. When pipe laying is not in progress, close the ends of the installed pipe by a child- and vermin-proof plug.

C. Installing Flanged Pipe and Fittings

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket,

reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

8. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried piping.

9. Prior to paint, trim back gasket and caulk joints.

D. Painting and Coating

1. Prior to finish coating, trim excess gaskets protruding from flanged connections and caulk the joint.

2. Coat pipe located above ground and in vaults and structures as shown in the Piping Schedule in the drawings. Apply prime coat in the shop before transporting pipe to the jobsite.

3. Apply intermediate coats in the field before installing the pipe, then touch up after installation.

4. All field cut pipe ends shall be coated, no bare metal shall be permitted.

5. Provide asphaltic coating on buried pipe per AWWA C151.

6. Coat submerged pipe with fusion-bonded epoxy.

E. Cleaning Pipe

Sweep pipe clean of all dirt and debris. If hardened mud exists in the pipe, remove with the use of pressurized water hoses.

F. Pipe Labeling

G. Labels for Exposed Piping

1. Labels for piping shall bear the full piping system name as shown in the Piping Schedule in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels and flow direction arrows shall be painted on using commercial paint stencils to spell out the pipe name.

2. Provide 1-inch thick molded fiberglass insulation with jacket for each plastic pipe label or marker to be

installed on uninsulated pipes subjected to fluid temperatures of 125°F or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

H. Labels for Valves

Provide each valve of size 3 inches and larger and all actuated valves regardless of size with an identification tag. Tag shall be 2-inch square or circular aluminum or 1/16-inch thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings. Tags for actuated valves shall show the power source of the actuator.

I. Labels for Valves

Provide each valve of size 3 inches and larger and all actuated valves regardless of size with an identification tag. Tag shall be 2-inch square or circular aluminum or 1/16-inch thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings. Tags for actuated valves shall show the power source of the actuator.

J. Buried Warning and Identification Tape

Provide detectable warning tape per Section 15075. Warning and identification shall read “CAUTION BURIED WATER PIPING BELOW” or similar wording.

END OF SECTION

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SECTION 15276 STAINLESS STEEL PIPE

PART 1 - GENERAL

A. Description

This section includes materials and installation of stainless steel pipe and fittings 30 inches in diameter and smaller conforming to ASTM A312 or A778 and having a maximum design pressure of 150 psi.

B. Submittals

Submit shop drawings in accordance with Section 01300.

PART 2 - MATERIALS

A. Pipe

1. Pipe smaller than 3 inches shall conform to ASTM A 312, Grade TP 304L. Pipe 3 inches and larger shall conform to ASTM A 312 or A778, Grade TP 304L.

2. Pipe sizes and wall thicknesses shall conform to ANSI B36.19 as follows:

Pipe Size	**Wall Thickness**
1 inch and smaller	Schedule 80S
1-1/4 inches through 3 inches	Schedule 40S
3-1/2 inches through 8 inches	Schedule 40S
Larger than 8 inches, through 30 inches	Schedule 40S

B. Fittings

1. Fittings 3 inches and smaller shall be threaded or socket welded, conforming to ANSI B16.11, 3,000-pound CWP. Material for threaded fittings shall conform to ASTM A 403, Class WP304 or ASTM A 182, Grade F304. Material for socket welded fittings shall conform to ASTM A 403, Class WP304L or ASTM A 182, Grade F304L.

2. Fittings for submerged pipe larger than 3 inches through 24 inches shall be butt-welded, conforming to ASTM A403, Class WP or ASTM A774, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

3. Fittings for aboveground or exposed pipe larger than 3 inches through 24 inches shall be butt-welded or flanged, conforming to ASTM A403, Class WP or ASTM A774, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

4. Fittings for pipe larger than 24 inches shall conform to ANSI B16.9, or shall be fabricated, per Section 15201. Material shall be the same as the pipe.

C. Protective End Caps

Provide protective end caps on each piece of pipe or fabricated section, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each fitting, or ship and store fittings in sealed boxes or containers.

D. Unions

Unions shall be 3,000-pound WOG forged stainless steel, with dimensions conforming to MSS SP-83. Ends shall be threaded per ANSI B1.20.1 or socket-welding type. Material shall conform to ASTM A 182, Grade F304 for threaded end unions and Grade F304L for socket welded type.

E. Joints

1. Joints for pipes 3 inches and smaller shall be threaded or socket welded, same material as specified for fittings, 3,000-pound WOG, conforming to ANSI B16.11.

2. Joints for submerged pipe larger than 3 inches shall be butt-welded.

3. Joints for aboveground or exposed pipe larger than 3 inches shall be flanged or butt-welded.

4. See Section 15201 for additional requirements.

F. Outlets and Nozzles

1. Outlets of size 3 inches and smaller in piping 4 inches and larger shall be of the Thredolet type, per MSS SP-97 and AWWA Manual M11 (1989 edition), Figure 13-23. Outlets shall be 3,000-pound WOG stainless steel per ASTM A 182, Grade F304L, or ASTM A 403, Grade WP304L. Threads shall comply with ANSI B1.20.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or equal.

2. See Section 15201 for additional requirements.

G. Thread Lubricant

Use Teflon thread lubricating compound or Teflon tape.

H. Flanges

1. Provide weld-neck flanges (conforming to ANSI B16.5) for piping 3 inches and smaller to connect to flanged valves, fittings, or equipment. Provide weld-neck or Van Stone flanges (per ASTM F2015) for piping larger than 3 inches. Flanges shall be Class 150 per ANSI B16.5. Flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment. Flanges shall be flat face.

2. Material for weld-neck flanges shall conform to ASTM A182, Grade F304L.

3. Material for Van Stone flanges shall be as follows:

Application	Material	Specification
Exposed	304 Stainless Steel	ASTM A 351, Grade CF8M
Submerged	304 Stainless steel	ASTM A 351, Grade CF8M

I. Bolts and Nuts for Flanges

1. Bolts and nuts for flanges shall be Type 304 stainless steel conforming to ASTM A 193, Grade B8 for bolts and ASTM A 194, Grade 8 for nuts.

2. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B8, Class 2.

3. Bolts for flange insulation kits shall conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H.

4. Provide washer for each nut. Washers shall be of the same material as the nuts.

J. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal.

K. Gaskets for Flanges

Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

L. Wye Strainers

Strainers 2 inches and smaller shall be stainless steel, wye pattern, with minimum pressure rating of 300-psi WOG. Material shall conform to ASTM A 351 or A 743, Grade CF8M. Screen shall be 20 mesh and same material as the strainer. Provide pet cock of the same material as the strainer body in the blowoff connection. Ends shall be threaded conforming to ANSI B1.20.1. Provide one spare screen for each strainer. Strainers shall be Sarco Type 316, Muessco No. 861, or equal.

PART 3 - EXECUTION

A. Fabrication, Assembly, and Erection

1. Use an inert or shielding gas welding method. Do not use oxygen fuel welding. The interior of the pipe shall be purged with inert gas prior to the root pass.

2. Welded butt joints (both longitudinal and circumferential) shall comply with AWWA C220, Section 4. Do not allow heat tint to form in the heat affected zone (HAZ) or remove heat tint completely from the HAZ of the finished weld. The maximum depth of grinding or abrasive blasting to remove defects shall not exceed 10% of the

wall thickness. Do not perform abrasive blasting with steel shot, grit, or sand.

3. No iron or steel surfaces shall come into contact with the stainless steel. This includes placing on steel tables, racks, pipe supports, etc. Do not use carbon steel wire brushes or grinders.

4. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS A5.9. Use electrodes as follows:

Pipe Material	Welding Electrode Material
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

B. Installing Threaded Piping

Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before installing fittings, couplings, unions, or joints.

C. Installing Flanged Piping

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably

engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer's specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

8. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried piping.

9. Prior to paint, trim back gasket and caulk joints.

D. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

E. Installing Unions

Provide unions on exposed piping 3 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).

2. 6 to 12 inches downstream of valves.

3. Every 40 feet in straight piping runs.

4. Where shown in the drawings.

F. Installing Aboveground or Exposed Piping

1. Provide pipe hangers and supports as detailed in the drawings.

2. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

G. Field Hydrostatic Testing

1. Do not allow test water to remain in the pipe for more than five days. Drain and dry the piping after completing the testing.

H. Painting and Coating

Do not coat stainless steel Van Stone flanges.

END OF SECTION

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SECTION 15278 STAINLESS STEEL TUBING

PART 1 - GENERAL

A. Description

1. This section includes materials and installation of stainless steel tubing and fittings 2 inches in diameter and smaller.

2. Stainless steel pipe conforming to Section 15276 may be substituted for stainless steel tubing. However, tubing (Section 15278) may not be substituted for pipe (Section 15276).

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's catalog data for swaged fittings and joints.

3. Submit fitting manufacturer's instructions for assembling fittings and joints.

PART 2 - MATERIALS

A. Tubing

1. Tubing shall conform to ASTM A269, Grade TP 316, seamless. Hardness shall not exceed Rockwell B80. Tube wall thicknesses shall be as follows:

Tube O.D. (inches)	Minimum Wall Thickness (inches)
1/8	0.028
3/16	0.028
1/4	0.028
5/16	0.035
3/8	0.035
1/2	0.042
5/8	0.058
3/4	0.065
7/8	0.072
1	0.083
1 1/4	0.109
1 1/2	0.134
2	0.165

2. Tubing shall be free of scratches. Tubing shall be suitable for bending and flaring.

3. Tubing shall be heat-treated, which shall consist of quenching in water or rapidly cooling by other means at a rate sufficient to prevent precipitation of carbides, as demonstrated by the capability of passing practice ASTM A262, Practice E (Supplementary Requirement S4 in ASTM A269).

B. Fittings and Joints

1. Fittings and joints shall be of the SWAGELOK type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. Fitting and joint material shall comply with ASTM A479, Type 316, or ASTM A182, Grade F316. End connections shall be of the union type.

2. Joints connecting two straight tubes together shall be of the nut and ferrule union type.

C. Protective End Caps

Provide protective end caps on each piece of tubing, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each

fitting, or ship and store fittings in sealed boxes or containers.

D. Outlets and Nozzles

Use a tee with nut and ferrule union ends to connect to the tubing and with an outlet to match the connecting valve or instrument.

E. Connections to Threaded-End Valves

When connecting tubing to threaded-end valves, provide tube to female NPT connectors. Provide a threaded Schedule 80S Type 316 stainless steel nipple (ASTM A312, seamless) between the connector and the valve end.

F. Spare Parts

1. Provide the following spare parts:

Quantity	Description
6	Nuts of each size used on the project
2	Hydraulic swaging units

2. Pack the spare parts in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 - EXECUTION

A. Installing Tubing

1. Do not drag tubing out of tube racks. Do not drag tubing across any surface that could scratch it.

2. Keep tube cutters and saws sharp. Do not cut too deeply with each turn of the cutter or motion of the saw.

3. Deburr tube ends before inserting into fittings and joints. Clean both the inside and outside of fitting and pipe ends before making up joints. Do not miter joints for elbows or notch straight runs of pipe for tees. Do not kink tubing.

4. Bends in tubing shall be long sweep. Provide the straight length of tubing recommended by the fitting and

joint manufacturer to allow the tube to be inserted into the fitting. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point. Do not use bends to make turns greater than 45 degrees. Use fittings to make turns greater than 45 degrees.

B. Installing Exposed Tubing

1. Install tubing without springing, forcing, or stressing the tubing or any adjacent connecting valves or equipment.

2. Provide pipe hangers and supports as specified in Section 15064.

C. Installing Fittings and Joints

1. Follow the manufacturer's instructions for installing fittings and joints.

2. For fittings and joints larger than 1 inch, use the manufacturer's hydraulic swaging unit to make up the connections.

D. Field Hydrostatic Testing

1. See Section 15144.

2. Do not allow test water to remain in the tubing for more than five days. Drain and dry the tubing after completing the testing.

END OF SECTION

SECTION 15290 PVC PIPE, 3 INCHES AND SMALLER

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of PVC pipe and fittings of size 3 inches and smaller for use in process piping having a maximum design pressure of 150 psi and having a maximum design temperature of 105°F.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit materials list showing materials of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM D1784, D1785, and D2467. Show wall thickness of pipe and fittings. Show fitting dimensions.

3. Submit data sheets for solvent cement and demonstrating compliance with ASTM D2564 and F656.

PART 2 - MATERIALS

A. Pipe

Pipe shall be Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D1784 and D1785.

B. PVC Pipe Coloring and Marking for Reclaimed Water

PVC pipe shall be purple (Pantone 522) and shall be marked on both sides of the pipe with the wording "CAUTION: RECLAIMED WATER--DO NOT DRINK." The lettering shall be minimum 1-inch-high black letters and shall be repeated every 36 inches. The purple coloring shall be achieved by adding pigment to the PVC material as the pipe is being manufactured.

C. Fittings

Fittings shall be Schedule 80 and shall conform to ASTM D2464 for threaded fittings and ASTM D2467 for socket-type fittings.

D. Flanges

PVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150, steel flanges for outside diameter, bolt circle, and bolt holes. Do not use Van Stone flanges.

E. Unions

Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.

F. Joints

Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to valves and equipment.

G. Solvent Cement

Solvent cement for socket joints shall comply with ASTM D2564 and F656. Solvent cement for use on sodium hypochlorite piping shall be chemically resistant to sodium hypochlorite such as Weld-On 724, or approved equal.

H. Gaskets for Flanges

See Section 15050.

I. Bolts and Nuts for Flanges

See Section 15050.

J. Lubricant for Stainless Steel Bolts and Nuts

See Section 15050.

K. Wye Strainers

PVC wye strainers shall be manufactured of the same material as the pipe, with 30-mesh screens and Viton seals. Connecting ends shall be the socket type, solvent welded. Provide one spare screen for each strainer.

PART 3 - EXECUTION

A. General

1. Do not install PVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shades for pipe stored outdoors or installed outdoors until the pipe is filled with water.

2. Store fittings indoors in their original cartons.

3. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.

4. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.

5. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it.

B. Solvent-Welded Joints

1. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air at the same temperature conditions as the pipe for at least one hour.

2. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.

3. Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded

with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.

4. The pipe and fitting socket shall have an interference fit. The diametrical clearance between pipe and entrance of the fitting socket shall not exceed 0.04 inch. Check the fit at every joint before applying solvent cement.

5. Make up solvent-welded joints per ASTM D2855. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire circumference.

6. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

7. Acceptance criteria for solvent-welded joints shall be as follows:

   a. Unfilled Areas in Joint: None permitted.

   b. Unbonded Areas in Joint: None permitted.

   c. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50%.

C. Flanged Joints

1. Lubricate carbon steel bolt threads with graphite and oil before installation.

2. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

Pipe Size (inches)	**Final Torque (foot-pounds)**
1/2 to 1-1/2	10 to 15
2 to 3	20 to 30

D. Installation of Stainless Steel Bolts and Nuts

See Section 15050.

E. Threaded Joints

1. Cut threaded ends on PVC to the dimensions of ASME B1.20.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed.

2. Pipe or tubing cutters shall be specifically designed for use on PVC pipe. Use cutters manufactured by Reed Manufacturing Company, Ridge Tool Company, or equal.

3. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.

4. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.

5. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.

F. Installing Unions

Provide unions on exposed piping 3 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).

2. 6 to 12 inches downstream of valves.

3. Every 40 feet in straight pipe runs.

4. Where shown in the drawings.

G. Installing Buried Pipe

1. Install in accordance with Section 02223 and as follows.

2. Trench bottom shall be continuous, smooth, and free of rocks. See the details in the drawings for trench dimensions, pipe bedding, and backfill.

3. After the pipe has been solvent-welded and the joints have set, snake the pipe in the trench per the pipe manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.

4. Do not backfill the pipe trench until the solvent-welded joints have set. Support the pipe uniformly and

continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.

5. Install buried PVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Backfill materials in the pipe zone shall be imported sand per Section 02223. If water flooding is used, do not add successive layers unless the previous layer is compacted to 90% relative compaction.

H. Installing Aboveground or Exposed Piping

1. See Section 15050.

2. Fill empty piping with water, provide temporary shading, or other means to keep the surface temperature of the pipe below 100°F.

I. Painting and Coating

Coat piping per Section 09900, System No. 41.

J. Hydrostatic Testing

Perform hydrostatic testing for leakage in accordance with Section 15144.

END OF SECTION

SECTION 16000 ELECTRICAL – GENERAL PROVISIONS

PART 1 GENERAL

A. Scope of Work

1. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems at the Orange County Eastern and Northern Water Reclamation Facility as shown on the Drawings and as specified herein.

2. The work shall include furnishing, installing and testing the equipment and materials specified in other Sections of the Division 16 Specifications and shown on the Drawings.

3. The work shall include furnishing and installing the following:

a. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.

b. Conduit, wiring and terminations for all field-mounted instruments furnished under other Divisions of these specifications, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions of these specifications.

c. A complete raceway system for the Data Highway Cables and specialty cable systems. Install the Data Highway Cables and other specialty cable systems furnished under Division 13 in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the computer system supplier and the cable manufacture to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install cables in separate raceways.

d. Conduit, wiring and terminations for variable frequency drives, harmonic filters furnished under other Divisions of these specifications.

e. Furnish and install precast manholes, precast handholes and light pole bases.

f. Furnish and install manhole and handhole frames and covers.

g. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

h. Modifications to existing control systems including installation of auxiliary motor starter contacts, relays, switches, etc., as required to provide the control functions or inputs as shown on the Drawings. Obtain the existing equipment shop drawings from the Owner before attempting to make any modifications to the existing equipment wiring. Verify all existing wiring and connections for correctness. If record drawings are not available, trace all circuits in the field and develop the wiring diagrams necessary for completion of the work. Document all changes made to the wiring diagrams and return a marked-up set of Record Drawings to the Owner after the work is complete.

i. Coordinate the sequence of demolition with the sequence of construction to maintain plant operation in each area. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of treatment.

4. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing site, buildings and structures in which work under this Division is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the site, buildings and structures and noted the locations and conditions under which the work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work.

5. Provide all electrical demolition work associated with the removal of equipment from the existing facilities, including disconnecting and removing all electrical wiring and conduit to equipment being removed under other sections. Survey the existing electrical systems with representatives from other trades prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

6. Buildings or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect

all electrical power, communications, alarm and signaling systems. Remove only specific electrical equipment noted for removal and turn over to the Owner. All other miscellaneous electrical materials, equipment, etc, will be demolished and removed from the site as specified in Division 2.

7. Provide all electrical relocation work associated with the relocation of equipment for the existing and new facilities, including disconnecting all existing wiring and conduits and providing new wiring and conduit to the relocated equipment.

8. All power interruptions to electrical equipment shall be scheduled at the Owner's convenience with requests submitted by the Contractor to the Owner using Owner’s Construction Administration Request (C.A.R.) documenting all planned activities. C.A.R. notice shall be submitted a minimum of seven (7) days in advance of interruption. Each interruption shall have Owner’s prior approval.

9. Field verify all existing underground electrical conduit, concrete duct banks, manhole, pull boxes, etc. and mechanical piping. The Contractor shall include in his bid all costs associated with relocation or removal of underground equipment as required for construction of the new facilities.

10. The Contractor shall prepare and furnish electrical and instrumentation conduit layout shop drawings for yard electrical, within and under all roads, buildings and structuresto the Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, manholes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, building and yard lighting, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale on 24 x 36 sheets. Refer to Division 16000, Part 1, submittal paragraph C8 for additional requirements. Minimum scale shall be 1″=50′ for overall site plans and 1/8″=1′-0″ for enlarged area/ conduit plans. Final submittal shall be based on approved shop drawings.

11. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

12. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility

circuits shall be used unless approved in writing by the Engineer. Any temporary added shall be removed at job completion.

13. Complete coordination with other contractors. Contractor shall coordinate with all other contractors' equipment submittals and obtain all relevant submittals.

14. Mount transmitters, process instruments, operator stations, etc. furnished under other Divisions of these specifications.

15. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and sod is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.

16. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.

B. Related Work

1. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in Division 2.

2. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, light pole bases and reinforcing steel, is specified in Division 3.

C. Submittals

1. Submit to the Engineer, in accordance with Section 01300, shop drawings for equipment, materials and other items furnished under Division 16.

2. Shop drawings shall be submitted for the following equipment and materials specified under Division 16:

a. Raceways, Boxes, Fittings and Hangers b.

Wires and Cables

c. Lighting Fixtures and Lamps

d. Switches, Receptacles and Covers e.

Lightning Protection System

f. Grounding Hardware and Connections

3. Submittals shall be required for the following items:

   a. Qualifications of Electrical Contractor Superintendent

   b. Final Power System Study (Modify existing study performed at each site NWRF-3A and EWRF PH V.)

   c. Training Plans

   d. Testing and Service Reports

4. Installation working drawings shall be submitted for all conduit routing layouts. Contractor shall utilize the Contract AutoCad drawings for base files and show conduit routing using the layers described herein. Colors, line types and line widths shall be appropriate forplotting using AIA standards. Dashed lines shall indicate the conduit is concealed or buried. Solid lines shall indicate the conduit is exposed. The conduits and any major pulling points shall be drawn in model space. The associated text shall be drawn in paper space at a sizenot less than 0.1-inch. Provide associated type written conduit schedules for easy cross check. Minimum scale shall be 1″=50′ for overall site plans and 1/8″=1′-0″ for enlarged area/ conduit plans. Final submittal shall be based on approved shop drawings. Schedules may be included on the drawings or in a separate spreadsheet/table.

   a. E-POWR-CNDT: 480-volt power

   b. E-LITE-CNDT: 120/208/240-volt power or lighting

   c. E-CTRL-CNDT: 120-volt control, instrumentation, signal, communication or fiber

   d. E-ANNO-TEXT: Annotation text

   e. Layouts shall be shown at an appropriate scale for clarity. If the Contract drawings need to be re-scaled to adequately represent the conduit routing, the Contractor shall do so. Contractor may submit separate drawings for power, lighting and control for one area to avoid re-scaling of drawings.

   f. Layouts shall include locations of process equipment, motor control centers, transformers,

panelboards, control panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments and any other electrical devices connected to concealed or buried conduits.

g. Contractor layouts of conduit routing shall comply with installation specifications 16110 and 16600 for raceway and underground systems. It is expected for major conduit corridors that there would be two separate ductbanks, with a minimum spacing of 12- inches between the two different ductbank systems. One ductbank would contain 480-volt and 120-volt power and control, while the other ductbank would contain fiber optic, Ethernet, Profibus, shielded instrumentation wiring or other signal / communication wiring. It is the Owner’s desire to utilize above ground pull boxes on the underground system rather than underground pull boxes or manholes in order to avoid the high water table of the site.

h. Submittal shall include a disc with the AutoCAD drawings along with full size (34-inch by 22-inch) hardcopy prints on high quality paper.

i. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

5. The manufacturers name and product designation or catalog numbers shall be submitted for the following material utilized:

   a. Cable Meggaring Testing Equipment

   b. Ground System Resistance Test Equipment

6. Contractor shall check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to the Specifications and the Drawings. This statement shall also list all exceptions to the Specifications and the Drawings. Shop drawings not so checked and noted shall be returned.

7. The Engineer's check shall be for conformance with the design concept of the project and compliance with the Specifications and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.

8. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

9. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM", "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED".

10. Operation and Maintenance Data

    a. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 01720. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc., to instruct operating and maintenance personnel unfamiliar with such equipment.

    b. Manuals shall include the following as a minimum:

        1) A comprehensive index.

        2) A complete "As-Built" set of approved shop drawings.

        3) A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

        4) A table listing of the "as left" settings for all timing relays and alarm and trip set points.

        5) System schematic drawings "As-Built", illustrating all components, piping and electric connections of the systems supplied under this Section.

        6) Detailed service, maintenance and operation instructions for each item supplied.

        7) Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

        8) The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

        9) Complete parts list with stock numbers, including spare parts.

D. Reference Standards

1. Electric equipment, materials and installation shall

comply with the latest edition of National Electrical Code (NEC) and with the latest edition of the following codes and standards:

a. National Electrical Safety Code (NESC)

b. Occupational Safety and Health Administration (OSHA)

c. National Fire Protection Association (NFPA)

d. National Electrical Manufacturers Association (NEMA)

e. American National Standards Institute (ANSI) f.

Insulated Cable Engineers Association (ICEA) g.

Instrument Society of America (ISA)

h. Underwriters Laboratories (UL)

i. Factory Mutual (FM)

j. International Electrical Testing Association (NETA)

k. Institute of Electrical and Electronic Engineers (IEEE)

2. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.

3. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

E. Priority of the Contract Documents

1. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

2. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

3. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

4. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.

5. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

F. Enclosure Types

1. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

   a. NEMA 1 for dry, non-process indoor locations. b.

      NEMA 12 for "DUST" locations.

   c. NEMA 4X for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP", "WET" and “PROCESS” locations.

   d. NEMA 4X for "CORROSIVE" locations.

   e. NEMA 7 (and listed for use in the area classifications shown) for "Class I Division 1 Group D", "Class I Division 2 Group D" and "Class II Division 1" hazardous locations shown on the Drawings.

   f. NEMA 3R for outdoor control panels.

G. Hazardous Areas

1. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502, 503, 504 and 510.

2. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

H. Codes, Inspection and Fees

1. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

2. Obtain all necessary permits and pay all fees required for permits and inspections.

I. Tests and Settings

1. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements. Employ the services of an "NETA Certified "independent recognized power systems testing company, other than the manufacturer of the switchgear or motor control centers, to perform the tests specified herein. Contractor will submit qualifications for NETA certified firm contracted for testing.

2. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" unless otherwise modified by these Sections.

3. A typed test report for each component tested shall be submitted to the Engineer for the project record files. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. A minimum of three complete copies shall be provided. Reports shall be signed by the person in responsible charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Contractor.

4. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

5. In addition to the specific testing requirements listed in the individual sections, the following minimum tests and settings shall be performed.

a. Mechanical inspection, testing and settings of

circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.

b. Check the full load current draw of each motor. Where power factor correction capacitors are provided the capacitor shall be in the circuit at the time of the measurement. Check ampere rating of thermal overloads for motors and submit a typed record to the Engineer of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.

c. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.

d. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.

e. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.

f. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation is incorrect for the driven equipment correct motor connections at the motor terminal box.

g. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.

h. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.

i. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 clockwise rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.

j. Verify correct wire termination positions across tie circuits, transfer switches, or other devices that have two sources of three-phase power by performing a hot phase test. That is, in addition to verifying clockwise rotation, a voltage reading across both incoming circuits should measure 0 volts when phase “A”of one side is compared to phase “A” of the other side.

k. Check all wire and cable terminations. Verify to the Engineer connections meet the equipment's torque requirements.

l. Field set all transformer taps as required to obtain the proper secondary voltage.

m. Infrared hot spot inspection shall be made of all new electrical equipment and existing electrical equipment that is refed. Equipment includes, but is not limited to switchgear, motor control centers, transformers, disconnect switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the Owner and again 3 months before expiration of the 1 year warranty period.

6. Make the following minimum tests and checks prior to energizing electrical equipment. Submit test reports upon completion in accordance with Section 01300.

a. Test and calibrate protective relays and circuit breakers.

b. Mechanical inspection of air interrupter switches and circuit breakers to assure proper operation.

7. Testing shall be scheduled and coordinated in writing with the Engineer at least 2 weeks in advance. The testing firm shall provide all material, labor, equipment and technical supervision to perform the tests and inspection. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date. The Contractor shall have qualified personnel present during the testing.

J. Power System Studies

1. General:

a. The major electrical equipment manufacturer (i.e. switchgear and motor control centers) shall provide a computerized Power System Study for the electrical power distribution and motor control equipment. The study shall verify adequacy of all of the existing 480 volt equipment being refed as well as new additions being implemented under these Specifications. A preliminary power study has been completed for EWRF phase V improvements by Eaton Services and Systems in September 2015. Reference Eaton report number TQSIMI150392.2. This report in hardcopy form can be made available to the

successful bidder. A power study was completed as part of the NWRF Phase IIIA Improvements. The NWRF Phase IIIA power study files can be made available to the successful bidder.

b. The study shall also include the utility company's protective devices, the emergency generators, the main switchgear, all feeders from the main switchgear, all substations and distribution and all associated MCC's. Graphic indication of coordination shall be furnished in the form of a clearly labeled and identified composite drawing showing time-current curves of system protective devices. Time-current curves of each device shall also be furnished.

c. The Contractor/Manufacturer shall be responsible for obtaining and verifying with the Power Company in writing all information needed to conduct this study. Provide this correspondence and information including contacts and phone numbers with the study submittal.

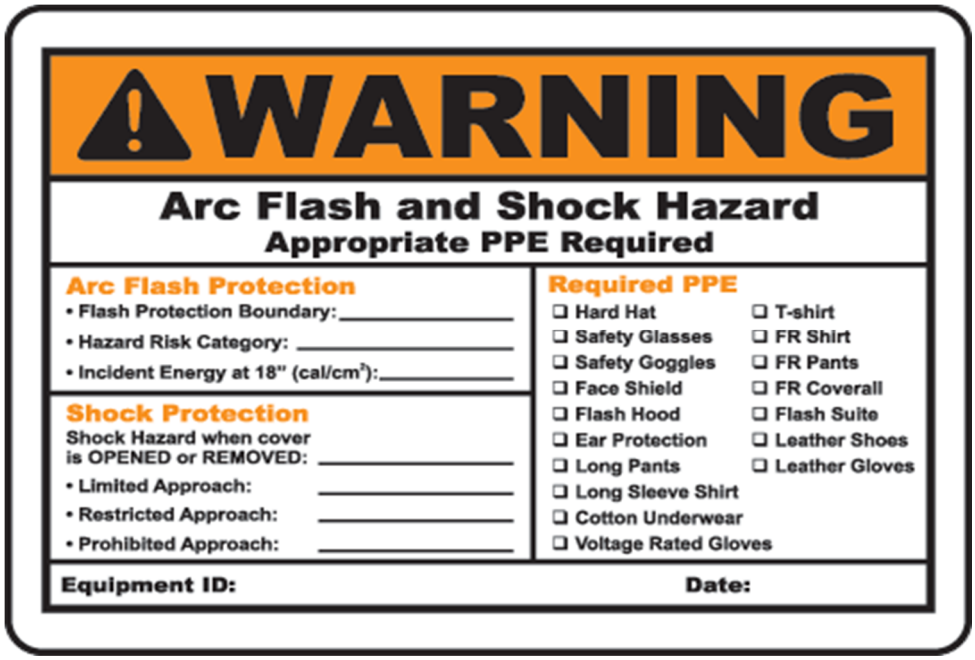
d. The Contractor shall set all protective devices and relays based on this coordination study to provide coordinated, selective protection for all equipment supplied or affected by the installation under this Contract. Devices shall be set in accordance with the approved coordination study, prior to equipment energization.

e. The Contractor/Manufacturer shall provide data necessary to perform the study. This includes feeder cable sizes, approximate feeder length, motor data, switchgear data, existing protective relay settings and any other information relevant to the study.

f. A summary of the short circuit analysis shall be provided to the Contractor at the time shop drawings for all of the new equipment is submitted for approval. This preliminary short circuit submittal shall be required in order to approve the equipment submittal.

g. The manufacturer shall be made aware that there is no available up-to-date single line diagram for the existing facility. The Contractor/Manufacturer shall provide and/or update the existing single line diagram as required in order to perform the coordination and short-circuit study.

h. The Contractor shall provide and install equipment specific arc flash warning labels per the arc flash study performed herein.



2. Scope:

a. The power system study consists of four major parts. The first part is the preliminary short circuit study. The preliminary short circuit study shall verify new and existing equipment is being applied within design ratings. Shop drawings for new equipment will not be reviewed until the preliminary short circuit study is approved by the Engineer.

b. The second and third parts of the power system study include the final short circuit and protective device coordination study. New equipment will not be energized until this study is approved by the Engineer and devices are set in the field in accordance with the study.

c. The fourth and final part of the power system study is the arc flash study. The arc flash study labels will be added after the equipment is energized and allchanges, upgrades or modifications have been made, to ensure field labeling will be accurate.

d. The short circuit study shall be in accordance with ANSI Standard C37.010 and C37.13, shall be performed to check the adequacy, and to verify the correct application of circuit protective devices and other system components specified. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating facilities. Minimum as well as maximum possible fault conditions

shall be adequately covered in the study.

e. Fault contribution of all motors shall be considered. The Contractor shall be responsible for obtaining all required data of equipment. All back-up calculations shall become part of the final report. The calculations shall be in sufficient detail to allow easy review.

3. Contents:

a. The study shall include representation of the power company's systems, the base quantities selected, impedance source-data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short circuit momentary duties, shall be calculated on the basis of an assumed bolted three-phase short circuit at each medium voltage bus, low voltage switchboard bus, switchboards, motor control centers, distribution panel boards, pertinent branch circuit panel boards, and other significant locations through the systems. The short-circuit tabulations shall include significant X to R ratios, asymmetry factors, KVA, and symmetrical fault current.

b. A protective device time current coordination study shall be included with coordination plots of key and/or limiting devices, tabulated data, rating, and/or settings selected. The study shall present an engineering balance between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

c. Separate plots shall be provided for each mode of "normal" and "stand-by" operation. Maximum fault values shall be shown in each case. Both power sources shown in one plot will not be accepted.

d. Existing protective device settings shall be reviewed to ensure selectivity under the new conditions. Recommended changes shall be indicated in the report. The Contractor shall be made aware of required changes immediately.

e. Transformer damage curves in accordance with ANSI C57.109.

f. Feeder cable damage curves.

g. Required settings for breakers and relays shall be maximized to provide the most effective protection

possible whether the system is fed from the normal or emergency source.

h. Tabulations indicating recommended set points for all protective devices shall be provided. This shall include the normal as well as the emergency source.

i. Generator short circuit decrement curves and thermal limit curves shall be included.

j. Tabulation of arc flash information.

k. An executive summary outlining the distribution system, the information received from the utility company, assumptions made to complete the study, statement of the adequacy of the distribution equipment to safely clear or close on any fault, and identification of any problem areas with recommendations for resolving the problem.

4. Motor Starting Study:

a. A motor starting study for all large electric drives (100 horsepower and above) to determine voltage dip or power inrush limitations at selected locations due to starting of motors shall be provided. This applies to both the normal and the emergency mode.

5. General Information for Time-Current Curves Presentations:

a. The coordination plots shall include complete titles, representative one-line diagrams, legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete parameters for power, and substation transformers, and complete operating bands for low-voltage circuit breaker trip devices.

b. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required.

c. The short-time region shall indicate the medium voltage relay instantaneous elements, the magnetizing in-rush, and ANSI withstand transformer parameters, the low-voltage circuit breaker instantaneous trip devices, fuse manufacturing to tolerance bands, and significant symmetrical and asymmetrical fault currents.

d. Each primary protective device required for a delta-to-wye connected transformer shall be selected so

that the characteristic or operating band is within the transformer parameters; which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.

e. Low-voltage power circuit breakers shall be separated from each other and the associated primary protective device, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.

f. Protective relays shall be separated, where feasible, by a 0.3 second time margin when the maximum three-phase fault flows, to assure proper selectivity.

6. Arc Flash Study:
   a. The study shall utilize the fault current values calculated in the short circuit study and the clearing time of the upstream protective device in the coordination study to calculate the incident energy at each fault location.

   b. Study shall be in accordance with IEEE Standard 1584 and NFPA 70E.

   c. Study shall calculate the incident energy and flash protection boundary at all significant locations in the electrical distribution system (switchgear, switchboards, motor control centers, panel boards) where work could be performed on energized parts. Include any 208 volt or 240 volt equipment that is fed from transformers greater than 125 kVA.

   d. Incident energy calculations shall include maximum and minimum fault contribution scenarios, since protective device clearing times can vary greatly depending upon the fault current.

   e. Tabulations shall be provided showing each fault location, the arcing fault magnitude, protective device clearing time, duration of the arc, arc flash boundary, working distance, incident energy and hazard risk category.

7. The power system study shall be bound in a standard 8-1/2" x 11" size report and submitted in accordance with Section 01300. The completed short circuit study shall be submitted to and approved by the Engineer before any of the equipment is shipped. All protective devices shall be adjusted, tested, and calibrated in the field, prior to energizing the equipment, per the settings listed in the study. This work shall be

performed by the manufacturer as described in this section and prior to final acceptance by the Owner.

8. All protective devices, existing and new related to this project shall be calibrated and tested as recommended by and under the supervision of the distribution gear manufacturer's representative as specified in this section.

9. The power system study shall be stamped and signed by a professional engineer registered in the state in which the equipment is to be installed.

10. Arc Flash Warning Labels:
    a. Provide machine printed 3.5-inch x 5-inch (nominal) thermal transfer type label of high adhesion polyester for each location identified in the arc flash study.

    b. Labels shall include the following machine printed information (hand lettering is not acceptable): equipment name, flash hazard boundary, incident energy, boundaries for shock hazard, limited approach, restricted approach and prohibited approach, PPE (personal protective equipment) category and date.

    c. One label shall be required at each applicable section of low voltage switchgear, switchboard, motor control center, or panel board. One label shall be required at each medium voltage switch or breaker.

K. Interpretation of Drawings

1. In general the Drawings do not show conduit routing. The Contractor shall be responsible for the planning and routing of all conduits in compliance with the specifications and Drawing details.

2. Drawings noting equipment identification and associated circuitry is found on the following drawings:

    a. Single line power diagrams show power, grounding and control circuitry requirements associated with substations, switchgear, switchboards, motor control centers, distribution panels, transformers, and feeders to lighting panels.

    b. Panel board schedules show branch circuit conduit and wire requirements.

    c. Riser diagrams show circuitry for instrumentation and control devices along with miscellaneous signal or communication wiring.

3. Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

4. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.

5. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

6. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

7. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation. Any adjustments required in the field shall be provided at no additional cost to the Owner and coordinated and approved by the Engineer.

8. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

9. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the Owner.

10. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

11. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by ½-inch spacers to provide a clearance between wall and equipment.

12. All floor mounted electrical equipment shall be placed on4-

inch thick (3/4-inch, 45- degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

13. The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc, required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

14. Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

L. Phase Balancing

1. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panel boards shall be field connected to result in evenly balanced loads across all phases.

2. Field balancing of circuits shall not alter the conductor color coding requirements as specified in Section 16120.

M. Size of Equipment

1. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

2. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional

integrity of the equipment.

N. Record Drawings

1. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings".

2. Record Drawings shall accurately show the installed condition of the following items:

   a. One-line Diagram(s).

   b. Equipment elevations (front views). c.

      Raceways and pullboxes.

   d. Conductor sizes and conduit fills. e.

      Panel Schedule(s).

   f. Control Wiring Diagram(s).

   g. Lighting Fixture Schedule(s).

   h. Lighting fixture, receptacle and switch outlet locations.

   i. Underground raceway and duct bank routing.

   j. Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers and panel boards.

3. Submit a schedule of control wiring raceways and wire numbers, including the following information:

   a. Circuit origin, destination and wire numbers. b.

      Field wiring terminal strip names and numbers.

4. In addition to the schedule, provide point-to-point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers.

5. Submit the record drawings, schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams to the Engineer. The schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams shall be computer generated (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted).

O. Equipment Interconnections

1. Review shop drawings of equipment furnished under other Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with the Record Drawings.

2. Furnish and install all equipment interconnections. P.

Materials and Equipment

1. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

2. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

3. Warrant all equipment furnished under Division 16 in accordance with the General Conditions. Refer to individual equipment sections for additional warranty items.

Q. Equipment and Device Identification

1. Identify all electrical equipment furnished under Division 16 and all equipment control panels furnished under other Divisions with nameplates as described herein. Equipment includes switchgear, switchboards, motor control centers, panel boards, transformers, variable frequency drives, disconnect switches, separately mounted motor starters, transfer switches, control panels, control stations, named terminal cabinets, etc. The designation of the equipment shall correspond to the designation shown on the Drawings.

   a. A minimum of two nameplates shall be required at electrical equipment. The first nameplate shall identify the equipment or the name of the equipment it serves. For example a panel board identification nameplate would have the identification of “LP-575” while a local disconnect switch for a pump motor would have the identification of “EFFLUENT PUMP 390- P-3”. The second nameplate shall identify the power source, i.e. “FED FROM MCC-17”.

2. Nameplates shall be engraved, laminated plastic, not lessthan 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high black letters on a white background.

3. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where

the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.

4. All voltages (e.g. 12,470 volts, 480 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background withwhite engraved lettering, lettering shall be a minimum of 1" high.

5. All receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, instruments, etc. shall be identified with the panel and circuit to which it is connected. For example a receptacle fed from circuit 4 from panel LP-575 would have the label “LP-575/4”. Identification shall be with machine generated labels with 1/4-in high letters.

R. Demolition

1. Remove electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused.

2. Remove unused exposed conduit and wiring back to point of concealment including abandoned conduit above accessible ceiling finishes. Remove unused wiring in concealed conduits back to source (or nearest point of usage).

3. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide stainless steel blank covers for abandoned outlets which are not removed.

4. Disconnect and remove abandoned panel boards, transformers,disconnect switches, control stations, distribution equipment, etc.

5. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.

6. Disconnect electrical circuits in the way of demolition work and re-establish circuits to remaining outlets, fixtures, equipment, etc. Disconnect electrical systems in walls, floors and ceilings scheduled for removal.

7. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

8. New lighting shall be in place or safe lighting levels maintained for plant operation during the construction

period.

9. Repair adjacent construction and finishes damaged during demolition and extension work.

10. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

11. Coordinate outages in systems with the Owner. Where duration of proposed outage cannot be allowed by the Owner, provide temporary connections as required to maintain service.

12. Removal and relocation of existing conduit, wire and equipment have not been detailed on the Drawings. Survey the affected areas before submitting bid proposal.

13. Trace out existing wiring that is to be relocated, or removed and perform the relocation or removal work as required for a complete operating and safe system.

14. Continuous service is required on all circuits and outlets affected by these changes, except where the Owner will permit an outage for a specific time. Obtain Owner's consent before removing any circuit from continuous service.

15. Remove exposed conduits, wire ways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide stainless steel blank covers for abandoned outlets which are removed.

16. All equipment, materials, controls, motor starters, branch and feeder breakers, panel boards, transformers, wiring, raceways, etc., furnished and installed to temporarily keep circuits energized shall be removed when the permanent installation is fully operational.

17. Electrical Removal

    a. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.

    b. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged and stored. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the

point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.

c. Wall switches, receptacles, and other miscellaneous electrical equipment, shall be removed and disposed of off the site as required. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired.

S. Disposition of Removed Materials and Equipment

1. In general, it is intended that material and equipment indicated to be removed and disposed of by the Contractor shall, upon removal, become the Contractor's property and shall be disposed of off the site by the Contractor, unless otherwise directed by the Owner. Any fees or charges incurred for disposal of such equipment or materials shall be paid by the Contractor. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be given to the Owner.

2. Ballasts in each existing lighting fixture shall be assumed to contain PCB's unless specifically marked with a label indicating "No PCBs". Remove ballasts from each lighting fixture and pack them in accordance with EPA PCB regulations. Ship ballasts in approved containers to an EPA approved recycling facility and pay all shipping, packaging and recycle costs.

3. The following electrical equipment shall be removed and shall be moved by the Contractor to a location on the site for storage as directed by the Owner:

a. Two - Blower Control Panels at Basin 5

b. Aqua Aerobics filter feed pump control panel

c. PLC-03A and associated fiber termination enclosure

d. Panel LP-T and associated transformer and disconnect switch.

T. Safety Requirements

1. The Contractor shall make every effort to keep all employees and/or subcontractors aware of the danger inherent in working in dangerous proximity to the existing power lines. The minimum recommended precautionary measures are as follows:

a. Make sure that all persons responsible for operating cranes, draglines and other mobile equipment have a copy of, and are familiar with the State Department of Commerce Regulations for Use of Cranes, Draglines and Similar Equipment near Power Lines, as well as the U.S. Department of Labor OSHA Regulations, before commencing operation of said equipment.

b. Make sure that all cranes, draglines and other mobile equipment have attached to them the black and yellow Department of Commerce warning signs required by the said Regulations of State Department of Commerce.

c. Warn all employees on the ground, new and old employees alike, of the danger of holding on to or touching a cable or other piece of equipment or machinery that is located or working close to any overhead power line.

d. If, during the course of construction, it becomes necessary for the contractor, or subcontractor, and their employees, to operate cranes, draglines, or their mobile equipment, in dangerous proximity of any overhead power lines, or in such a manner that such equipment might come close to any overhead power lines, the Contractor shall give the Power Company or overhead power line owner prior notice of such proposed operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

A. Sleeves and Forms for Openings

1. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

2. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

3. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

4. Seal all openings, sleeves, penetration and slots as specified in Section 16110.

B. Cutting and Patching

1. Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete as specified in Section 03740. Saw cut concrete and masonry prior to breaking out sections.

2. Core drill holes in existing concrete floors and walls as required.

3. Install work at such time as to require the minimum amount of cutting and patching.

4. Do not cut joists, beams, girders, columns or any other structural members.

5. Cut opening only large enough to allow easy installation of the conduit.

6. Patching to be of the same kind and quality of material as was removed.

7. The completed patching work shall restore the surface to its original appearance or better.

8. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

9. Remove rubble and excess patching materials from the premises.

10. When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

C. Installation

1. Any work not installed according to the Drawings and this Division or without approval by the Engineer shall be subject to change as directed by the Engineer. No extra compensation will be allowed for making these changes.
2. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged unit(s) or

systems shall remain on site and returned to the manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be borne by the Contractor.

3. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.

4. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting requirements in Division 9, at no additional cost to the Owner.

D. Manufacturers Service

1. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturers warranty repairs.

2. The manufacturers of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:

a. The equipment shall be visually inspected upon completion of installation and prior to energization to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer’s criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on-site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "as-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity

b. The Field Service Engineers shall provide engineering support during the energization and check-out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the manufacturer’s performance specifications.

c. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.

d. A final report shall be written and submitted to the Contractor within fourteen days from completion of final

system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action. The reports after review by the Contractor shall be submitted to the Engineer.

E. Power System Study

1. Provide a complete system Power System Study including preliminary short circuit, final short circuit, protective device coordination and arc flash study as specified herein.

2. Provide and install arc flash warning labels at equipment identified within the arc flash study.

F. Cleaning

1. Remove all rubbish and debris from inside and around electrical equipment and enclosures.

2. Remove dirt, dust or concrete spatter from the interior and exterior of equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

END OF SECTION

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SECTION 16110 RACEWAYS, BOXES, FITTINGS AND SUPPORTS

PART 1 GENERAL

A. Scope of Work

1. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

B. Related Work

1. Refer to Section 16600 for additional requirements.

C. Submittals

1. Submit to the Engineer, in accordance with Section 01300, the manufacturers' names and product designation or catalog numbers with cut-sheets of all materials specified. Indicate in the submittal, the areas where specific materials are used.

2. Above ground raceway routing in accordance with Section 16000, PART 1, paragraph C, 4.

PART 2 PRODUCTS

A. Materials

1. Rigid Aluminum Conduit

a. Rigid aluminum conduit shall be 6063 alloy and shall be as manufactured by New Jersey Aluminum Corp.; Reynolds Aluminum International Services Inc.; Alumax Extrusions, Inc; VAW of America, Inc. or equal.

b. Rigid aluminum conduit shall be for use under the provisions of NEC Article 344.

2. Electrical Metallic Tubing

a. Electrical metallic tubing shall be hot-dipped galvanized steel as manufactured by the Allied Tube and Conduit Corp.; Triangle PWC Inc.; Wheatland Tube Co.; Bridgeport or equal.

b. Electrical metallic tubing shall be for use under the provisions of NEC Article 358.

3. Rigid Nonmetallic Conduit

a. PVC conduit shall be rigid polyvinyl

chloride

schedule 80 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.

b. PVC conduit used in underground concrete encased duct banks shall be rigid polyvinyl chloride schedule 40 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.

c. PVC conduit shall be for use under the provisions of NEC Article 352.

4. Liquid tight Flexible Metal Conduit, Couplings and Fittings

a. Liquid tight flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal.

b. Fittings used with liquid tight flexible metal conduit shall be of the 3-piece screw-in type malleable iron as manufactured by the O.Z. Gedney Co. or equal.

c. Liquid tight flexible metal conduit shall be for use under the provisions of NEC Article 350.

5. Flexible Metallic Tubing

a. Flexible metallic tubing shall be for use under the provisions of NEC Article 360.

b. Flexible metallic tubing shall be hot-dipped galvanized steel strips shaped into interlocking convolutions firmly joined to one another assuring a complete lock similar to Tristeel as manufactured by Triangle - PWC, Inc. or equal.

c. Flexible metallic tubing shall be used only indoors for connection to lighting fixtures in NEMA 1 administration and office areas.

d. Furnish and install insulated bushings at terminations for conductor protection.

6. Flexible Couplings

a. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

7. Boxes and Fittings

a. Pressed steel switch and outlet boxes shall be hot-dipped galvanized with hot-dipped galvanized tile rings as manufactured by the Raco Manufacturing Co.; Adalet Co.; O.Z. Manufacturing Co. or equal.

b. NEMA 1 and NEMA 12, junction boxes, pull boxes etc., shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements). Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal. All boxes shall be shop primed and painted by the box manufacturer.

c. NEMA 4X stainless steel, junction boxes and pull boxes shall be 316 stainless steel with 316 stainless steel hardware and gasketed covers. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements.) Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal.

d. Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations. They shall be cast aluminum, with stainless steel hinged covers and stainless steel hardware and bolts; Type EJB-N4 as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Adalet-PLM or equal.

e. Cast aluminum boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws as manufactured by the Killark Electric Co..; Crouse-Hinds Co.; Appleton Electric Co.; or equal.

f. Cast aluminum device boxes shall be Type FD. All cast aluminum boxes and fittings shall be copper-free aluminum with cast aluminum covers and stainless steel screws as

manufactured by the Killark Electric Co.; Crouse-Hinds Co.; L. E. Mason Co. or equal.

g. Cast aluminum fittings (C's, T's, LB's, etc.) shall be of the mogul design (with rollers) as manufactured by Appleton Electric Co. or equal.

h. Conduit shall be of the grounding type as manufactured by Myers Electric Products, Inc. or equal.

i. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK; Spring City Electrical Manufacturing Co., Type WDP or equal.

j. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co. or equal.

k. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co. or equal.

l. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; O.Z./Gedney Co.; Spring City Electrical Mfg. Co. or equal.

m. Combination expansion-deflection fittings installed exposed shall be Type XJ as manufactured by Crouse- Hinds Co.; O.Z. Gedney Co.; Spring City Electrical Mfg. Co. or equal.

n. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

o. Conduit sealing bushings shall be O.Z./Gedney, TypeCSB or equal.

p. Elbows and couplings shall be aluminum.

r. Electrical metallic tubing fittings shall be of the steel, raintight, concrete-tight, insulated throat (connectors), compression type as manufactured by the Appleton Electric Co.; Crouse-Hinds Co. or equal.

8. Conduit Mounting Equipment

a. In dry indoor non-process areas, hangers, rods,

backplates, beam clamps, channel, fasteners, anchors, nuts, washers, etc., shall be hot-dipped galvanized steel.

b. 316 Stainless steel channel with 316 stainless steel hardware (hangers, rods, backplates, beam clamps, fasteners, anchors, nuts, washers, etc.) shall be used in process areas, as shown on the drawings, in areas designated “PROCESS”, "WET", "DAMP" and "CORROSIVE" on the Drawings and in outdoor locations. All channel and hardware shall be resistant to the chemicals present in the area in which it is used.

c. Expansion anchors (minimum 3/8" diameter) shall be 316 stainless steel and equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, MI; Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO; or Kwik-Bolt II as manufactured by the Hilti Fastening Systems, Inc, Tulsa, OK. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the steel reinforcement. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no cost to the Owner.

9. Wall and Floor Slab Opening Seals

a. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.;Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc. or equal.

10. Cold Galvanizing Compound

a. Cold galvanizing compound shall be 95% zinc rich paint as manufactured by ZRC Products Company, a Division of Norfolk Corp. or equal.

11. Corrugated Innerduct

a. Innerduct shall be UL listed corrugated, manufactured from High Density Polyethylene (HDPE), colored orange, sized per Drawings and as manufactured by Innerduct.com, or equal.

PART 3 EXECUTION

A. Raceway Applications

1. Except where otherwise shown on the Drawings, or specified, all wiring shall be in rigid aluminum

conduit.

2. Where transitioning from underground to above grade and conduit will be exposed, conduit shall be rigid aluminum. Refer to Section 16600 for additional requirements.

3. Schedule 80 PVC conduit shall be used where shown on the Drawings and in chemical rooms, chlorinator rooms and chlorine storage areas or areas designated "CORROSIVE" on the Drawings.

4. Schedule 80 PVC shall be used underground. Where schedule 80 PVC is used all elbows shall be rigid aluminum. On this project, all below grade conduit shall be concrete encased. Aluminum Conduit below grade or in contact with concrete shall be coated in mastic or other protective coating.

5. PVC conduit shall be used for concrete encased underground duct banks except that all elbows shall be rigid aluminum.

6. Electrical metallic tubing and fittings may be used only in NEMA 1 administration and office areas. Electrical metallic tubing and fittings shall not be embedded in concrete, installed outdoors, in process areas, shops, maintenance areas, electrical rooms, etc. On this project, no EMT is expected to be used.

7. All conduit of a given type shall be the product of one manufacturer.

B. Box Applications

1. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.

2. Exposed switch, receptacle and lighting outlet boxes and condulet fittings shall be cast aluminum.

3. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel. Welded seamed boxes will not be permitted.

4. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

C. Fittings Applications

1. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Structural Drawings for expansion joint locations. Provide bonding jumpers around fittings.

2. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.

3. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

D. Installation

1. No conduit smaller than 3/4 inch electrical trade size shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required or directed.

2. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

3. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.

4. Conduit supports, other than for underground raceways, shall be spaced at intervals of 8-ft or less, as required to obtain rigid construction.

5. Single conduits shall be supported by means of aluminum one-hole pipe clamps in combination with aluminum one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

6. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete expansion anchors shall be provided.

7. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.

8. Conduit terminating in pressed steel boxes shall have double locknuts (aluminum) and insulated grounding

bushings.

9. Conduit terminating in gasketed enclosures shall be terminated with grounding type conduit hubs.

10. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings with lay-in type lugs.

11. Conduits shall be installed using threaded fittings unless otherwise specified herein.

12. Liquid tight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present.

13. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

14. Aluminum fittings and boxes shall be used with aluminum conduit. Aluminum conduit shall not be imbedded in concrete containing chlorides, unwashed beach sand, sea water, or coral bearing aggregates. Aluminum conduit shall be isolated from other metals with heat shrink tubing (Raychem or equal) or plastic-coated hangers. Strap wrenches shall be used for tightening aluminum conduit. Pipe wrenches, channel locks, chain wrenches, pliers, etc. shall not be used.

15. All threads on aluminum conduit and fittings shall be cleaned and coated with “No-Oxide” compound before installing.

16. Aluminum conduit installed in concrete or below grade shall be completely covered with two (2) coats of bit mastic paint or with heat shrink tubing (Raychem or equal).

17. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.

18. PVC conduit to non-metallic and metallic box connections shall be made with sealing rings, with a stainless steel retainer as manufactured by Thomas & Betts Co.

19. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

20. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as provided per

the NEC and approved by the PVC conduit manufacturer.

21. All conduit entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated.

22. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 7.

23. Spare conduits and conduit stubouts for future construction shall be provided with threaded PVC end caps at each end.

24. No unbroken run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90 degree elbow.

25. Aluminum conduit entering manholes and below grade pull boxes shall be terminated with grounding type bushings and connected to a 3/4" x 20' rod with a #6 bare copper wire.

26. Underground circuits shall be installed directly to the respective motor control centers, lighting panels, etc., except stainless steel pull boxes shall be wall mounted on structures to eliminate excessive bends. With prior written approval, below grade pull boxes may be used. Splices shall not be made in above or below grade pull boxes unless otherwise indicated on the plans and approved in writing by the Engineer.

27. All conduits shall have a 4-inch concrete housekeeping pad at all slab and grade penetrations. The housekeeping pad shall have 45 degree, 3/4-inch chamfer at all exposed edges.

28. All risers from underground, concrete pads, floors, etc.

29. Existing conduits are to be reused only where specifically noted on the drawings. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits 2-in in diameter and larger prior to installing conductors.

30. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.

31. Where no size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314.

32. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling

construction.

33. The use of running threads is prohibited. Where such threads are necessary, a 3-piece cast aluminum union shall be used.

34. Conduits passing from heated to unheated spaces, and at all exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

35. All field cut ends of hot dipped galvanized mounting channel shall be cleaned and painted with cold galvanizing compound before installation.

36. All underground control and instrumentation conduits shall be separated from power conduits by a minimum of 12 inches unless specifically noted otherwise. Crossing of control and instrumentation conduits with power conduits shall be kept to a minimum and where they must cross they shall cross at 90 degree angles.

37. All Supporting material, hardware, nuts, bolts, washers, etc. shall be manufactured of 316 stainless steel.

END OF SECTION

SECTION 16120 WIRES AND CABLES

PART 1 GENERAL

A. Scope of Work

1. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

2. Install data highway, fiber optic, coaxial and I/O cables furnished under Division 13.

B. Submittals

1. Submit to the Engineer, in accordance with Section 01300, samples of proposed wire. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.

2. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.

3. Installed unapproved wire shall be removed and replaced at no additional cost to the Owner.

C. Delivery, Storage and Handling

1. Carefully handle all conductors to avoid kinks and damage to insulation.

PART 2 PRODUCTS

A. General

1. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

2. All conductors shall be stranded, except that lighting and receptacle wiring may be solid.

3. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

4. All wire of a given type shall be the product of a single manufacturer.

B. Materials

1. 600 Volt or Less Wire and Cable

a. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type XHHW-2. Below grade and underground the wire shall be type XHHW-2.

b. Wire for circuits over 150 volts to ground shall be NEC type XHHW-2 for sizes 4/0 AWG and smaller, and shall be NEC type RHW-2 for sizes 250 MCM (kcmil) and larger.

c. Wire for control circuits shall be #14 AWG minimum NEC type XHHW-2 stranded.

d. Equipment grounding conductors shall be installed in all raceways. Equipment grounding conductors shall be the same NEC type as the phase conductor, green and sized per NEC Table 250.122. Ground grid conductors shall be tinned copper and uninsulated unless shown otherwise on the Drawings.

e. Types XHHW-2 and RHW-2 wire shall be as manufactured by the Southwire Co., Pirelli Cable Corp., Okonite Co., or equal.

f. Multi-conductor control cable shall be stranded, #14 AWG, 600 V, cross-linked polyethylene insulated w/PVC jacket. Type "XLP" as manufactured by the Southwire Co., American Insulated Wire Corp., or equal.

g. All bare wire for grounding systems shall be tinned copper.

C. Instrumentation Wire

1. Process instrumentation wire shall be twisted pair, 600 V, cross linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed type "XLP" as manufactured by the Rockbestos Co., or equal.

2. Cable for 4-20 mA instrumentation, potentiometer, RTD and similar analog circuits shall be multi-conductor twisted and shielded.

a. Single pair cable:

1) Conductors: 2 No. 16 AWG stranded and twisted

2) Insulation: XLP

3) Shield: 100 percent tape with drain wire

4) Jacket: PVC with UL and manufacturers identification

b. Three conductor (triad) cable:

1) Conductors: 3 No. 16 AWG stranded and twisted

2) Insulation: XLP

3) Shield: 100 percent tape with drain wire

4) Jacket: PVC with UL and manufacturers identification

c. Multiple pair cables (where shown on the Drawings):

1) Conductor: Multiple 2 No. 16 AWG stranded and twisted

2) Insulation: XLP

3) Shield: Individual pairs and overall shielded with 100 percent tape and drain wire

4) Jacket: PVC with UL manufacturers identification

D. Communication Wire

1. Ethernet cable shall be designed for use with a high-speed (100 Mbps/Gbps) Ethernet communications network. The twisted pair cable shall have nominal impedance of 100 ohms at 1 Mhz and a maximum attenuation of 10 dB per 1000 feet at 1 Mhz. The twisted pair cable shall be non-plenum rated and shall have a minimum of four 24 AWG solid copper conductor pairs with an overall foil shield. Cable shall be Category 5e, *Ethernet/IP* compliant with a voltage insulation rating of 600V. Cable shall be able to be terminated using RJ-45 terminations. Cable shall be Belden 7958A or equal.

2. Profibus PA cable shall be 300 V, 1 pair 18 AWG, stranded tinned copper, 100% foil shield, color blue and orange, 100 ohms at 31.25 kHz, PVC jacket, Belden Type 3076F or equal.

3. Profibus DP cable shall be 300 V, 1 pair 22 AWG, stranded tinned copper, 100% foil shield, color red and green, 150 ohms, PVC jacket, Belden Type 3079E or equal.

4. DeviceNet cable shall be Class 1 (600V), 2 pair, 16 AWG, stranded tinned copper, 100% individually foil shielded, ODVA (Open DeviceNet Vendor Association) Cable V, Belden Type 7896A or equal.

E. Terminations and Splices (Power Conductors)

1. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials for all 600 volt splices shall be made with long barrel tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

2. 600 volt wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co., or equal.

F. Termination and Splices (Control Conductors)

1. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials and installation shall be as required by the Engineer. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

2. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

G. Terminations (Instrumentation Cables)

1. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by 3M Co.; Panduit Corp. or equal.

H. Motor Connections

1. For wire sizes #8 AWG and larger, long barrel tin plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

I. Wire and Cable Markers

1. Wire and cable markers shall be type written, heat shrinkable type as manufactured by the W.H. Brady Co., Thomas & Betts Co., 3M Co., or equal.

2. Wire and cables with diameters exceeding the capacity of the heat shrinkable markers shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co., Panduit Corp., or equal.

J. Wall and Floor Slab Opening Seals

1. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp. or equal.

PART 3 EXECUTION

A. Installation

1. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with wire and cable markers.

2. Use lubrications to facilitate wire pulling. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. The material shall be UL listed and compatible with the cable insulation and jacket.

3. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the Engineer as the manufacturer of the particular item or wire and cable.

4. Seal openings in slabs and walls through which wires and cables pass.

5. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.

6. Pull cable from direction that requires the least tension.

7. Feed cable into raceway with zero tension and without cable crossover at raceway entrance.

8. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer's recommended minimum bending radius.

9. Use a dynamometer and constant velocity power pulling. Velocity should not be less than 15-ft./min or more than 50-ft/min. Do not exceed the cable manufacturer's maximum recommended tension.

10. If cable cannot be terminated immediately after installation, install heat shrinkable end caps.

11. Fireproof exposed cables in manholes, vaults, pullboxes, switchgear and other areas not protected by conduit where medium voltage cables of different circuits are present. Use fire-proofing tape and glass tape in accordance with the manufacturer's instructions. Fire-proofing tape shall be with one half-lapped layer of Scotch Brand 77 Electric Arc and Fireproofing Tape by 3M Corp. or equal. Tape shall be secured with a two-layer band of Scotch Brand 69 Glass Electrical Tape by 3M Corp. or equal over the last wrap.

12. Uniquely identify all cable at supply and receiving ends and in all manholes, handholes or pullboxes. Use embossed brass tags and tywrap fasteners.

13. Hydraulically or manually operated cable benders shall not be used unless approved in writing by the Engineer.

14. Instrumentation cables shall be installed in conduits as specified. pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

15. Install shielded instrumentation wire from terminal to terminal with no splicing at any intermediate point. Shielded instrumentation wire, coaxial, data highway, I/O and

fiberoptic cables shall be run without splices between instruments, terminal boxes, or panels.

16. Terminal blocks shall be provided at all instrument cable junctions, and all circuits shall be identified at such junctions.

17. Ground shielding on instrumentation wire at one end only as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for interconnecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own terminal block.

18. Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from all other (i.e. power, control, etc.) cables in manholes.

19. All shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. The tubing shall extend 1" minimum over the jacket end and extend ½" minimum from the jacket end over the exposed conductors.

B. Wire Color Code

1. All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

2. The following coding shall be used:

System	Wire	Color
240/120 Volts Single-Phase, 3 Wire	Neutral	White
	Line 1	Black
	Line 2	Red
208Y/120, Volts 3 Phase, 4 Wire	Neutral	White
	Phase A	Black
	Phase B	Red
	Phase C	Blue
240/120 Volts 3 Phase, 4 Wire delta, center tap ground on phase coil A-C	Neutral	White
	Phase A	Black
	Phase B (High)	Orange
	Phase C	Blue
480Y/277 Volts 3 Phase, 4 Wire	Neutral	Gray
	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
Control (Individual Conductors)	AC	Red
	DC	Blue

C. Field Testing

1. Test all 600 volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 volts DC. Testing to be limited to circuits rated at 60 Amperes or more. Submit a written test report of the results to the Engineer. Notify Engineer in writing 48 hours prior to testing.

2. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.

3. All service conductors shall be tested as in paragraph 1 above with the Owner’s representative present.

END OF SECTION

SECTION 16191 MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

A. Scope Of Work

1. Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.

2. This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

B. Related Work

1. Surge protective devices are included in Section 16192.

C. Submittals

1. Submit to the Engineer, in accordance with Section 01300, detailed catalog information or drawings with sufficient detail to determine compliance with the specifications including describing electrical and physical characteristics of all equipment specified.

D. Reference Standards

1. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

PART 2 PRODUCTS

A. Materials

1. Disconnect Switches

a. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. Enclosure type shall be as noted on the drawings. All current carrying parts shall be copper.

b. NEMA 4X enclosures shall be stainless steel.

c. NEMA 7 enclosures shall be cast aluminum.

d. Lugs shall be copper.

a. All exterior hardware shall be stainless steel.

f. Switches shall be as manufactured by Eaton / Cutler Hammer, Schneider Electric / Square D Company, or Siemens.

2. Fused Disconnect Switches

a. Fused disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

b. Fuses shall be rejection type, 600 Volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron®, Class RK-5 or equal.

c. NEMA 4X enclosures shall be stainless steel. d.

NEMA 7 enclosures shall be cast aluminum.

e. Lugs shall be copper.

f. All exterior hardware shall be stainless steel.

g. Switches shall be as manufactured by Eaton / Cutler Hammer, Schneider Electric / Square D Company, or Siemens.

3. Manual Motor Starters

a. Manual starters shall be furnished and installed for alltyped of single-phase motors. Manual starters shall be non-reversing, reversing or two speed type as required. NEMA sizes shall be as required for the actual horsepower of the motor furnished. Manual starters shall have motor overload protection in each phase. Built-in control stations shall be furnished as required or as shown on the Drawings. All manual motor starters shall be provided with provisions to padlock the switch in the OFF position.

b. NEMA 4X enclosures shall be stainless steel. c.

NEMA 7 enclosures shall be cast aluminum.

d. Manual motor starters shall be as manufactured by Eaton / Cutler Hammer, Schneider Electric / Square D Company, or Siemens.

4. Control Stations and Indicators

   a. Control stations shall be heavy-duty type, with full size (30.5mm) NEMA 4X or 7 operators, indicators, etc.

   b. Indicators shall be full voltage and push-to-test type. Indicators located indoors shall be LED type and indicators located outdoors shall be incandescent lamp type.

   c. NEMA 4X enclosures shall be stainless steel. d.

      NEMA 7 enclosures shall be cast aluminum.

   e. Control stations shall be Square D Company Class 9001, or similar by Eaton / Cutler Hammer or Siemens.

5. Retrofit of Existing Motor Control Center Cubicles

   a. A complete new bucket assembly shall be provided for motor control center cubicles that are substantially changed from the existing cubicle. Insubstantial changes shall be defined as a change-out of an MCP or circuit breaker with the same physical frame size, or a change-out of overloads. All other changes shall be considered substantial.

   b. Components and material requirements shall comply with previous paragraphs regarding combination magnetic motor starters and control stations and indicators.

   c. All components used shall not be required to be from the same manufacturer as the original MCC bucket, but shall be UL listed.

6. Wireway

   a. NEMA 1 wireway shall be gasketed painted steel with stainless steel screw covers.

   b. NEMA 4X wireway shall be 316 stainless steel with gasketed clamped covers.

   c. NEMA 1 wireway shall be Square-Duct as manufactured by the Square D Co.; NEMA 4X shall be Bulletin F-22 as manufactured by the Hoffman Engineering Co. or equal.

7. Control Relays

   a. Control relays shall be heavy duty machine tool type, per

manufacture with 10 Amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as shown on the Drawings. General use relays shall be Square D Company, Class 8501 Type X, similar by; Eaton / Cutler-Hammer, or Allen-Bradley Company. Latching relays shall be Square D Company, Class 8501 Type X, similar by; Eaton / Cutler-Hammer, or Allen-Bradley Company

b. Time delay relays shall be pneumatic, 600 Volt, 20 Amp contacts, with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing ranges shall be as shown on the Drawings or as required for proper operation of the actual equipment furnished. Relays shall be Agastat Model 7012 or 7022 or equal.

8. Detectable Polyethylene Warning Tape

a. Warning tape shall be 5 mil red polyethylene film, 6-in minimum width. Tape shall be capable of being detected or located by either conductive or inductive location techniques.

b. Warning tape shall be Mutual Industries Part No. 17774 or equal.

9. Terminal Blocks

a. Terminal blocks shall be 600 Volt, channel mounted, with tubular screw and pressure plate.

b. Terminal blocks shall be Bulletin 1492-CA1 as manufactured by the Allen-Bradley Co. or equal.

10. JIC Boxes for GF Receptacles

a. JIC boxes shall be 6-inches x 6-inches x 4-inches aluminum continuous hinge clamp cover boxes, Hoffman Catalog Number A-606 CHAL with Type L23 stainless steel fast operating JIC clamp, or equal.

b. Install 1-1/2-inch bushings in bottom of box for cord and plug to pass through.

11. Corrosion Inhibitors

a. All equipment enclosures, terminal boxes, etc, located in a NEMA 4X rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally er’s standard for the kVA size mounted, chemically treated

corrosion inhibitor pad.

b. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M or equal.

12. Equipment Mounting Stands

a. Mounting stands shall be custom fabricated from 1/4-in 316 stainless steel plate and 3-in 316 stainless steel channel, unless otherwise shown on the Drawings.

b. All hardware shall be 316 stainless steel.

13. Terminal Cabinets:

a. Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished with a minimum of 50 spare terminals.

b. All interiors shall be completely factory assembled with control relays, terminal blocks, insulating barriers, etc. All 120 volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.

c. All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.

d. All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted shielded pair and the shield for each connected thereto, unless otherwise noted on manufacturer's shop drawings.

e. Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 volts. Terminal blocks shall be Allen Bradley Catalog Number 1492-CA1 or equal.

f. Boxes shall be made from 14 gauge galvanized steel and shall be of sufficient size to provide a minimum of 4 inches of wiring space on all sides and between adjacent terminal blocks. A minimum 2-inch spare shall be provided between control relays. A minimum of four mounting studs shall be provided on each cabinet. Cabinets shall be furnished without knockouts. Holes for raceways shall be drilled on the job.

g. A single or double hinged door shall cover the front of

each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three point catch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (typewritten) as to function.

h. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with ANSI 61 grey over a rust-inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.

i. Cabinets in wet, damp, corrosive and all outdoor locations shall be NEMA 4X 316 stainless steel.

j. Cabinets shall be Hoffman Engineering Company with latch kit hardware or be an equal product.

14. Emergency Shower Alarm Horn and Light

a. Emergency shower alarm horn shall be vibrating type for 120 Volts, 60 Hz and shall be Federal Signal Corp.; Catalog No. 350+WB for surface mounting, Catalog No. 350+FG+FB for flush mounting, similar by Benjamin Co.; Edwards Co. or equal. Provide with flow switch for remote monitoring through SCADA.

b. Emergency shower alarm light shall be a flashing strobe unit with red fresnel globe, for use on a 120 Volts, 60 Hz power supply, and shall be Benjamin Catalog No. KL-4011-120, similar by Federal Signal; Edwards Co. or equal.

15. Intrinsically Safe Relays

a. Intrinsically safe relays shall be solid state type with 5 Amp output contacts, suitable for use on a 120 Volt, 60 Hz power supply and shall be FM approved for pilot devices in Class I, Division 1, Group D hazardous atmospheres.

b. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

16. Break-Glass Emergency Station

a. Break-Glass Emergency Station shall be of the break glass design with a weatherproof cast metal outer case

finished in fire red and have an attached chain hung"Hammer". A glass panel shall be mounted in front of the push button operator. Switch contacts shall be 1-open, 1-closed, rated 10 Amp, 600 Volts.

17. Lighting Contactor

    a. Lighting contactor shall be of the electrically operated, mechanically held type mounted in NEMA 1, enclosures (except where noted otherwise on the Drawings) with number of poles as noted on the Drawings. Operating coils shall be rated for 120 Volts unless otherwise indicated on the Drawings and shall be for momentary operation. Provide with "Hand Off- Auto" switch on cover where shown on the Drawings.

    b. Contactors shall be rated for 20 Amps, 600 VAC and shall be Automatic Switch Co., Bulletin 917 RC, similar by Square D Co.; Cutler Hammer or Siemens.

18. Digital Lighting Control Time Switches

    a. Time switches for lighting control shall have astronomic ON/Timed OFF and Timed ON/astronomic OFF; pulse switching for mechanically held contactors or low voltage latching relay; LCD digital display for basic setting; manual ON/OFF override and 72 hour rechargeable 9 Volt Nickel Cadmium battery back-up and NEMA III indoor/ outdoor enclosure. Time switches shall be Tork, Catalog No. DZS 200/120 Volt or equal.

19. Beacon Alarm Light

    a. Beacon alarm light for building exterior mounting shall be flush mounted, weatherproof construction and have a 750,000 candlepower xenon strobe tube and red polycarbonate lens. Beacon alarm light shall be Federal Signal, Model 371 DST or equal.

20. Alarm Horn and Light

    a. Alarm horn shall be vibrating type for 120 volts, 60 Hertz and shall be Federal Signal Corp. Cat. No. 350 + WB for surface mounting, Federal Signal Corp. Cat. No. 350+FG+FB for flush mounting, equal by Benjamin Co. or Edwards Co. or equal.

    b. Alarm light shall be a NEMA 4X flashing strobe unit with red glass globe, for use on a 120 volts, 60 Hertz power supply, and shall be Federal Signal Co. Model

191X, or equal.

21. Photocells
    a. The photocells shall be suitable for power duty with individual fixtures or for pilot duty with contactors as detailed on the Drawings. Enclosure shall be NEMA 3R or 4. Contacts shall be rated for 2,000 watts continuous at 120 Volts. The unit shall turn on at 1.5 footcandles and off at 5.5 footcandles.

    b. Photocells shall be Tork, Model 2101 or equal.

22. Power Monitors

    a. Microprocessor based metering: At each circuit locati shown on the Drawings, furnish a digital microprocessor based metering device capable of monitoring and displaying the functions listed below. The device shall provide the status input functions indicated and the capability to communicate data to a centralized monitoring system via Ethernet Cat 6 cable using Profinet. The device shall be UL listed. The device shall be Power Logic type as manufactured by the Siemens or equal.

    b. Metering Functions

        1) The Digital AC Instrumentation Package shall be capable of measuring, calculating and directly displaying on the front panel display the following information:

            a) Volts on each phase plus average of all three phases

            b) Current on each phase plus average of all three phases

            c) Neutral or ground current

            d) Frequency

            e) Power Factor

            f) KVA

            g) KVAR

            h) KW

i) Total KWH as an accumulating total, providing bi-directional (import/export) indication

j) Total KVARH as an accumulating total, providing bi-directional (import/ export) indication

k) Amps Demand.

c. Monitoring and Control Functions

1) Provide eight self-powered digital status inputs to monitor the following points:

a) Circuit breaker OPEN status

b) Circuit breaker CLOSED status

c) Circuit breaker TRIPPED status

d) Circuit breaker OUT OF SERVICE

2) Provide one auxiliary analog input rated 1.0 VAC/VDC nominal full scale input which can be used to measure an external variable such as transformer temperature, air temperature, or battery voltage.

3) Provide one auxiliary analog output (selectable 0-20ma or 4-20ma) proportional to any measure parameter.

4) Provide three Form C dry contact control relay outputs rated 277 VAC or 30 VDC at 10 Amp maximum load current, that can each function as:

a) Setpoint relays that operate as a function of any measured parameter for demand, power factor, or load control. Seventeen programmable setpoints shall each have programmable operate and release limits and time delays on operate and release. Relays shall provide selectable pulse mode or tach mode operation.

b) Remote control relays operated by commands via the communications port.

c) Breaker trip relay (over/under volt, volt unbalance, phase reversal, current unbalance, over/under frequency).

d) KWH or KVARH pulse output relay.

e) Alarm relays.

d. Operational Features

1) Provide the following operating features:

2) True RMS measurements.

3) Connect directly to PT's and CT's for systems over 600 volts.

4) Provision for a fourth current input for measurement of ground or neutral current.

5) 300 amp, one second surge protection on all four current inputs.

6) 3-field, 20 character, high visibility 0.4-in character height vacuum-fluorescent display with a programmable time out feature.

e. Store in non-volatile memory the following:

1) A time-stamped alarm and event log of up to 50 events which records event date, time (to 1 second), event type and value for all over/under limit conditions, all status input activity and all relay operations. Log shall be read via the communications port.

2) A time-stamped minimum/maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log shall be read from the front panel display or via communication port.

3) A time-stamped snapshot (historical) log, with a 100 snapshot capacity and user-definable snapshot interval from 1 second to 400 days which records snapshot values for Average Volts, Average Amps, KW, KVAR, KW Demand, Power Factor, Frequency, KWH, KWH Reverse, KVARH and Auxiliary Volts Input. Log shall be read via the communications port.

4) All setup data.

f. The device shall be field programmable as follows:

1) Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate and the relay operation shall be programmable from the front panel.

2) All parameters above, plus additional alarm/event parameters shall be programmable via the communications port using a portable terminal or a computer.

a) The programming shall be password protected.

g. Waveform Capture

1) Provide waveform capture capability allowing any of the eight voltage and current input channels to be digitally sampled at 256 samples/60 Hz cycle. Waveform capture shall be initiated using commands made via the communications port. Waveform capture data shall be mad accessible via the communications port.

h. Data Communications

1) Provide a serial communication port which has:

a) Switchable RS-232C and RS-485 capability. b)

Addressable polling of multiple units.

c) Packet transmission.

d) Selectable transmission at 300 to 19,200 baud.

2) Provide all communication cables to interconnect monitors within the electrical equipment.

3) All necessary cables, connectors, software, hardware, etc. shall be provided as required to interface with a computer system and/or related PLCs as specified herein or in other Sections and Divisions of the specifications.

23. Enclosed Circuit Breakers

a. Service: 480 volt, 3-phase, 3-wire, 60 Hertz, ampacity as noted on the Drawings.

b. The overall short circuit withstand rating of the equipment and devices shall be 65,000 Amperes R.M.S. symmetrical at 480 volts. Bus shall be tin plated copper.

c. Circuit Breakers

1) Power circuit breakers (400 Amps and larger): 100 percent equipment rated, 600 volt, molded case circuit breakers with integral fully adjustable solid state trip device. Trip device shall be temperature insensitive and have the following characteristics and functions:

a) Independently adjustable long time pick-up and delay.

b) Independently adjustable short time pick-up and delay.

c) Adjustable instantaneous.

d) Independently adjustable ground fault pick-up and delay.

e) Trip mode targets for over load, short circuit, and ground fault.

2) Circuit breakers (Less than 400): Thermal-magnetic trip type, 600 Volt, 2 or 3 Pole as required, labeled in accordance with UL 489. Provide independently adjustable magnetic trips on 225A frame breakers and larger.

d. Circuit Breakers shall be housed in an enclosures that matches area equipment to be installed. (Indoor Dry, Outdoors, Process areas, etc.)

e. Each breaker shall be identified with nameplate identification per the Drawings. Signage shall also be provided which reads as follows "DANGER 480 VOLTS - KEEP OUT".

f. Manufacturer shall provide ground fault CT's, metering, lightning arresters, etc. as shown on the drawings.

g. Surge protection shall be as shown on the drawings in accordance with Section 16192.

h. Circuit breakers, enclosures, etc., shall be as manufactured by Cutler-Hammer, Square D or Siemens.

3) Spare Parts

a. The following number of spare parts shall be furnished for each control panel.

1) 1 Indicator light assembly

2) 2 control relays for each type furnished

3) 5 fuses for each type/size furnished

4) 1 set thermal overloads for each size furnished

5) 1 selector switch for each type furnished

6) 1 starter coil for each size furnished

PART 3 EXECUTION

A. Installation

1. Mounting Stands

a. Field mounted disconnects, pushbutton control stations, etc, shall be mounted on 316 stainless steel stands as specified herein or as shown on the Drawings. Where clearance requirements for stands may not be maintained, the Engineer may direct equipment to be wall-mounted adjacent to the motor or device, but in no case shall the distance from the motor or device to the control station exceed 3-ft.

B. Cleaning

1. Clean the interior and exterior of electrical equipment in accordance with Section 16000.

END OF SECTION

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SECTION 16192 SURGE PROTECTIVE DEVICES

PART 1 GENERAL

A. Scope Of Work

1. Furnish and install all surge protective devices (SPDs), formerly referred to as transient voltage surge suppressors (TVSSs), for power systems as shown on the Drawings and as specified herein.

B. Related Work

1. Refer to Division 13 for SPDs for instruments, telecommunication systems, antenna systems, or computer systems.

C. Submittals

1. Submit to the Engineer, in accordance with Section 01300, the following:

a. Detailed catalog information with sufficient detail to determine compliance with the specifications including the electrical and physical characteristics.

b. Minimum electrical ratings shall include operating voltage, voltage protection rating (VPR), frequency and phasing.

c. Minimum performance ratings for type 1 and type 2 SPDs shall include nominal discharge current (In) rating, maximum continuous operating voltage (MCOV), and short circuit current rating (SCCR).

d. UL 1449, Third Edition (minimum) listing compliance certification.

2. Warranty statement. D.

Reference Standards

1. The materials and installation shall comply with the codes and standards of the following organizations:

a. American National Standards Institute (ANSI)

b. Institute of Electrical and Electronic Engineers (IEEE)

b. National Electrical Manufacturers Association (NEMA)

d. National Fire Protection Association (NFPA)

e. Underwriters Laboratories (UL)

2. Specific codes and standards that apply include the following:

a. ANSI/IEEE C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

b. ANSI/IEEE C62.45 – Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

c. NEMA LS-1 – (Rescinded August 19, 2009, replacement undetermined)

d. NFPA 70 – National Electrical Code, Article 285

e. NFPA 780 – Standard for the Installation of Lightning Protection Systems

f. UL 1283 – Electromagnetic Interference Filters

g. UL 1449 – Surge Protective Devices

3. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

E. Warranty

1. All SPD panel units shall be guaranteed by the installing contractor and surge suppression manufacturer to be free of defects in materials and workmanship for a period of not less than 10 years from the date of substantial completion of the system to which the suppressor is installed.

PART 2 PRODUCTS

A. Manufacturers

1. The following manufacturers are acceptable. No substitution will be allowed:

a. Josyln (Total Protection Solutions)

c. Surge Suppression Inc.

d. Current Technologies

B. Products

1. The SPD supplied shall be selected to match the voltage, phasing, and frequency of the power system.

2. The SCCR rating of the SPD shall have at least the same rating of the electrical equipment being protected.

3. The SPD enclosure shall be rated NEMA 12 for indoor dry locations and NEMA 4X for outdoor, wet, damp, chemical, or corrosive areas.

4. The SPD shall protect against surges produced by a 1.2 /50 µs and 8 / 20 µs combination waveform generator.

5. SPDs shall include noise filtration with a 10 kHz to 100 MHz range.

6. The SPD shall be of a parallel design using fast-acting energy protection that will divert and dissipate the surge energy for 480-volt distribution panels, switchgear, switchboards, substations and motor control centers.

7. The SPD shall provide LED indicator lights to provide continuous positive operational status of each protected phase. Indicator lights shall be visible without the need to open any compartments.

8. The SPD shall have a minimum of 10 mode operation for all three phase wye and high leg delta configurations, and six modes of protection for all three phases of delta (no neutral) configurations.

9. The voltage protection ratings (VPRs) shall not exceed the following:

System Voltage	Line-Neutral	Line-Ground	N-Ground	Line-Line
120 (2W+G)	600	600	600	n/a
240 (2W+G)	1000	1000	1000	n/a
120/240 (3W+G)	600	600	600	1200
120/208Y (4W+G)	600	600	600	1200
277/480Y (4W+G)	1200	1200	1200	1200
240△ (3W+G)	1000	1000	1000	1000

10. SPD shall have a one nanosecond of less response time for any individual component, and shall be self restoring and fully automatic.

12. Minimum surge current ratings per mode shall be as follows:

    a. Branch panels and control panels (480V): 80 kA

    b. Branch panels (120/208/240V, single or three phase):40 kA

13. The fusing system shall be capable of allowing the rated maximum single impulse surge current to pass through without fuse operation.

PART 3 EXECUTION

A. Installation

1. Install surge protective devices as shown on the Drawings and in accordance with manufacturer’s instructions.

2. SPDs shall be installed with leads as short as possible (not to exceed 24-inches) and routed to avoid sharp bends or kinks.

3. SPDs may be mounted internally in motor control centers, switchgear or switchboards provided they are in an individual compartment.

4. SPDs may be mounted internally in variable frequency drives.

5. SPDs shall be mounted externally at panelboards and control panels.

END OF SECTION

SECTION 16500 LIGHTING SYSTEM

PART 1 GENERAL

A. Scope of Work

1. Furnish and install complete lighting systems including lighting fixtures, receptacles, switches, contactors, and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

B. Related Work

1. All concrete and reinforcing steel required for exterior lighting pole bases shall be as specified under Division 3, but the responsibility of furnishing and installing the material shall be that of Division 16.

2. Conduit is included in Section 16110.

3. Wire is included in Section 16120.

C. Submittals

1. Submit, in accordance with Section 01300. Submittals shall include those set forth in Section 16000, Paragraph 1.03.

2. Wiring Devices

3. Lighting Fixtures

4. Spare parts list for this project. D.

Reference Standards

1. All lighting fixtures shall be in accordance with the National Electrical Code (NEC) and shall be constructed in accordance with the latest edition of the Underwriters Laboratories (UL) "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be UL labeled.

E. Spare Parts

1. Provide the following spare parts:

a. Five (5) spare single pole switches

b. One (1) spare three-way switch

c. Five (5) weatherproof covers for light switches

d. Ten (10) spare lamps for each type of lamp

PART 2 PRODUCTS

A. Materials

1. Lighting Fixtures

a. Lighting fixture types shall be furnished as required by the "Lighting Fixture Schedule" on the Drawings. The catalog numbers are given as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be acceptable upon approval by the Engineer.

2. Flexible Fixture Hangers

a. Flexible fixture hangers used in non-hazardous areas shall be type ARB and flexible fixture supports used in hazardous areas shall be Type ECHF as manufactured by the Crouse-Hinds Co., similar by Appleton Electric Co.; Killark Electrical Mfg. Co. or equal.

b. Where required in Section 16000 all pendent mounted and recessed in suspended ceilings, recessed lighting fixtures shall be provided with four anti-sway supports to meet Type II seismic requirements.

3. Photo Electric Controls

a. Photo electric control with time delay for outdoor lighting shall be completely self-contained and not affected by moisture, vibration or temperature changes.

b. ON/OFF adjustments are to be made by movement of a light level selector without the use of tools in a range from 2 to 50 foot candles.

c. Photo electric control device shall be SPST, and have 2000 watt tungsten capacity and be Tork Catalog Number 2101 (120V); 2104 (208-277V) or equal by Intermatic Inc., Carlon, or other approved equal.

4. Device Color

a. In administrative office areas, conference rooms, breakrooms, restrooms, and control rooms, switches, receptacles and other devices shall be white.

b. In all other areas (electrical, mechanical, process,

etc.), switches, receptacles and other devices shall be gray.

c. In existing rooms, devices shall match color of existing devices.

5. Switches

a. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification WS896-E.

b. Wall switches shall be the manufacturer's "industrial specification grade". Wall switches shall be the following types and manufacturer or approved equal.
1) Single pole - Arrow-Hart, Catalog Number 1991, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.

6. Receptacles
a. Receptacles shall be the manufacturer's "industrial specification grade". Receptacles shall be of the following types and manufacturer or approved equal. Receptacles shall conform to Federal Specification WC596-F.

1) Duplex, 20A, 125V, 2P, 3W; Arrow-Hart, Catalog Number 5362, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.
2) Weatherproof or corrosion resistant single, 20A, 125V, 2P, 3W; by Harvey Hubbell, Inc., Pass & Seymour, Inc., with TayMac Corp., #30310G cover, or approved equal.

3) Weatherproof or corrosion resistant duplex, 20A, 125V, 2P, 3W; by Harvey Hubbell, Inc., Pass & Seymour, Inc., with TayMac Corp., #10310G cover, or approved equal.

4) Ground fault interrupter, duplex, 20A, 125V, 2P, 3W; Arrow-Hart Catalog Number GF 5342, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.

5) Duplex, 20A, 125V, 2P, 3W with transient voltage surge suppressor and indicator light; Pass & Seymour Catalog 6362-5P, approved equal by Harvey Hubbell Inc., Bryant Electric Co., or approved equal.

6) Stainless steel indoor mounting plate for G.F.I.

receptacle; Arrow-Hart Catalog Number 97061, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc. or approved equal.

7) Weatherproof cover for G.F.I. receptacle shall be TayMac Corp., #20310G, or approved equal.

8) Explosion-proof, 20A, 125V, 2P, 3W; Appleton Electric Co. Catalog Number EFS175-2023 or EFSC175-2023 or approved equal by Crouse-Hinds Co., Killark Electric Manufacturing Co., or approved equal. Furnish one Appleton Electric Co. Catalog Number ECP-1523 cap or approved equal by Crouse-Hinds Co., Killark Electric Manufacturing Co., or approved equal for every two receptacles (minimum of one).

9) Single, 20A, 250V, 2P, 3W; Arrow-Hart Catalog Number 5861, or approved equal by Harvey Hubbell, Inc., Pass & Seymour, Inc., or approved equal.

10) Single, 30A, 125V, 2P, 3W; Arrow-Hart Catalog Number 5716; cap: Arrow-Hart Catalog Number 5717 or approved equal.

11) Single, 30A, 250V, (3 phase) 3P, 4W; Arrow Hart Catalog Number 8430N; Cap: Arrow-Hart Catalog Number 8432AN or approved equal.

7. Device Plates

a. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be:

1) Smooth high strength thermoplastic or nylon of the same manufacturer as the device for all administrative office type areas. Color to match device.

2) Type 302 (18-8) high nickel stainless steel of the same manufacturer as the device.

b. Plates for surface mounted device boxes shall be of the same material as the box.

PART 3 EXECUTION A.

Installation

1. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the

proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

2. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

3. Fixtures noted to be installed flush in suspended ceilings shall be of mounting types suited for the type ceiling involved. It shall be the responsibility of the electrical contractor to verify the ceiling types prior to ordering fixtures.

4. Flexible fixture hangers shall be used for all pendant mounted fixtures. Fixtures 2-ft long and larger shall be supported with a minimum of two fixture hangers.

5. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.

6. Exterior lighting poles shall be mounted plumb.

7. Fixture locations are shown on the Drawings in approximate locations; however exact locations shall be coordinated so as to avoid conflicts with HVAC ducts, equipment and other obstacles.

8. Switch and receptacle outlets shall be installed flush with the finished floor or wall when raceways are shown as "concealed" on the Drawings.

9. Device Mounting Height

   a. Light switches shall be mounted 48″ AFF (above finished floor) to center of box, located on the strike side of the door.

   b. Wall mounted receptacles shall be vertically mounted, AFF to the center of the box as follows, unless otherwise noted on the Drawings.

      1) Process areas and shops – 36″

      2) Administration office areas – 18″

      3) Corridors and hallways – 18″

      4) Electrical and mechanical rooms – 18″

5) Restrooms – 18″

6) Exterior walls – 18″

c. Where the wall and partitions are of unplastered brick or masonry, the height of wall outlets as given above shall be adjusted so that one horizontal edge of the box lines up with a horizontal joint in the masonry.

10. Identification labels of light switches and receptacles shall be per Section 16000.

B. Replacement

1. Lamps (except for H.I.D.) used during the building construction, prior to 2 weeks from completion of the work, shall be removed and replaced with new lamps.

C. Cleaning Up

1. Plastic dust cover bags to be provided with new parabolic reflector lighting fixtures shall be removed after all construction activity that may cause dust formation on reflector surfaces has been completed.

2. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

END OF SECTION

SECTION 16502 LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

A. Scope of Work

1. Provide a lightning protection system (LPS) for light poles and bond all lightning protection system components together.

2. The system shall be UL Master Labeled and shall be designed and installed in compliance with provisions of UL 96A and NFPA 780.

3. The Contractor shall employ the services of a licensed lightning protective systems engineering company to design and install the lightning protection system and prepare detailed installation drawings and material specifications. These drawings and specifications shall be submitted for review in accordance with Section 01300.

4. The lightning protection system shall be checked by a UL field inspector upon completion of the installation. The Contractor shall assume full responsibility for the correctness of the installation and shall make any and all corrections and additions deemed necessary by the UL inspector. The Contractor shall pay for all costs of the UL inspection and any subsequent reinspections as required.

5. The lightning protection system for the buildings shall consist of conductors, air terminals and accessories which shall be grounded to the building structural steel or ground grid at regular intervals. The contractor may submit alternate methods of lightning protection with his proposal, provided the alternate provides equal or greater lightning protection than specified.

6. The lightning protection system contractor shall coordinate his work with the electrical contractor.

7. Each bidder or his authorized representatives shall, before preparing his proposal, visit all area of the existing buildings and structures in which work under this section is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the buildings and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.

B. Related Work

1. Refer to Section 16660 for Grounding Systems.

C. Submittals

1. Contractor shall submit to the Engineer/Owner for review the facility lightning protection system. The submittal data shall contain the following minimum information.

   a. Plan view of site showing buildings and structures, locations of air terminals, and associated zone of protection for each air terminal; show all equipment on roofs which require protection.

   b. Schematic diagram of lightning protection system showing air terminals, conductors, and other connectors or fittings required for the complete system. Provide details showing bonding requirements to structural steel, water piping, etc.

   c. Locations of connection points of lightning protection system to facility grounding system.

   d. Bill-of-materials

   a. Final test results and certifications

D. Reference Standards

1. Underwriters Laboratories (UL)

   a. UL 96 – Standard for Lightning Protection Components

   b. UL 96A – Standard for Installation Requirements for Lightning Protection Systems

2. National Fire Protection Association (NFPA)

   a. NFPA 780 – Standard for the Installation of Lightning Protection Systems

3. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODCUTS

A. Materials

1. All materials shall be new and shall comply in weight, size, and composition with the requirements of UL and NFPA.

2. Grounding materials and methods shall be equal to those specified under Section 16660.

3. The following is a brief description of the various items of material.

   a. Air Terminals

      1) Buildings 75 feet and less in height shall use Class I air terminals. Aluminum air terminals shall be solid aluminum, ½″ minimum diameter. Copper air terminals shall be nickel plated solid copper, 3/8″ minimum diameter. Length 18″.

      2) Buildings over 75 feet tall shall use Class II air terminals. Aluminum air terminals shall be solid aluminum, 5/8″ minimum diameter. Copper air terminals shall be nickel plated solid copper, ½″ minimum diameter. Length 18″.

      3) Air terminal type shall be copper unless the following applies. Copper lightning protection materials shall not be installed on aluminum roofing, siding or other aluminum surfaces.

      4) Air terminal base supports shall be specifically designed for the surface where used. All air terminal bases shall be cast bronze with stainless steel bolt pressure cable connectors. Air terminal bases for flat roof areas shall be of the adhesive type.

   b. Conductors

      1) Buildings 75 feet and less in height shall use Class I conductors. Main conductors shall be either aluminum 14 AWG, 28 strand (weighing 105 lbs. per 1,000 feet) or tinned copper 17 AWG, 32 strand (weighing 220 lbs. per 1,000 feet).

      2) Buildings over 75 feet tall shall use Class II

conductors. Main conductors shall be either aluminum 13 AWG, 37 strand (weighing 200 lbs. per 1,000 feet) or tinned copper 14 AWG, 28 strand (weighing 380 lbs. per 1,000 feet).

3) Conductor type shall be copper unless the following applies. Copper lightning protection materials shall not be installed on aluminum roofing, siding or other aluminum surfaces. Aluminum lightning protection materials shall not be embedded in concrete, masonry, or on or below copper surfaces.

c. Fasteners

1) Conductor fasteners shall be an approved type of non-corrosive metal and have ample strength to support conductors.

d. Cable Connectors

1) All cable connectors shall be per NFPA standards, cast bronze with screw pressure type stainless steel bolts and nuts. For buried and non- accessible connections, exothermic weld process shall be used.

PART 3 EXECUTION

A. Installation

1. All materials shall be installed by a UL listed lightning protection contractor. The lightning protection system shall be installed per approved shop drawings and UL and NFPA recommended practices.

2. The lightning protection system engineering company shall provide jobsite assistance and supervision of the installation as required, and shall be present during the UL inspection.

3. Lightning Protection System shall be installed in a neat and inconspicuous manner.

4. All mounting and penetration of roof surface shall be coordinated with roofing contractor to assure maximum roofing guarantee. All through-roof penetration flashings shall be furnished, sealed and guaranteed by a licensed roofing contractor.

5. Excavate and backfill as required. Finish grade and restore to original condition.

6. All metal bodies within 6 feet of the conductor shall be bonded to the system with approved fittings and conductors. Connections between dissimilar metals shall be made with approved bimetallic connections.

7. As the work progresses, legibly record all field changes on a set of project contract drawings. When the project is complete, furnish a complete set of reproducible "As-built" drawings for the Project Record Documents per Section 01720.

8. Air Terminals:

   a. Air terminals shall be spaced so as not to exceed 20 feet apart around the outside perimeter of the roof or ridge and not over 50 feet apart through the center of flat roof areas.

   b. Air terminals shall not project more than 24 inches nor less than 10 inches above the protected object.

9. Conductor Routing:

   a. All main conductors shall maintain a downward or horizontal course, free from "U" or "V" pockets.

   b. Conductors shall not form an angle of less than 90 degrees nor less than an 8-inch radius bend.

   c. Metal roofing and siding, eave downspouts or other metal parts subject to displacement will not be permitted as substituted parts of the lightning conductor system.

   d. Fasteners shall be spaced not more than 3 feet horizontally or vertically and shall be the same material as the conductor.

   e. Bimetallic fittings shall be used for all connections between dissimilar metals.

10. Down Conductors:

   a. Down conductors shall follow the most direct patch possible between roof conductors and ground terminals.

   b. All buildings, with a ground perimeter less than 250 feet shall have a minimum of two down conductors installed at the diagonally opposed corners of the building.

c. Any building with a ground perimeter in excess of 250 feet shall have down conductors installed so that the distance between the conductors does not exceed 100 feet.

d. Within the building, the down conductors shall be placed in Schedule 80 PVC conduit in the wall. Care shall be taken not to damage the conductors. Connections through roof shall be made with through- roof connectors.

e. Splices will not be permitted on conductors embedded in concrete.

f. Down conductors shall be installed concealed. When conductors cannot be concealed they shall be substantially guarded to prevent mechanical injury or displacement. The guards shall protect the conductor from grade level to a height of at least 6 feet. All conduit used for physical protection of down conductors shall be Schedule 80 PVC.

11. Roof Conductors:

a. Roof conductors shall interconnect and provide a two- way path from all air terminals.

b. Roof conductors shall bond together all air terminals and shall be installed exposed except that where connections are made to equipment located under roof.

c. Conductors on perimeters of flat roofs shall form closed loops.

d. Dead end air terminals shall not be permitted.

e. All interconnecting cables from air terminals to roof conductors or metal roof decks shall be similar to roof conductor.

12. Pitch Pockets:

a. Contractor shall subcontract all pitch pocket work to a qualified roofing contractor.

13. Grounding System:

a. Ground rods shall be provided at each down conductor and they shall be installed a minimum of 3 feet away from the foundation walls.

b. The ground rods shall be in addition to the ground rods provided for the system grounding grid.

c. Connectors used to connect ground rods to the down conductors shall make contact with the ground rods for a distance of 1-1/2" measured parallel to the ground rod. In addition, ground terminals shall be interconnected with the grounding grid, and all grounding mediums. This shall include electric and telephoneservice grounds and underground metallic piping systems.

d. Bonding of down conductors to the system grounding grid and splicing of conductors in concealed work shall be made by an exothermic weld process.

e. Where conductors are bonded to structural steel or metal roof decks, a bolted-on bonding plate shall be used. All other bonding of the lightning protection system shall be made with pressure clamps.

f. Contractor shall notify design Engineer prior to concealment for Engineer's inspection.

B. Testing

1. General:

a. Notify the Engineer in writing at least two weeks prior to scheduling any testing. Testing shall be witnessed by the Engineer.

b. The Lightning Protection System shall be tested for continuity of all conductors and air terminals.

c. Maximum resistance of system shall not exceed five (5) ohms unless otherwise specified or scheduled. If such resistance cannot be obtained with the system, provide additional grounding as directed by the Engineer, at no additional cost to the Owner.

d. Contractor shall submit written test results to the Engineer.

2. Indicators:

a. Stamped metal tags shall be attached to, or adjacent to, each down conductor indicating in feet the exact vertical depth in the ground of each ground terminal.

1) Down leads connected to water pipes shall also be

indicated.

2) Tags shall be of a corrosion resistant metal and shall be placed at a height of 5 feet above finish grade.

END OF SECTION

SECTION 16600 UNDERGROUND SYSTEM

PART 1 GENERAL

A. Scope Of Work

1. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein. This work includes all underground raceways which are direct buried or concrete encased. All conduits on this project shall be concrete encased or below a building slab.

B. Related Work

1. All concrete and reinforcing steel shall be as specified in Division 3, but the responsibility of furnishing and installing the material shall be that of this Section.

2. All trenching, excavation and backfilling, including gravel and sand bedding and surface restoration shall be as specified in Division 2, but the responsibility of furnishing and installing the material shall be that of this Section.

3. Conduit, fittings, installation, etc. shall be as specified in Section 16110.

4. Polyethene warning tape shall be as specified in Section 16191.

5. Ground rods and other grounding materials and methods shall be as specified in Section 16660.

6. Precast electrical concrete manholes and handholes shall be furnished under Division 16 and shall be in compliance with precast concrete structures as specified in Division 3.

7. Concrete encasement for electrical ductbanks shall be as specified in Section 16900.

C. Submittals

1. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following:

a. Manholes and handholes along with associated buoyancy calculations.

b. Plastic duct spacers

c. Manhole and handhole frames and covers

d. Underground raceway routing in accordance with Section 16000, PART 1, paragraph C,4.

PART 2 PRODUCTS

A. Materials

1. Cable racks, supports, pulling-in irons, manhole steps and hardware shall be hot dipped galvanized steel as manufactured by Line Materials Co. or equal.

2. Precast concrete manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Brooks Products Co. or equal.

3. Manhole frames and covers shall be cast iron heavy duty type for class H-20 wheel loading, and shall be as manufactured by Neenah, or equal. Manhole covers shall be marked “ELECTRIC”.

4. Handhole covers and frames shall be hot dipped galvanized and designed for a Class H-20 wheel load. Handhole covers and hatches shall have 316 stainless steel security bolts. Handhole covers shall be marked “ELECTRIC”.

5. Bell ends and plastic duct spacers shall be as manufactured by Carlon or equal.

PART 3 EXECUTION

A. Installation

1. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3-in per 100-ft.

2. Reinforce raceway banks as shown on the Drawings.

3. Lay raceway lines in trenches on a clean sand backfill bedding (not gravel or rock) not less than 6 inches thick and well graded and compacted.

4. Use plastic spacers located not more than 4-ft apart to hold raceways in place. Spacers shall provide not less than 2-in clearance between raceways.

5. The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Engineer.

6. Make raceway entrances to buildings and vaults with rigid aluminum conduit not less than 10-ft long. Conduits which are not concrete encased for runs below floor slabs in slab-on-grade construction shall be rigid aluminum conduit. Conduits which are concrete encased for runs below floor slabs in slab-on-grade construction shall be encased under the slab to their respective equipment.

7. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

8. For bends in 2 inch and larger raceways, long radius elbows, sweeps and offsets shall be used.

9. All 2 inch and larger raceways shall have a mandrel drawn through followed by a swab to clean out any obstructions which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 1/2 inch less than the inside diameter of the raceway. All 1-1/2 inch and smaller raceways shall be swabbed clean before installing cables.

10. Plug spare raceways and seal them watertight at all buildings and structures.

11. Raceways in use shall be sealed watertight at all buildings and structures.

12. Install pulling-in irons opposite all raceway entrances to manholes.

13. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet-0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation. Branch circuit conductors shall not be run in manholes.

14. All joints shall be made so as to prevent the passage of

concrete inside the conduit to form obstructions or cause cable abrasions.

15. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3 inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1-foot above the floor and center line of the highest conduit entering will be not less than 1 foot below the roof slab.

16. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.

17. A #6 bare copper wire (stranded) shall be installed in each 4-inch PVC conduit containing control cable unless otherwise noted.

18. A 3/4-inch by 20-foot copperclad ground rod shall be driven in the bottom of each manhole. All bond wires, galvanized conduits and metal cable racks shall be bonded to the ground rod.

19. Polyethylene warning tape shall be provided for all underground raceways, duct banks etc. Tape shall be placed along the raceways entire length and shall be installed 18" above the raceways on compacted backfill material.

20. Spare and empty conduits shall have a pull wire (3/16 inch polypropylene) installed.

21. As-built drawings shall be furnished showing each conduit terminations, elevations, locations, manholes, handholes, etc.

END OF SECTION

SECTION 16660 GROUNDING SYSTEM

PART 1 GENERAL

A. Scope Of Work

1. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as shown on the Drawings and as specified herein.

2. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum size shall be No. 12 AWG.

B. Submittals

1. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following:

a. Manufacturer's name and catalog data for ground rods, test stations, materials and exothermic welding methods and materials.

b. Test results

PART 2 PRODUCTS

A. Materials

1. Conduit shall be as specified under Section 16110.

2. Wire shall be as specified under Section 16120.

3. Ground rods shall be 3/4-in diameter by 20-ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm. Ground rods shall be Copperweld or equal.

4. Grounding conduit hubs shall be malleable iron type, manufactured by Thomas & Betts Co.; Catalog No. 3940 (3/4-in conduit size), similar to Burndy; O.Z./Gedney Co. or equal, and of the correct size for the conduit.

5. Waterpipe ground clamps shall be cast bronze saddle type, manufactured by Thomas & Betts Co. Cat. No. 2 (1/2-in, 3/4-in, or 1-in size), similar by Burndy; O.Z./Gedney Co. or equal, and of the correct size for the pipe.

6. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

7. Direct buried bare copper wire shall be tinned.

PART 3 EXECUTION

A. Installation

1. The service entrance equipment ground bus shall be grounded to a ¾-inch cold water pipe and to the ground as indicated on the Drawings. Run grounding electrode conductors in Schedule 80 PVC conduits and seal conduits watertight. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.

2. Install equipment grounding conductors with all feeders and branch circuits.

3. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus, as shown on the Drawings.

4. Ground wire connections to structural steel columns shall be made by exothermic welding.

5. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250.122, except that a minimum No. 12 AWG shall be used.

6. Ground transformer neutrals to the nearest available grounding electrode with a minimum conductor sized in accordance with NEC Article 250 or as shown on the drawings.

7. Drive grounding electrodes (where rock is encountered, grounding plates may be used in lieu of grounding rods) and install ground grids as shown on the Drawings.

8. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NECto be grounded, shall be grounded and bonded in accordance with the NEC.

9. Seal exposed connections between different metals with No-Oxide Paint Grade A or equal.

10. Lay all underground grounding conductors slack and, where exposed to mechanical injury, protect by pipes or other

substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

11. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

12. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 XHHW-2 green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

B. Inspection And Testing

1. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

2. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance to ground of the system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method. Notify the Engineer in writing at least two weeks prior to scheduling any testing. Testing shall be witnessed by the Engineer. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date.

3. All test equipment shall be provided under this Section and approved by the Engineer.

4. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.

5. Testing shall be performed before energizing the distribution system.

6. A separate test shall be conducted for each building or system.

7. Dry season resistance of the system at each testing location shall not exceed five ohms. If such resistance cannot be obtained with the system, provide additional grounding, as directed by the Engineer, at no additional cost

to the Owner.

8. Contractor shall submit written test results to the Engineer.

END OF SECTION

ATTACHMENTS

Attachment A - Orange County Utilities Standards and Construction Specifications Manual
Appendix D: List of Approved Products
February 11, 2011

Attachment B – "Geotechnical Engineering Report, Orange County Eastern Regional Water Reclamation Facility, Phase V Improvements"
Nodarse & Associates – A Terracon Company
August 8, 2012

Attachment C – Orange County SCADA H-21 Appendix

Attachment D – Disk Filter Pre-Purchase Specifications

Attachment A:

Orange County Utilities Standards and Construction Specifications Manual
Appendix D: List of Approved Products
February 11, 2011

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Air Release	ARV Enclosure	**All ARV above ground enclosures shall be vented with tamper proof locking device**						
		Water Plus Polyethylene Enclosure	131632 H30-B	Blue 44" Tall	131632 H30-P	Pantone 44"	131632 H30-G	Green 44" Tall
			171730 H40-B	Blue 30" Tall	171730 H40-P	Pantone 30"	171730 H40-G	Green 30" Tall
		Hot Box Vent Guard Fiberglass Enclosure	AVG2036 Encl GP3232 Base	Blue 36" Tall	AVG2036 Encl GP3232 Base	Pantone 36" Tall	AVG2036 Encl GP3232 Base	Green 36" Tall
			AVG2041 Encl GP3232 Base	Blue 41" Tall	AVG2041 Encl GP3232 Base	Pantone 41" Tall	AVG2041 Encl GP3232 Base	Green 41" Tall
		Safety-Guard/Hydro Guard	15100 Encl	Blue 34" Tall	15100 Encl	Pantone 34" Tall	15100 Encl	Green 34" Tall
	Air Release Valves	**Air Release Valves shall be Combination Type, 316 SS**						
		ARI	D-040SS	Combination	D-040SS	Combination	D-020 (SS)	Combination
		H-TEC	NA	NA	NA	NA	986 (316SS)	Combination
		Vent-O-Mat	Series RBX DN50	2"	Series RBX DN50	2"	RGX series	
	ARV Vault	**Air Release Valve Frame and Cover**						
		US Foundry	NA	NA	NA	NA	USF 7665-HH-HJ	
Blow Off	Auto Blow Off	**Automatic Blow Off Valve**						
		Hydro Guard	HG-1 Standard Unit	Automatic	NA	NA	NA	NA
	Blow Off Valve	**Blow Off Valve - Fits standard 5-1/4 inch Valve Box**						
		Kupferle Foundry Co	Truflo Series TF #550		Truflo Series TF #550		NA	NA
		Water Plus Corp	The Hydrant Plus Series VB 2000B		The Hydrant Plus Series VB 2000B		NA	NA
Casing Seals / Spacers	Casing End Seals	**Casing End Seals. Annular space between pipe and steel casing shall be brick and mortar with end seals to secure ends.**						
		Advance Products	Model AC and AW		Model AC and AW		Model AC and AW	
		BWM Company	Model WR and PO		Model WR and PO		Model WR and PO	
		Cascade Water Works	Model CCES		Model CCES		Model CCES	
		CCI Pipeline	Model ESW and ESC		Model ESW and ESC		Model ESW and ESC	
		Pipeline Seal & Insulator, Inc (PSI)	Model C and W		Model C and W		Model C and W	
		Power Seal	Model 4810ES		Model 4810ES		Model 4810ES	

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Casing Seals / Spacers	Casing spacer	**Casing spacers shall be a min. 8-inches wide for pipe 12" Dia or less or min. 12-inches wide for pipe 16 or greater , shall have a minimum 14 gauge 304 stainless steel shell/band, minimum 10 gauge 304 reinforced risers; minimum thickness of 0.090 EPDM or PVC interior liners, glass reinforces polymer or ultra high molecular weight polyethylene and 304 stainless bolts, nuts and washers.**						
		Advance Products	SSI8 / SSI12		SSI8 / SSI12		SSI8 / SSI12	
		BWM Company	BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		BWM-SS-8 / SS-12	
		Cascade Water Works	Series CCS 8" / 12"		Series CCS 8" / 12"		Series CCS 8" / 12"	
		CCI Pipeline	Model CCS8 / CSS12		Model CCS8 / CSS12		Model CCS8 / CSS12	
		Pipeline Seal & Insulator, Inc (PSI)	Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		Series S8G-2 / S12G-2	
Coatings	Exterior Coatings for Exposed Metal Assets	**Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 1 Zinc / Urethane / Fluoropolymer application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.**						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
			Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils
			EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils
			Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils
	Exterior Coatings for Exposed Metal Assets	**Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 2 Zinc / Epoxy / Urethane application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.**						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
			Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils
			Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils
			EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils
		PPG / Ameron	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils
			Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils
			Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Fittings	Fittings	**Ductile Iron Fittings C153 SSB / C110 FLG: (Water & Reclaimed Water fittings shall cement lined or holiday free fusion bonded epoxy lined) (Wastewater fittings interior shall be Protecto 401 and holiday free)**						
		American	30" & up	FBE / Cement	30" & up	FBE / Cement	30" & up	Protecto 401
		Sigma		FBE / Cement		FBE / Cement		Protecto 401
		Star		FBE / Cement		FBE / Cement		Protecto 401
		Tyler Union & Clow		FBE / Cement		FBE / Cement		Protecto 401
Flow	Flow Meter	**Flow Meters With Replaceable Sensors**						
		EMCO	NA	NA	NA	NA	Unimag 4411E	
Hydrants	Hydrants	**Hydrants Shall open left, 1-1/2 Pentagon operating nut, NST hose & pumper thread, rotate 360 degrees, closed drains, epoxy on shoe in & out and 304 SS nuts & bolts below ground.**						
		American Flow Control	B-84-B (6 inch)		NA	NA	NA	NA
		Clow	Medallion 2545		NA	NA	NA	NA
		Mueller	Super Centurion 250		NA	NA	NA	NA
Joint Restraints	Ductile iron pipe MJ Restraints	**Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain ductile iron pipe to mechanical joint fittings, pipe and appurtenances.**						
		EBAA Iron Inc	Megalug Series 1100		Megalug Series 1100		Megalug Series 1100	
		Ford / Uni-Flange	UFR-1400		UFR-1400		UFR-1400	
		Sigma	OneLok Series SLD/SLDE		OneLok Series SLD/SLDE		OneLok Series SLD/SLDE	
		Smith Blair	Cam Lok Series 111		Cam Lok Series 111		Cam Lok Series 111	
		Star	Star Grip Series 3000		Star Grip Series 3000		Star Grip Series 3000	
		Tyler Union	TufGrip Series TLD		TufGrip Series TLD		TufGrip Series TLD	
	DIP Bell Joint Restraints (4"-12") (New & Existing)	**Bell Joint Restraints for Ductile Iron Pipe (4"-12") (New & Existing) - All restraints split serrated on bell and spigot ends. Pipe 16" and greater shall have restraint gaskets or locking bells. (Wastewater only for restraint of existing DIP FM)**						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390C		Uni-Flange Series 1390C		Uni-Flange Series 1390C	
		Sigma	PV-Lok Series PWP-C		PV-Lok Series PWP-C		PV-Lok Series PWP-C	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	StarGrip Series 3100S		StarGrip Series 3100S		StarGrip Series 3100S	
		Tyler Union	TufGrip-Series 300C		TufGrip-Series 300C		TufGrip-Series 300C	
	DIP Bell Joint Restraints (16" & Greater)	**Ductile Iron Pipe Bell Joint Restraints for Ductile Iron Pipe (16" & Greater) - All restraints shall have a split back-up ring for the bell and a serrated or wedge action gland for the spigot end. New installation for water & reclaimed water piping 16" and greater shall have restraint gaskets or locking bells.**						
		EBAA Iron Inc	Series 1100HD	Existing Only	Series 1100HD	Existing Only	Series 1100HD	Existing Only
		Sigma	Series SSLDH	Existing Only	Series SSLDH	Existing Only	Series SSLDH	Existing Only
		Star	Series 3100S	Existing Only	Series 3100S	Existing Only	Series 3100S	Existing Only

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Joint Restraints	Ductile iron pipe Bell Joint Restraint Gaskets and Locking Bell (4" & Above)	**Bell Joint Restraint Gaskets and Locking Bell (4" & Above) Stainless Steel locking wedges built into the gasket-rubber. ANSI/AWWA C111/A21.11 Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe. Ductile Iron Bell Joint Restraint for Push-On Pipe- Locking bell joint system that prevents joint separation and allows for joint deflection. Bells shall be painted red to verify restrained gasket.**						
		American	Fast Grip Gasket	Gasket	Fast Grip Gasket	Gasket	NA	NA
			Flex-Ring Joint	Bell Lock	Flex-Ring Joint	Bell Lock	NA	NA
			Lok-Ring Joint	Bell Lock	Lok-Ring Joint	Bell Lock	NA	NA
		Griffin	Talon RJ Gasket	Gasket	Talon RJ Gasket	Gasket	NA	NA
			Snap-Lok	Bell Lock	Snap-Lok	Bell Lock	NA	NA
		McWane Inc. DI Pipe Group	Sure Stop 350 Gasket	Gasket	Sure Stop 350 Gasket	Gasket	NA	NA
			Thrust-Lock	Bell Lock	Thrust-Lock	Bell Lock	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			Super-Lock	Bell Lock	Super-Lock	Bell Lock	NA	NA
		US Pipe	Field Lok 350 Gasket	Gasket	Field Lok 350 Gasket	Gasket	NA	NA
			Field Lok Gasket	Gasket	Field Lok Gasket	Gasket	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			HP Lok Restraint Joint	Bell Lock	HP Lok Restraint Joint	Bell Lock	NA	NA
	SS to DIP Transition Restraint	**SS to DIP Transition Restraint -Flanged stainless steel pipe from Wetwell to Valve box restrained joint transition (epoxy coated, SS hardware) Flg x PE RJ.**						
		EBAA Iron Inc	NA	NA	NA	NA	Megaflange 2100	
		Sigma	NA	NA	NA	NA	SigmaFlange with One Lock SLDE	
		Smith Blair	NA	NA	NA	NA	911 Flange - Lock Restrained FCA	
	PVC Pipe MJ Restraints	**Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain PVC pipe to mechanical joint fittings, and appurtenances.**						
		EBAA Iron Inc	Mega-lug Series 2000PV		Mega-lug Series 2000PV		Mega-lug Series 2000PV	
			NA	NA	NA	NA	Megalug Series 2200	(42"-48")
		Ford / Uni-Flange	UFR 1500 Series		UFR 1500 Series		UFR 1500 Series	
		Sigma	One Lok Series SLC/SLCE		One Lok Series SLC/SLCE		One Lok Series SLC/SLCE	
		Smith Blair	Cam Lok Series 120		Cam Lok Series 120		Cam Lok Series 120	
		Star	Star Grip Series 4000		Star Grip Series 4000		Star Grip Series 4000	
		Tyler Union	TufGrip Series TLP		TufGrip Series TLP		TufGrip Series TLP	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	**PVC Bell Joint Restraints: PVC pipe Split Serrated on Bell End and Spigot End. (4" - 12") (New & Existing)**						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390		Uni-Flange Series 1390		Uni-Flange Series 1390	
		Sigma	PV-Lok Series PWP		PV-Lok Series PWP		PV-Lok Series PWP	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	Series 1100C		Series 1100C		Series 1100C	
		Tyler Union	TufGrip 300C		TufGrip 300C		TufGrip 300C	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Joint Restraints	PVC Bell Joint Restraints (16" & Greater)	**PVC Bell Joint Restraints: (16" & Greater) PVC pipe Split Serrated on Bell End and Spigot End. Water & Reclaimed Water Existing pipe only. Wastewater shall be new and existing pipe.**						
		Ford / Uni-Flange	Series 1390	Existing Only	Series 1390	Existing Only	Series 1390	
		JCM	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	
		Sigma	PV-Lok PWP	Existing Only	PV-Lok PWP	Existing Only	PV-Lok PWP	
		Smith Blair	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	
		Star	Series 1100C	Existing Only	Series 1100C	Existing Only	Series 1100C	
Pipe	PVC C900 DR 18 Bell & Spigot (4" - 12")	**C900 Bell & Spigot PVC Pipe: 4 to 12-inch - AWWA C-900, Minimum DR18 for Water, Reclaimed and Wastewater. DR14 for Fire Lines. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed 4" to 12"	Certa-Lok C900/RJ	Blue	Certa-Lok C900/RJ	Pantone Purple	Certa-Lok C900/RJ	Green
		Diamond Plastics Corp	C-900	Blue	C-900	Pantone Purple	Diamond C900	Green
		Ipex Inc	C-900 Blue Brute	Blue	C-900	Pantone Purple	C900 Blue Brute	Green
		JM Eagle	C-900	Blue	C-900	Pantone Purple	C-900	Green
		National Pipe & Plastics Inc	C-900 Dura- Blue	Blue	C-900	Pantone Purple	C-900 Pipe	Green
		North American Pipe Corp (NAPCO)	C-900	Blue	C-900	Pantone Purple	C-900	Green
		Sanderson Pipe Corp	C-900	Blue	C-900	Pantone Purple	C-900	Green
	PVC C905 DR 18 Bell & Spigot 16" and Larger	**C905 Bell & Spigot PVC Pipe 16" and Larger: AWWA C-905, Minimum DR18 for all Force Mains up to 24". Minimum DR21/DR25 for 30" and greater. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed 16"	NA	NA	NA	NA	Certa-Lok C905/RJ	NA
		Diamond Plastics Corp	NA	NA	NA	NA	Trans-21 DR18	Green
		Ipex Inc	NA	NA	NA	NA	IPEX Centurion	Green
		JM Eagle	NA	NA	NA	NA	C905 Big Blue	Green
		National Pipe & Plastics Inc	NA	NA	NA	NA	C905	Green
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	C905 Big Blue	Green
	HDPE C906 DR11	**HDPE Pipe DR11 AWWA C906 shall be Ductile Iron Pipe Size, PE 3408/3608/4710 DIPS manufactured in accordance with ASTM F-714 and listed with NSF. Pipe shall be marked in accordance with either AWWA C901,AWWA C906. Compression type connections are not acceptable in new installations. Pipe joints shall be butt fusion or electro-fusion with flange or adapter. All HDPE shall be color coded to the Utility. Color identifications are in accordance with the APWA/ULCC Uniform Color Code. Manufacturers shall be members in good standing with PPI to maintain approval status.**						
		JM Eagle	HDPE	DR11 Blue	HDPE	DR11 Pantone	HDPE	DR11Green
		Performance Pipe(Chevron)	Driscoplex 4000	DR11 Blue	Driscoplex 4000	DR11 Pantone	Driscoplex 4300	DR11 Green
		PolyPipe, Inc.	EHMW Poly Pipe	DR11 Blue	EHMW	DR11 Pantone	EHMW	DR11Green

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pipe	Ductile Iron Pipe	**Ductile iron/Cast iron: (4" to 12" = Class 350, 16" to 24" - Class 250, 30" to 64" = Class 200). Water and Reclaimed water shall be cement lined. Wastewater Piping shall be Protecto 401 and Holiday Free. Exterior coatings as specified. Wastewater DIP piping shall be for pump station piping only. Manufacturers shall be members in good standing with DIPRA to maintain approval status.**						
		American	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		Griffin	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		McWane Inc. DI Pipe Group	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		US Pipe	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
Sample	Sample Station	**Sample Stations - Bacteriological Sample Station with built in flush system, all internal piping to be 2", brass and includes lockable green enclosures.**						
		Safety-Guard	SG-BSS-05 pedestal #77	green enclosure	NA	NA	NA	NA
		Water Plus Corp	Model 5000	green	NA	NA	NA	NA
Services	Brass Service Saddles	**Brass Service Saddles for 1" & 2" water & reclaimed water services on 4" through 12" Mains - Service saddles can be hinge or bolt controlled OD saddles to be used on C-900 and existing IPS OD PVC pipe.**						
		Ford	Series S-70, S-90	4"-12"	Series S-70, S-90	4"-12"	NA	NA
		AY McDonald	Model 3891 / 3895,3801 / 3805	4"-12"	Model 3891 / 3895,3801 / 3805	4"-12"	NA	NA
		Mueller	Series S-13000/H-13000	4"-12"	Series S-13000/H-13000	4"-12"	NA	NA
	Service Saddles	**Service Saddles for 1" (CC) & 2" (Iron pipe threads) Water & Reclaimed Water services on mains greater than 12". Service saddles for 2" taps (iron pipe threads) on 4" mains and greater for Waste Water. : Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on C-900 / C905 or DI for all 1-in and -2in taps on pipes over 12in.**						
		Ford	Series FC202	16" & greater	Series FC202	16" & greater	Series FC202	4" & greater
		JCM	Series 406	16" & greater	Series 406	16" & greater	Series 406	4" & greater
		Mueller	DR2S	16" & greater	DR2S	16" & greater	DR2S	4" & greater
		Romac	Series 202NS	16" & greater	Series 202NS	16" & greater	Series 202NS	4" & greater
		Smith Blair	Series 317	16" & greater	Series 317	16" & greater	Series 317	4" & greater
	Service Saddles for HDPE	**Service Saddles for 1" (CC) & 2" (Iron Pipe threads) Water and Reclaimed Water Services: Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on HDPE for all 1-in and -2in taps. Taps to HDPE pipe shall be approved on a case by case basis.**						
		Ford	Series FCP202		Series FCP202		Series FCP202	
		Romac	Series 202N-H		Series 202N-H		Series 202N-H	
		Smith Blair	Series 317-1 for HDPE		Series 317-1 for HDPE		Series 317-1 for HDPE	
	Corporation Stops Ball Type	**Corporation Stops Ball Type (1-inch with AWWA taper C threads only/pack joint outlet for CTS) 2" Corporation Stop Ball Type shall be 2" MIP X FIP threads.**						
		Ford	FB1000, FB1700-7		FB1000, FB1700-7		FB1700-7	2" ARV
		AY McDonald	4701B-22, 3149B2		4701B-22, 3149B2		3149B2	2" ARV
		Mueller	P25008, B-20046		P25008, B-20046		B-20046	2" ARV

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Services	Curb Stops	**Curb Stops - Straight Valves: Ball type compression 2" cts O.D. tubing by 2" FIP**						
		Ford	B41-777W		B41-777W		NA	NA
		AY McDonald	6102W-22		6102W-22		NA	NA
		Mueller	P25172		P25172		NA	NA
	Curb Stops	**Curb Stops - Straight Valves: ball type compression x compression**						
		Ford	B44-444W		B44-444W		NA	NA
		AY McDonald	6100W-22		6100W-22		NA	NA
		Mueller	P25146		P25146		NA	NA
	PE tubing	**Polyethylene tubing: AWWA C901. UV protection (SDR-9) 1-inch and 2-inch only. PE 3408 / PE 4710**						
		Charter Plastics	Blue Ice		Lav Ice		NA	NA
		Endot	Endopure Blue		Endocore Lavender		NA	NA
		JM Eagle	Pure-Core		NA	NA	NA	NA
Tapping Sleeves and Valves	Line Stops	**Line Stops**						
		JCM						
		Romac						
		Smith Blair						
	Tapping Sleeves	**Tapping Sleeves: (Mechanical joint for taps on cast iron, ductile iron, PVC & AC pipe, including size on size) with stainless steel nuts and bolts.**						
		American Flow Control	Series 2800		Series 2800		Series 2800	
			Series 1004		Series 1004		Series 1004	
		Clow	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC
			Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	Series F-5207	A/C Pipe
		JCM	Series 414	FBE	Series 414	FBE	Series 414	FBE
		Mueller	Series H-615	DIP/PVC	Series H-615	DIP/PVC	Series H-615	DIP/PVC
			Series H-619	A/C Pipe	Series H-619	A/C Pipe	Series H-619	A/C Pipe
		Smith Blair	Style 623	FBE	Style 623	FBE	Style 623	FBE
	Tapping Valves: 12" and smaller	**Tapping Valves: 12" and smaller - Tapping Valves shall be furnished with an alignment lip and installed in the vertical position for Water and Reclaim Water. Wastewater shall be installed horizontally and abandoned in the open position. Tapping valves shall be resilient seated only and meet the requirements of AWWA C509 or C515**						
		American Flow Control	Series 2500	Alignment Lip	Series 2500	Alignment Lip	Series 2500	Alignment Lip
		Clow	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip
		Mueller	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Tapping Sleeves and Valves	Tapping Valves: 16" and Larger	**Tapping Valves: 16" and Larger - Tapping valves shall be furnished with an alignment lip and be installed in the vertical position for Water and Reclaimed Water. No tapping valve shall be installed horizontally for Water and Reclaim Water unless approved by the engineer. Tapping Valves 16" and larger AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a spur gear actuator unless noted by the engineer. All tapping valves above 24" shall be furnished with NPT pipe plugs for flushing the tracks when valves are installed horizontally. Tapping valves for Wastewater shall be installed horizontally and abandoned in open position.**						
		American Flow Control	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port
		Clow	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port
		Mueller	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port
Valves	Butterfly Valve 42" and Above	**Butterfly Valves 42"and above. AWWA C504. Actuators input torques based on 150 psi valve pressure and 16 fps velocity with a maximum input of 80 ft-lb on 2" nuts and shall withstand 250 ft-lbs. Valve seats shall be leak-tight in both directions at 150 psi.**						
		Clow	Style #1450		Style #1450		NA	NA
		Dezurik	BAW		BAW		NA	NA
		Mueller / Pratt	LINSEAL III / Groundhog		LINSEAL III / Groundhog		NA	NA
	Check Valves	**Valves (Check) 4-inch and Larger (8 mil epoxy lined)**						
		American Flow Control	NA		NA		Series 600 or 50 line	
		Clow / M&H / Kennedy	NA		NA		106	
		Mueller	NA		NA		Series 2600	
	Gate Valves 4" - 12"	**Gate Valves 12" and smaller - resilient seated only AWWA C509 or C515. Valve seat shall be leak-tight in both directions at 150 psi.**						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2360		Series A-2360		NA	NA
	Gate Valves (Vertical) 16" and Up	**Gate Valves 16" and larger (Vertical Installation) AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a gear actuator unless noted by the engineer. Valve seat shall be leak-tight in both directions at 150 psi.**						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100			
		Mueller	Series A-2361		Series A-2361		NA	NA

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Valves	Plug Valves	**Plug Valves - Bi-directional, MJ & Flanged (min. 8mil fusion bonded epoxy with stainless steel bolts), gear operator to be sized for rated pressure of the valve. Valves 4"-20" shall be 80% Full Port and valves 24" and greater shall be minimum of 70% full port. Valve shall be factory tested to minimium 100 PSI in both directions.**						
		Clow	NA	NA	NA	NA	F-5412 FLG	4" & up
			NA	NA	NA	NA	F-5413 MJ	4" & up
		Dezurik	NA	NA	NA	NA	Series PEF or PEC	4"& up
		Millikan / Pratt	NA	NA	NA	NA	Eccentric / Ballcentric	4"& up
		Val-Matic	NA	NA	NA	NA	5600 or 5800 (FLG)	4" & up
			NA	NA	NA	NA	5700 or 5900 (MJ)	4" & up
Valve Boxes	Valve Boxes with Locking Lids (Cast Iron)	**Two piece standard screw type Heavy Duty Valve Boxes with Locking Lids (Cast Iron) and type of service cast in heavy duty traffic lid (H20 loading) ASTM A48**						
		Bingham/Taylor	Series 4905	Box	NA	NA	Series 4905	Box
			4905-X	Extension	NA	NA	4905-X	Extension
			4904-L	Blue Water Locking Lid	NA	NA	4904-L	Green Sewer locking Lid
		Sigma	Series VB 261X-267X	Box	VB-25031LK-VB-2612	Box	Series VB 261X-267X	Box
			VB 6302	Extension	VB-6302	Extension	VB 6302	Extension
			VB 4650W	Blue Water Locking Lid	VB2503LK	Purple Square Locking Lid	VB 4650S	Green Sewer locking Lid
		Star	Series VB-0002	Box	NA	NA	Series VB-0002	Box
			VBEX 12-24S	Extension	NA	NA	VBEX 12-24S	Extension
			VBLIDLOCK	Blue Water Locking Lid	NA	NA	VBLIDLOCK	Green Sewer locking Lid
		Tyler Union	Series 6850	Box	NA	NA	Series 6850	Box
			58, 59, 60	Extension	NA	NA	58, 59, 60	Extension
			Locking Lid	Blue Water Locking Lid	NA	NA	Locking Lid	Green Sewer locking Lid
	Valve Box	**For mains equal to, or greater than, 16" diameter or equal to greater than 6' feet deep**						
		American Flow Control	# 2A - 9A Retrofit Valve Box Insert	Fit inside std valve boxes	NA		2A - 9A Retrofit Valve Box Insert	Green Sewer locking Lid
		Mueller Company	MVB050C thru MVB130C with Extension Stem MVB875 Guide Plate	Blue Water Locking Lid	MVB050CR thru MVB130CR with Extension Stem MVB875 Guide Plate	Purple Square Locking Reclaim Lid	MVB050C thru MVB130C with Extension Stem MVB875 Guide Plate	Green Sewer locking Lid

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Coatings	Anti-Graffiti Paint	**Block Walls-Anti-Graffiti Paint per Section 3119 Coatings & Linings**						
		American Building Restoration Products	NA	NA	NA	NA	Polyshield Graffiti Preventer for Unpainted Masonry Type B	Super Bio Strip or Strip it all
		Tnemec / Chemprobe	NA	NA	NA	NA	626 DUR A PEL	680 Mark A Way
		Professional Products of Kansas, Inc	NA	NA	NA	NA	Professional Water Seal & Anti-Graffitiant (PWS-15 Super Strength)	Professional Phase II Cleaner
	Coatings for Existing Manholes	**Rehabilitation corrosion protection system per Section 3119 Coatings & Linings. Interior coating for force main connections to existing concrete manholes only. New precast structures and existing pump stations shall be lined.**						
		CCI Spectrum, Inc	NA	NA	NA	NA	Spectrashield	min of 500 mils
		Kerneos Aluminate Technologies	NA	NA	NA	NA	Sewpercoat	1" (1000mil)
		Raven Lining System	NA	NA	NA	NA	Raven 155 Primer Raven 405	min 8 mils min 125 mils
		Sauereisen	NA	NA	NA	NA	210 Series Topcoat Glaze 210G	min 125 mils min 20 mils
		Tnemec	NA	NA	NA	NA	Series 434 Topcoat Glaze 435	min 125 mils 15-20 mils
PVC Pipe and fittings	Pipe SDR 35 Gravity Mains	**PVC Pipe for Gravity SDR26/SDR 35 (Green in color) ASTM-D034. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed	NA	NA	NA	NA	Gravity Sewer Pipe	
		Diamond Plastics Corp	NA	NA	NA	NA	Sani-21 SDR-35	
		JM Eagle	NA	NA	NA	NA	Gravity Sewer	
		National Pipe & Plastics, Inc.	NA	NA	NA	NA	Ever-Green Sewer Pipe	
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	Gravity Sewer	
		Sanderson Pipe Corp	NA	NA	NA	NA	Gravity Sewer	
	Locate Balls	**Locating Marker Systems - Wastewater Locator balls placed at all sanitary sewer cleanouts**						
		3M	NA	NA	NA	NA	3M™ EMS 4" Extended Range 5' Ball Marker 1404-XR	
	Fittings SDR 35	**Fittings, Adapters and Plugs - Gravity PVC ASTM-D3034, Min SDR26/ SDR 35**						
		GPK Products, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Harrington Corporation (HARCO)	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Multi Fittings Corp.	NA	NA	NA	NA	SDR26/SDR 35 Trench Tough Sewer Fittings	
		JM Eagle	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Plastic Trends Inc	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		TIGRE USA, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
PVC Pipe a	Flexible Pipe Connectors	**Flexible Pipe Connectors and Transitions**						
		Fernco	NA	NA	NA	NA	1002, 1051, 1056 Series	
		Indiana Seal	NA	NA	NA	NA	102, 151, 156 Series	
		Mission Rubber	NA	NA	NA	NA	MR02, MR51, MR 56 Series	
Precast Concrete Structures	MH Lids	**Frame and Cover**						
		USF Fabrication Inc.	NA	NA	NA	NA	USF 225-AS	
	Adj Ring	**Top Adjusting Rings - HDPE with heavy duty loading (H-20)**						
		Ladtech, Inc	NA	NA	NA	NA	24R, 24S with Rope Sealant CS2455	
	Hatches	**Wet Well and Valve Vault Access Frames and Covers (Include the term "Confined Space" etched or cast into the cover with recessed lock & hasp. Frames and covers per manufacturers specifications.**						
		Halliday Products	NA	NA	NA	NA	S1R or S2R Series	
		USF Fabrication Inc.	NA	NA	NA	NA	APS or APD Series	
	Precast Concrete Structures	**Precast Manhole and Wetwell Structures ASTM C478. Precast concrete shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Concrete without admixture or without color tint /tracer shall be rejected.**						
		Allied Precast	NA	NA	NA	NA	Dyed Admix	
		Atlantic Concrete Products, Inc.	NA	NA	NA	NA	Dyed Admix	
		Delzotto Products, Inc.	NA	NA	NA	NA	Dyed Admix	
		Dura Stress Underground Inc.	NA	NA	NA	NA	Dyed Admix	
		Hanson Pipe & Product	NA	NA	NA	NA	Dyed Admix	
		Mack Concrete	NA	NA	NA	NA	Dyed Admix	
		Oldcastle Precast	NA	NA	NA	NA	Dyed Admix	
		Standard Precast Inc.	NA	NA	NA	NA	Dyed Admix	
	Concrete Admix	**Crystalline Waterproofing Concrete Admix with color dye shall be added to all concrete structures (precast and cast-in-place) to provide waterproofing and corrosion resistance. Concrete without admixture or without color tint / tracer shall be rejected. % concentration of admix with colored dye added to the mix shall be based on weight of cement.**						
		Kryton International	NA	NA	NA	NA	KIM K-301R (with red dye)	2%
		Xypex Chemical Corp	NA	NA	NA	NA	Xypex Admix C-1000Red (with red dye)	3.0 - 3.5%
	Liners	**Interior Liner for New or existing Precast Manhole and Precast Wetwell Structures per Section 3119 Coatings & Linings**						
		AFE	NA	NA	NA	NA	Fiberglass Liner	
		AGRU Liner	NA	NA	NA	NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)	
		Containment Solutions Inc. (Flowtite)	NA	NA	NA	NA	Fiberglass Liner	
		GSE Studliner	NA	NA	NA	NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)	
		GU Liner	NA	NA	NA	NA	Reinforced Plastic Liner	
		L & F Manufacturing	NA	NA	NA	NA	Fiberglass Liner	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Precast Concrete Structures	Heat Shrink Seal	**Heat Shrink Seal - Precast structures shall be primed with manufacturer approved primer prior to application of heat shrunk encapsulation.**						
		Canusa-CPS	NA	NA	NA	NA	Wrapid Seal with WrapidSeal Primer (Canusa G Primer)	
		Pipeline Seal & Insulator, Inc (PSI)	NA	NA	NA	NA	Riser Wrap with Polyken 1027 or 1039 primer	
	Jointing Material	**Jointing Material Min. 2" width for all products to ensure squeeze out with manufacturer approved primer.**						
		Henry Company	NA	NA	NA	NA	Ram-Nek	with Primer
		Martin Asphalt Company	NA	NA	NA	NA	Evergrip 990	with Primer
		Trelleborg Pipe Seals	NA	NA	NA	NA	NPC – Bidco C-56	with Primer
	Pipe Seals Gravity	**Resilient Connector Pipe Seals, Manhole - Gravity less than 12-inch and less than 15-ft deep**						
		Atlantic Concrete	NA	NA	NA	NA	A-Lok (cast-in-place)	
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal (cast-in-place)	
		IPS	NA	NA	NA	NA	Wedge Style	
		NPC	NA	NA	NA	NA	Kor-N-Seal Model WS	
		Press seal gasket	NA	NA	NA	NA	PSX Direct Drive	
	Pipe Seals Gravity	**Cast in Place Pipe Seals, Manhole - Gravity Greater Than or Equal to 12-inch and all pipe sizes greater than 15-ft deep**						
		Atlantic Concrete	NA	NA	NA	NA	A-Lok	cast in place
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal	cast in place
	FM Pipe Seals	**Modular Pipe Seals for Wet Well and Valve Box penetrations and all forcemain connections to existing and new precast concrete structures. EPDM Rubber with 316 SS Hardware**						
		CCI Pipeline Systems	NA	NA	NA	NA	Wrap-It Link WL-SS Series	
		Pipeline Seal & Insulator, Inc / Link Seal	NA	NA	NA	NA	Link-Seal S-316 Modular Seal	
		Proco Products, Inc	NA	NA	NA	NA	PenSeal ES-PS Series	

APPENDIX D **LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Generator	Gen	**Generator Systems, Fixed Shall be UL 2200 Certified.**						
		Caterpillar	NA	NA	NA	NA	CAT Diesel Generator Set	
		Cummins Power Generation	NA	NA	NA	NA	Diesel Generator Set	
	Fuel Tanks	**Generator Fuel Tanks. Shall be UL2085 certified.**						
		Convault	NA	NA	NA	NA	CVT-3SF or CVT-3FF	
		Phoenix	NA	NA	NA	NA	Envirovault	
	GR	**Generator Receptacle (GR)**						
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042 (230V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042-S22 (460V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Pyle National	NA	NA	NA	NA	JRE-4100 (230V, 100A, 3P, 4W)	
	ATS	**Generator Transfer Switch**						
		Russelectric	NA	NA	NA	NA	RMTD Series with model 2000 controller	NEMA 12/3R 316SS Enclosure
Odor Control Units	Biotrickling Filters	**Biotrickling filters**						
		BioAir	NA	NA	NA	NA		
		Biorem	NA	NA	NA	NA	Biosorbens BTF	
		Envirogen	NA	NA	NA	NA	BTF	
		Siemens	NA	NA	NA	NA	Zabocs BTF	
	Carbon Adsorption Units	**Carbon Adsorption Units**						
		Calgon	NA	NA	NA	NA		
		Pure Air Filtration	NA	NA	NA	NA		
		Siemens	NA	NA	NA	NA		
Pressure Gauges	Pressure Gauges	**Pressure Gauges shall have Diaphragm Seals. Oil filled.**						
		Ashcroft	NA	NA	NA	NA	10 1008SL 02L 60# 25 200SS 02T XYTSE	Gauge Diaphragm Seal
		Trerice	NA	NA	NA	NA	D83LFSS4002LA100 - Gauge M51001SSSS - Diaphragm Seal D99100 Fill and Mount Charge	
		Winter Gauges	NA	NA	NA	NA	PFQ770 0-60 PSI D70950 top D70954 Bottom	
Pumps	Pumps	**Submersible Pumps**						
		ABS	NA	NA	NA	NA		
		Flygt	NA	NA	NA	NA		

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pumps	Floats	**Float Regulator (FR) - Duplex and Triplex Pump Stations**						
		Atlantic Scientific	NA	NA	NA	NA		Roto-Float
	Radar	**Radar - Pulse Burst Radar Transmitter. Input 24 VDC and Output 4-20 mA**						
		Magnetrol	NA	NA	NA	NA		R82-520A-011
Pump Station Main Ser	Main Srvc Disconne	**Main Service Disconnect Breaker**						
		Square D	NA	NA	NA	NA		H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)
	Surge Protector Device	**Surge Protector - UL 1449, 3rd Edition listed and labeled, minimum 10 year warranty, NEMA LS-1 and IEEEC62, 41/45 tested with NEMA 4X enclosure, internal fusing, voltage and phase to match service. Rated 80,000 amps per mode for Duplex & Triplex stations and 150,000 Amperes per mode for Master Stations. All devices shall be provided with a NEMA 4X Plastic enclosure which is approved in lieu of stainless steel.**						
		Current Technology (Power & Systems	NA	NA	NA	NA		XN-80, TG-150 or CurrentGuard 150 Plus Series
		Josyln AKA (Total Protection Solutions)	NA	NA	NA	NA		TSS-ST 160 Series, ST 300 Series or JSP-300 Series
		Surge Suppressors, Inc	NA	NA	NA	NA		LSE Series or SHL Series
Sub Panel	Sub Panel	**Sub-Panel Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated-finish inside and out, With 3 Point Pad lockable Handle, and Door Stop**						
		Hoffman	NA	NA	NA	NA		
		Schaefer	NA	NA	NA	NA		
		Universal enclosure systems	NA	NA	NA	NA		
Pump Station Control Panel	Control Panel	**Control Panel Supplier**						
		ECS	NA	NA	NA	NA		
		Sta-Con Inc	NA	NA	NA	NA		
	Enclosure	**Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated finish inside and out, With 3 Point Pad lockable Handle, and Door Stop**						
		Hoffman	NA	NA	NA	NA		
		Schaefer	NA	NA	NA	NA		
		Universal enclosure systems	NA	NA	NA	NA		
	Mnts	**Mounting Channel for Enclosures**						
		Unistrut Stainless Steel	NA	NA	NA	NA		1" 5/8 x 1" 5/8 316 SS
	Seal-off	**Explosion-Proof Sealoff**						
		Cooper Crouse-Hinds	NA	NA	NA	NA		EYSR - 2 Inch Min.
	FL	**Flasher (FL)**						
		MPE	NA	NA	NA	NA		025-120-105
		SSAC	NA	NA	NA	NA		FS-126

APPENDIX D **LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	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	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	PM	**Phase Monitor (PM)**						
		MPE 240 V.	NA	NA	NA	NA	001-230-118-OVG5	
		MPE 480 V.	NA	NA	NA	NA	002-480-123-OVG5	
	Pump Alternator	**Pump Automatic Alternator (PAA)**						
		Diversified Duplex	NA	NA	NA	NA	ARA-120-ACA	
		Diversified Triplex	NA	NA	NA	NA	ARA-120-AME	
		MPE Duplex	NA	NA	NA	NA	008-120-13SP	
		MPE Triplex	NA	NA	NA	NA	009-120-23P	
		MPE Triplex Socket	NA	NA	NA	NA	SD-12-PC	
	Alt. Test Switch	**Alt. Test Switch**						
		Carling Technologies	NA	NA	NA	NA	6GG5E-78	
		Honeywell	NA	NA	NA	NA	2TL1-50	
	Relay	**Relay**						
		Potter Brumfield 24 Volt	NA	NA	NA	NA	KRPA-11AN-24	
		Potter Brumfield 120 Volt	NA	NA	NA	NA	KRPA-11AN-120	
		Square D 24 Volt	NA	NA	NA	NA	8501KP12P14V14	
		Square D 120Volt	NA	NA	NA	NA	8501KP12P14V20	
	Relay Base	**Relay Base**						
		IEDC 8 Pin Relay Base 600 Volt	NA	NA	NA	NA	SR2P-06	
	Duplex Receptacle / GFCI	**Duplex Receptacle/GFCI (DR) Upgraded to 20 Amp**						
		Hubbell	NA	NA	NA	NA	GFTR20BK	
		Pass & Seymour	NA	NA	NA	NA	2095TRBK	
	ETM	**Elapse Time Meter (ETM)**						
		Reddington	NA	NA	NA	NA	711-0160	
	Grounding	**Grounding System**						
		Marathon	NA	NA	NA	NA	Neutral Isolation Block 1421570	
		Panduit	NA	NA	NA	NA	Ground Lug LAM2A 1/0 - 014 -6Y	
		Square D	NA	NA	NA	NA	Ground Buss PK7GTA	
	TS	**Terminal Strip (TS)**						
		Marathon	NA	NA	NA	NA	Series 200	
		Square D	NA	NA	NA	NA	9080GR6	
	TS	**Terminal Strip End Blocks and End Clamps**						
		Square D	NA	NA	NA	NA	9080GM6B & 9080GH10	

APPENDIX D **LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	PL	**Pilot Light (PL) 24 Volt with 1819 Bulb**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelight 930507X	
	RL	**Run Indicator Light (RL) 120 Volt**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X With 120MB Bulb	
	MT	**Moisture and Temperature Failure Light (MT) 120 Volt with 120MB Bulb**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X	
Sluice	Sluice Gate	**Sluice Gate for Wet Well with Motorized Operator**						
		BNW	NA	NA	NA	NA	Model 77 - 316 SS	
		Fontaine	NA	NA	NA	NA	Model 20 - 316 SS	
VFD	VFD	**Variable Frequency Drives**						
		Square D	NA	NA	NA	NA		

Attachment B:

“Geotechnical Engineering Report, Orange County Eastern Regional Water Reclamation Facility, Phase V Improvements”
Nodarse & Associates – A Terracon Company
August 8, 2012

Geotechnical Engineering Report

Orange County Eastern Regional Water Reclamation Facility
Phase V Improvements
Orlando, Florida

August 8, 2012
Project No. H1115424

Prepared for:
AECOM Technical Services, Inc.
Orlando, Florida

Prepared by:
Nodarse & Associates
A Terracon Company
Winter Park, Florida

August 8, 2012

AECOM
150 N. Orange Avenue, Suite 200
Orlando, FL 32801

Attn: Mr. William D. Marshall, P.E.
P: [407] 513-8233
F: [407] 422-3866
Email: bill.marshall@aecom.com

Re: Geotechnical Engineering Report
Eastern Regional Water Reclamation Facility, Phase V
Orange County, Florida
Terracon Project Number: H1115424

Dear Mr. Marshall:

Nodarse & Associates, a Terracon Company (Nodarse/Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number 01-10-0458-101. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and foundation design and construction of multiple structures and water management facilities for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Nodarse & Associates, a Terracon Company
Certificate of Authorization Number 8830

Kevin C. Martin, E.I
Project Engineer

Amr M. Sallam, Ph.D., P.E.
Principal
Florida PE- #67578

AMR M. SALLAM, PhD
LICENSE
No. 67578
STATE OF
FLORIDA
PROFESSIONAL ENGINEER
08/10/12

Jay W. Casper, P.E.
Senior Associate
Florida PE #36330

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EXECUTIVE SUMMARY

Geotechnical explorations were performed for the proposed Eastern Region Water Reclamation Facility Phase V Improvements planned to be constructed on the Facility located on the south side of Alafaya Trail east of Curry Ford Road in Orlando, Orange County, Florida. Twenty Nine (29) SPT and auger borings were performed to depths of 10 to 100 feet below existing grades within the proposed structure improvement areas and stormwater retention area. Also, six (6) SPT borings were performed and six (6) piezometers were installed to a depth of 15 feet below the berm level between the existing reject pond and Rapid Infiltration Basins Systems (RIBs).

Based on the information obtained from our geotechnical exploration, it appears that the subsoil and groundwater conditions are suitable for the proposed improvements to the facility. The following geotechnical considerations were identified:

- The proposed structures may be supported on shallow foundations bearing on existing site soil or on newly placed engineered fill, if the site preparation recommendations shown in the Earthwork Section of this report are strictly followed.

- Assuming the recommended contact pressures, depths of footings, and proper site preparations are followed for each structure according to the design and construction sections of this report, total and differential settlement should be within tolerable limits.

- The in-place shallow sands appear suitable for re-use as general engineered fill.

- Recommendations for design and recovery analysis of the stormwater management pond located in the southwest corner of the site are included in the stormwater section of the report.

- Based on our field explorations within the berm separating the Reject Pond and the RIBS, shallow subsoil explorations performed within the reject pond, and the reject pond load test, we did not encounter a reject pond bottom clay liner. The reject pond is leaking to the RIBs through the sides and to the surrounding areas through the bottom. Further remediation actions are needed.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
EASTERN REGIONAL WATER RECLAMATION FACILITY
PHASE V IMPROVEMENTS
ORANGE COUNTY, FLORIDA

Project No. H1115424
August 8, 2012

1.0 INTRODUCTION

This geotechnical engineering report was prepared for the proposed Eastern Region Water Reclamation Facility Phase V Improvements located on the south side of Alafaya trail just east of Curry Ford Road in Orlando, Orange County, Florida as shown on the Topographic Vicinity Map included as Exhibit A-1 in Appendix A.

Twenty Nine (29) SPT and auger borings were performed to depths between 10 and 100 feet below the existing ground surface in the proposed structure improvement areas and stormwater retention pond area.

Also, six (6) SPT borings and six (6) temporary monitoring wells were performed to a depth of 15 feet below the berm between the existing reject pond and RIBS. Logs of the borings along with a Boring Location Diagram (Exhibit A-3 and A-4) are included in Appendix A of this report. Laboratory testing procedures are included in Exhibit B-1 in Appendix B.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- stormwater design parameters
- utility pipe design and construction
- reject pond liner conditions

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-3 and A-4: Boring Location Plan

Item	Description
Structures	The project will include new structures including: ■ Clarifier No. 11 ■ Preliminary Treatment Structure and truck loading building ■ Filters & Chlorine Contact Chamber structure ■ Secondary effluent Reject Pump Station ■ RAS/WAS pump stations ■ Supplemental Carbon Feed building ■ Secondary Effluent Reject Diversion structures ■ West electrical building
Building Construction	Assumed shallow foundations, slab on grade, concrete and masonry construction with special considerations for each structure.
Maximum loads	Each proposed structure is independent and will have different loading depending on the application as shown later in the report.
Maximum allowable settlement	Each proposed structure is independent and may have different tolerable settlement requirements depending on the application. Total settlement expectations are assumed to be in the order of 2 to 3 inches and about 1 inch for differential settlement. These assumptions do not include Clarifier No. 11, which typically allows more total and differential settlements.
Grading	Fill – fine grading, estimated at up to approximately 1 foot. Cuts – not anticipated.
Reject water pond	The existing reject water pond is surrounded by RIBS. The pond was reported to have been constructed with a 12 inch clay liner but details about the construction are not available. The effectiveness of the existing clay liner was evaluated.
Stormwater Management	A stormwater management pond is proposed to be constructed on the south west corner of the facility to assist with runoff from the proposed improvements.

2.2 Site Location and Description

Item	Description
Location	The existing plant is located on the south side of Alafaya Trail just east of Curry Ford Road in Orlando, Orange County, Florida.
Current ground cover	Developed with numerous structures, pavements, and ponds.

Item	Description
Existing topography	The USGS topographic quadrangle map Oviedo SW, Florida depicts the undeveloped topography as nearly level with gradual elevation changes, with native ground surface elevations ranging from about elevation +80 feet to +90 feet referencing the National Geodetic Vertical Datum of 1929 (NGVD29).

3.0 SUBSURFACE CONDITIONS

3.1 Regional Geology

The Soil Survey of Orange County, Florida, cites T. M. Scott of the Florida Geological Survey who wrote that Orange County is located in the north-central part of peninsular Florida, east and southeast of the crest of the Ocala Uplift, or the Ocala High. Two major, generalized physiographic divisions occur in Orange County. They are the Central Highlands and the Coastal Lowlands. The Central Highlands form the western one-third of the county, and the Coastal Lowlands (which include the project site) form the eastern two thirds.

Orange County is underlain by Upper Eocene limestone units of the Ocala Group. The surface of the limestone generally dips eastward from the outcrop area west of Orange County under an increasing thickness of younger materials. The sedimentary deposits immediately above the Upper Eocene limestone units are of the Hawthorn Group. The highly variable, diverse, lithologic character of the Hawthorn Group includes interbedded and interfingering sand, clayey sand, sandy clay, phosphatic sediment, dolomite, and limestone. .

Unconsolidated sand blankets the county. This sand consists of medium to fine sand and silt and does not contain clay or shell fragments. They are underlain in some areas by a shelly sand and clay, in other areas by the Hawthorn Group, and in a few scattered areas by limestone of the Eocene age. Shell beds of Miocene age through Pleistocene age occur in portions of the eastern part of the county.

3.2 General Potential for Sinkhole Development

The USGS Geological Survey map “Sinkhole Type, Development, and Distribution in Florida” prepared by the USGS in cooperation with state agencies (1985) divides Florida into four areas that have varying potentials for sinkhole development and type as follows:

- Area I. Bare or thinly covered limestone. Sinkholes are few, shallow and broad, and develop gradually. Solution Sinkholes dominate.

- Area II. Cover is 30 to 200 feet thick and consists mainly of in-cohesive and permeable sand. Sinkholes are few, shallow, of small diameter, and develop gradually. Cover-subsidence Sinkholes dominate.
- Area III. Cover is 30 to 200 feet thick and consists mainly of cohesive clayey sediments of low permeability. Sinkholes are most numerous, of varying size, and develop abruptly. Cover-collapse Sinkholes dominate.
- Area IV. Cover is more than 200 feet thick and consists of cohesive sediments interlayered with discontinuous carbonate beds. Sinkholes are very few, but several large diameter deep sinkholes occur. Cover-collapse Sinkholes dominate.

Review of the map listed above indicates the site is located in Area II. Review of the Florida Geological Survey sinkhole database indicates no reported sinkholes within three miles of the project site. It should be noted that according to the published literature and previous experience, the risk for sinkhole potential at the site general area is low. However, it is prudent to state that no special sinkhole explorations and evaluations were performed for each and every components of the project.

3.3 USDA – Soil Survey

The Soil Survey of Orange County, Florida, (print, CD/floppy disk, and web versions) as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS; later renamed the Natural Resource Conservation Service - NRCS), originally published in 1975, identifies the soil type at the subject site shown below:

Soil Type No.	Soil Types
3	Basinger Fine Sand, Depressional
34	Pomello Fine Sand, 0 to 5 percent slopes
37	St. Johns Fine Sand
44	Smyrna Fine Sand

It should be noted that the Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be encountered. Boundaries between adjacent soil types on the Soil Survey maps are approximate. Descriptions of the mapped soil units are included in Appendix A as Exhibit A-41.

3.4 Typical Profile of the Site

Based on the results of the performed borings within the anticipated improvement areas, subsurface conditions on the project site may be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13[1]	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 28	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense
3	28 to 43[2]	Silty fine sand (SM)	Loose to very dense
4	43 to 53[3]	Clayey fine sand to sandy clay (SC/CL)	Very loose to loose
5	53 to 100	Fine sand with silt to silty fine sand (SP-SM/SM)	Medium dense to dense

1. Auger borings AB-1 through AB-5 encountered silty fine sands (SM) ranging from 5 to 10 feet below existing grade.
2. Hardpan (SP-SM/SM) was encountered at borings B-1 and B-4 ranging from 28 to 38 feet below existing grade.
3. Fine sand with silt (SP-SM) and silty fine sand (SM) was encountered in this stratum at borings B-3 and B-4 within the depth range of this stratum.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. Descriptions of our field exploration are included as Exhibit A-40 in Appendix A. Descriptions of our laboratory testing procedures are included as Exhibit B-1 in Appendix B.

3.5 Groundwater

The boreholes for the proposed structures and retention ponds were observed during drilling for the presence and level of groundwater. Groundwater was observed in all the borings between depths of 2 and 6 feet below existing grade. It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was performed. In addition, perched water can develop within higher permeability soils (sands and sands with silt) overlying less permeable

soils (Hardpan). Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the boring logs.

We estimate that during the wet season, with rainfall and recharge at a maximum, groundwater levels will be at or within few feet below existing grades. Our estimates of the seasonal groundwater conditions are based on the USDA Soil Survey, the encountered soil types, and the encountered water levels. The following table summarizes the water depth and/or elevations of the encountered Groundwater Table (GWT) and the estimated Seasonal High Water Level (SHWL) at location of performed borings.

Boring #	Existing ground elevation, feet	Elevation of the encountered water table, feet	Elevation of the estimated SHWL, feet	Depth to the encountered water table, feet	Depth to the estimated SHWL, feet
AB-1	80.0	76	78	4	2
AB-2	80.05	76.05	78	4	2.05
AB-3	80.03	76.03	78	4	2.03
AB-4	80.37	76.37	78	4	2.37
AB-5	79.24	77.24	78	2	1.24
AB-6	79.6	75.6	78	4	1.6
B-1	---	---	---	2	0.5
B-2	---	---	---	3.5	1
B-3	---	---	---	3.5	1
B-4	---	---	---	3	1
B-5	---	---	---	5	2.5
B-6	---	---	---	5	2.5
B-7	---	---	---	3.5	1.5
B-8	---	---	---	NE @10 feet	1.5
B-9	---	---	---	NE @10 feet	1.5
B-10	---	---	---	3.5	1.5
B-11	---	---	---	NE @10 feet	1
B-12	---	---	---	3.5	1.5
B-13	---	---	---	NE @10 feet	1
B-14	---	---	---	6	2
B-15	---	---	---	4	2
B-16	---	---	---	4	2
B-17	---	---	---	3.5	2

Boring #	Existing ground elevation, feet	Elevation of the encountered water table, feet	Elevation of the estimated SHWL, feet	Depth to the encountered water table, feet	Depth to the estimated SHWL, feet
B-18	---	---	---	3	1.5
B-19	---	---	---	4	2
B-20	---	---	---	5.5	2.5
B-21	---	---	---	3	1.5
B-22	---	---	---	4	2
B-23	---	---	---	4	2

Piezometers were installed in the boreholes that were drilled for the reject pond with surrounding RIBS. The piezometers were installed to the boring termination depth of 15 feet below the existing berm between the reject pond and the RIBS. The following table summarizes the groundwater observed in all the piezometers before, during, and after loading the reject pond (explained later in the report).

Boring # (Piezometer #)	**Groundwater Depth in feet below Ground Surface**				
	Initial Reading	3/27/2012 at 3:30pm	3/28/2012 at 10:19 am	3/29/2012 at 12.48pm	3/30/2012 at 12:30pm
B-24 (1)	6.00	3.67	3.50	3.50	3.42
B-25 (6)	3.00	3.00	2.67	2.67	2.42
B-26 (5)	---	3.00	2.67	2.67	3.00
B-27 (4)	5.00	3.00	5.08	4.42	5.08
B-28 (3)	4.00	3.33	1.42	1.42	1.42
B-29 (2)	7.50	1.58	1.50	1.42	1.42

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The following conclusions and recommendations are based on the project characteristics previously described, the data obtained in our field exploration and our experience with similar subsurface conditions and construction types. If the proposed construction is significantly different from what is previously described in this report, or if subsurface conditions different

from those disclosed by the borings are encountered during construction, we should be notified immediately so that we might review and modify, if necessary, the following recommendations in regards to such changes.

Support of foundations on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the original fill may go undetected. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but could be reduced by performing additional testing and/or review of earthwork monitoring and testing reports from the original facility construction.

Our recommendations regarding design and construction of each proposed improvement to the facility is provided in the following sections.

4.2 Clarifier No. 11

Four (4) SPT borings, designated B-1 through B-4, were performed to depths of 75 to 100 feet below the existing ground surface in the proposed Clarifier Tank No. 11 area. Based on the provided construction plans, the proposed clarifier is 125 feet in diameter and about 15 feet in height with a 2.5 feet thick slab embedded about 5 to 6 feet.

Based on the results of the borings, the subsoil conditions at the Clarifier No. 11 can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13[1]	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 28	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense
3	28 to 43[2]	Silty fine sand (SM)	Loose to very dense
4	43 to 53[3]	Clayey fine sand to sandy clay (SC/CL)	Very loose to loose
5	53 to 100	Fine sand with silt to silty fine sand (SP-SM/SM)	Medium dense to dense

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density

1. All borings for the Clarifier No. 11 were water jetted from 6 to 12 feet below existing grade to clear deep utilities that may have been encountered while drilling.
2. Hardpan (SP-SM/SM) was encountered in this stratum at borings B-1 and B-4 ranging from 28 to 38 feet below existing grade.
3. Fine sand with silt (SP-SM) and silty fine sand (SM) was encountered at borings B-3 and B-4 within the depth range of this stratum.

In our opinion, the proposed Clarifier No. 11 can be supported by conventional shallow foundation bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations. Design recommendations for shallow foundations for the proposed Clarifier No. 11 are presented in the following table:

Description	Clarifier No. 11
Net allowable bearing pressure [1] ■ **Compacted structural fill or native soils**	2,500 psf
Minimum foundation embedment[2]	3 feet
Estimated or provided average contact pressure below the tank	1200 psf (maximum)
Approximate total settlement from at the center of the tank [3]	About 3 inches[4]
Estimated differential settlement between the center and the perimeter of the tank [3]	About 1 ½ inches[4]
Minimum Compaction Requirements	A minimum of 95% of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads have assumed that the tank floor diameter is 125 feet.
4. Clarifier Tank will have to be preloaded with water prior to connecting the pipe in order to advance the settlement and minimize post-construction settlement, which might lead to pipe breakage.

4.3 Preliminary Treatment Structure and Truck Loading Building

Three (3) SPT borings, designated B-5 through B-7, were performed to depths of between 15 and 25 feet below the existing ground surface in the proposed Pretreatment Structure area. Based on the given construction plans, the proposed preliminary treatment structure is approximately 27 feet high with multiple concrete chambers throughout the structure. The drawing showed the foundation system to consist of a 2 feet thick continuous slab supporting the entire structure.

Based on the results of the borings, subsurface conditions at the Pretreatment Structure can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 25	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense

In our opinion, the proposed Preliminary Treatment Structure can be supported by a shallow foundation system bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations. Design recommendations for shallow foundations for the proposed Preliminary Treatment Structure are presented in the following table:

Description	Preliminary Treatment Structure
Net allowable bearing pressure [1] ■ **Compacted structural fill or native soils**	2,500 psf
Minimum foundation embedment [2]	3 feet
Provided average contact pressure below the foundations	1800 to 2200 psf
Approximate total settlement assuming the pretreatment structure is full of water (1900 psf) [3]	About 2½ to 3½ inches
Estimated differential settlement between the center and the perimeter assuming the pretreatment structure is full of water (2200 psf) [3]	About 1 to 2 inches

Description	Preliminary Treatment Structure
Minimum Compaction Requirements	A minimum 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads assumed that the foundation/slab size is 65 feet in width and 120 feet in length.

4.4 Filters and Chlorine Contact Chamber Structures

Four (4) SPT borings, designated B-8 through B-11, were performed to depths of 30 feet below the existing ground surface in the proposed Filter and Chlorine Contact Chamber Structures area. Based on the given construction plans 60 % submittal (sheets S-580-101 and S-540-301 dated January 2012), the proposed structure is approximately 15.5 feet in height. The proposed foundation system consists of a 1.3 feet thick continuous slab to support the entire weight of the structure loads.

Based on the results of the borings, subsurface conditions at the Filter and Chlorine Contact Chamber Structures can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13[1]	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 30	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense

1. Silty fine sand (SM) was encountered in this stratum at boring B-11 between 4 to 6 feet below existing grade.

In our opinion, the proposed Filter and Chlorine Contact Chamber Structures can be supported on a shallow foundation system bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations.

Design recommendations for shallow foundations for the proposed Filter and Chlorine Contact Chamber Structures are presented in the following table:

Description	Filters and Chlorine Contact Chamber Structures
Net allowable bearing pressure [1] ■ **Compacted structural fill or native soils**	2,500 psf
Minimum foundation embedment [2]	2 feet
Estimated or provided average contact pressure below the foundations	975 psf (maximum)
Approximate total settlement from foundation loads [3]	About 2 inches
Estimated differential settlement from foundation loads [3]	About 1 inch
Minimum Compaction Requirements	A minimum of 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads have assumed that the foundation/slab size is 55 feet in width and 106 feet in length.

4.5 Secondary Effluent Reject and RAS/WAS Pump Stations

One (1) SPT boring, designated B-12 was performed to a depth of 30 feet below the existing ground surface in the proposed Secondary Effluent Reject Pump Station areas. Also, two (2) SPT borings, designated B-21 and B-22, have been performed to depths of 30 feet below the existing ground surface in the proposed RAS/WAS Pump Station areas. Based on the given construction plans 60 % submittal (sheet S-560-101 dated January 2012), the proposed structure that will contain the Secondary Effluent Reject Pump station is approximately 28 feet in height with the proposed foundation bottom being 16 feet below final grade. The proposed foundation system consists of a 2.3 feet thick continuous slab to support the entire weight of the pump station. The RAS/WAS Pumps are supported on concrete pads above grade with minimal loading.

Based on the results of the borings, subsurface conditions at the Secondary Effluent Reject and RAS/WAS Pump Stations can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13[1]	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 30	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense

1. Silty fine sand (SM) was encountered in this stratum at boring B-12, B-21, and B-22 between 4 to 8 feet below existing grade.

In our opinion, the proposed Secondary Effluent reject and RAS/WAS Pump Stations can be supported by a shallow foundation system bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations. Design recommendations for shallow foundations for the proposed Secondary Effluent reject and RAS/WAS Pump Stations are presented in the following table:

Description	Secondary Effluent Reject Pump Stations	RAS/WAS Pump Stations
Net allowable bearing pressure [1] ■ **Compacted structural fill or native soils**	2,500 psf	1,500 psf
Minimum footing embedment[2]	4 feet	12 inches
Approximate total settlement from foundation loads	about 1 inch	about 1 inch
Estimated differential settlement from foundation loads	about ½ inch	about ½ inch
Minimum Compaction Requirements	A minimum of 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom	A minimum of 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.

For the Secondary Effluent Reject Pump Stations, the construction should also be sequenced so that a dewatering system, if necessary, is not turned off until the pump station has enough weight to counteract an uplift force equivalent to the amount of water displaced. It may also be prudent to place additional concrete in the structure foundation to provide ballast against such uplift force. This uplift force should account for the head difference from the bottom elevation of the foundation to the seasonal high groundwater level or the groundwater level at the time of construction, whichever is most shallow, plus any possible flooding conditions that may occur at the project site.

For calculations of resistance to the uplift force, 50 pounds per cubic foot may be used for the buoyant unit weight of the soil. The buoyant weight of the concrete and overlying soils below the seasonal high groundwater level should be used in calculating the necessary amount of ballast required.

4.6 Supplemental Carbon Feed Building

Three (3) SPT borings, designated B-15 through B-17, were performed to depths of 25 feet below the existing ground surface in the proposed Supplemental Carbon Feed building area. Based on the given construction plans 60 % submittal (sheet S-520-101 dated January 2012), the proposed Supplemental Carbon Feed building includes four (4) 6100 Gallon IMFO tanks covered by light steel structure. The IMFO tank is 10 feet in diameter and 12 feet in height. The light steel building inclosing the tanks is about 30 feet by 45 feet.

Based on the results of the borings, subsurface conditions at the Supplemental Carbon Feed Building can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13[1]	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 30	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense

1- Silty fine sand (SM) was encountered in this stratum at boring B-17 within 4 to 8 feet below existing grade.

In our opinion, the proposed Supplemental Carbon Feed Building can be supported by a shallow foundation system bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations. Design

recommendations for shallow foundations for the proposed Supplemental Carbon Feed Building are presented in the following table:

Description	Supplement Carbon Feed Building
Net allowable bearing pressure [1] ■ **Compacted structural fill or native soils**	2,000 psf
Minimum footing embedment[2]	18 feet
Estimated or provided average contact pressure below the foundations	800 psf (maximum for the tanks)
Approximate total settlement from foundation loads[3]	About 1 ½ inch
Estimated differential settlement from foundation loads	About ½ inch between center and perimeter of the tank
Minimum Compaction Requirements	A minimum of 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads have assumed that the maximum tank footing size is about 12 feet in diameter (separate footings for each tank).

4.7 Secondary Effluent Reject Diversion Structures

Three (3) SPT borings designated B-18 through B-20, were performed to depths of 25 feet below the existing ground surface in the proposed Secondary Effluent Diversion Structures area. Based on the given construction plans 60% submittal (sheets S-562-101, S-562-101 and, S-563-101 dated January 2012), the proposed diversion structure is 16 feet in height with the proposed foundation bottom being 2 feet and 9 feet below final grade. The proposed foundation system consists of 1.3 to 2 feet thick continuous slab to support the entire weight of the Effluent Diversion Structure.

Based on the results of the borings, subsurface conditions at the Secondary Effluent Diversion Structures can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 13[1]	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	13 to 30	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense

1. Silty fine sand (SM) was encountered in this stratum at boring B-18 between 6 to 13.5 feet below existing grade.

In our opinion, the proposed Secondary Effluent Diversion Structures can be supported by a shallow foundation system bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations. Design recommendations for shallow foundations for the proposed Secondary Effluent Diversion Structures are presented in the following table:

Description	Secondary Effluent Diversion Structures
Net allowable bearing pressure[1] ■ **Compacted structural fill or native soils**	2,500 psf
Minimum footing embedment[2]	2 feet
Estimated or provided average contact pressure below the foundation/slab	1100 psf (maximum)
Approximate total settlement from foundation loads[3]	About 1 ½ inches
Estimated differential settlement from foundation loads[3]	About ½ inch
Minimum Compaction Requirements	A minimum of 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads have assumed that the footing size is 15 feet by 15 feet supporting the entire weight of the Secondary Effluent Diversion Structure.

4.8 West Electrical Building

Two (2) SPT borings, designated B-13 and B-14, were performed to depths of 25 feet below the existing ground surface in the proposed West Electrical Building area. Based on the given construction plans 60% submittal (sheet S-575-101 dated January 2012), the proposed West Electrical Building is a one-story, cast in place concrete building with a 10" hollow core roofing system. The total area of the West Electrical Building is 1200 square feet and supported on a standard strip footing foundation system.

Based on the results of the borings, subsurface conditions at the West Electrical Building can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	N/A to 6	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense
2	6 to 13	Silty fine sand (SM)	Medium dense
3	13 to 30	Fine sand with silt to silty fine sand (hardpan) (SP-SM/SM)	Medium dense to very dense

In our opinion, the proposed West Electrical Building can be supported by a shallow foundation system bearing on native soil or newly placed fill extending to native soil. The contractor is responsible to follow all proper site preparations according to the Earthwork and Temporary Dewatering sections of this report before construction of foundations. Design recommendations for shallow foundations for the proposed West Electrical Building are presented in the following table:

Description	West Electrical Building
Net allowable bearing pressure[1] ■ **Compacted structural fill or native soils**	2,000 psf
Minimum foundation embedment[2]	2 feet
Estimated or provided average contact pressure below the foundations	4000 pounds per lineal foot
Approximate total settlement from foundation loads[3]	About 1 inch
Estimated differential settlement from foundation loads[3]	about ½ inch per 40 feet

Description	West Electrical Building
Minimum Compaction Requirements	A minimum of 95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557) to a depth of 24 inches below footing bottom

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads have assumed that the maximum strip footing size is 2 feet in width.

4.9 Stormwater Management Pond

We anticipate a shallow dry stormwater retention pond will be used. Dry retention ponds generally need to be at least 2 feet above the seasonal high water table to recover within the time required by SJRWMD, although actual recovery performance will vary with pond geometry as well as soil and groundwater conditions.

The auger borings at the proposed stormwater management pond location encountered fine sand to 6 feet and silty fine sand to the termination depth of 10 feet. A somewhat restrictive layer was encountered at 13 feet below existing grade at adjacent boring location B-10.

Laboratory permeability tests were performed on relatively undisturbed samples of the anticipated stormwater pond subgrade soil at Boring locations AB-1 and AB-4 at depths of 3 and 3.5 feet below existing grade. The measured permeability rates were 21 and 38 feet per day for Borings AB-1 and AB-4, respectively. This value is indicative of the saturated vertical permeability. The vertical permeability is on the order of ½ to 2/3 of the horizontal permeability rate for the observed soil types. Recommended design values based on our experience and the potential for pond bottom siltation or hydro-compaction as presented in the table below:

Parameters	Recommended Values
Estimated elevation of the restrictive layer	+74 feet
Estimated elevation of the Seasonal High Water Table Depth	+78 feet

Recommended Unsaturated Vertical Permeability, k_V	15 feet/day
Recommended Horizontal Saturated Hydraulic Conductivity, k_H	25 feet/day
Fillable Porosity, η	25 percent

4.10 Reject Pond and Rapid-Infiltration Basins (RIBs)

Six (6) SPT borings and six (6) piezometers, designated B-24 through B-29, were performed to depths of 15 feet below the existing berm surface in the proposed West Reject Pond and RIBs area. Based on the results of the borings, subsurface conditions at the Reject Pond and RIBs can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	0 to 15	Fine sand to fine sand with silt (SP/SP-SM)	Loose to medium dense

A site visit was conducted by a Senior Geotechnical Engineer and a Senior Geotechnical Technician of Terracon to evaluate the presence or absence of a liner as was shown on the record drawings for the reject pond bottom. A series of hand auger borings were performed at different locations of the reject pond bottom to depths of 3 to 5 feet. The borings encountered clean sands to silty sands. No clays or clayey sands that might be indicative of a pond bottom liner were encountered.

The piezometers were installed at each boring to about a depth of 15 feet below the existing grade of the berm in between the reject pond and the RIBS. The main purpose of the piezometers was to monitor the water depth at the berm between the reject pond and the RIBs prior to loading the pond. The piezometers were then monitored during and after the pond was loaded; it was anticipated that an increase in the water level in the piezometers should be an indication of the deficiency or lack of reject pond liner or cutoff. The results of piezometer readings are summarized in the following table.

Boring # (Piezometer #)	Groundwater Depth in feet below Ground Surface				
	Initial Reading	3/27/2012 at 3:30pm	3/28/2012 at 10:19 am	3/29/2012 at 12.48pm	3/30/2012 at 12:30pm
B-24 (1)	6.00	3.67	3.50	3.50	3.42

Boring # (Piezometer #)	Groundwater Depth in feet below Ground Surface				
	Initial Reading	3/27/2012 at 3:30pm	3/28/2012 at 10:19 am	3/29/2012 at 12.48pm	3/30/2012 at 12:30pm
B-25 (6)	3.00	3.00	2.67	2.67	2.42
B-26 (5)	---	3.00	2.67	2.67	3.00
B-27 (4)	5.00	3.00	5.08	4.42	5.08
B-28 (3)	4.00	3.33	1.42	1.42	1.42
B-29 (2)	7.50	1.58	1.50	1.42	1.42

Given the above as well as the data collected by AECOM during and after the reject pond loading, it is our opinion that the reject pond leaks substantial amount of water either due to the total lack of a liner of a substantially diffident liner. A new liner should be installed in order to control reject water seepage through the side slopes and the bottom of the reject pond. A few options are available such as compacted clay liners, geosynthetic clay liners, or geomembrane liners (HDPE or PVC). The liner will need to be anchored at the top of slope as shown on the typical detail for PVC liner top anchor shown on Exhibit A-41 in Appendix A.

For the selected liner, the effect of uplift force due to seepage through the berm from the RIBs to the reject pond when the RIBs are totally filled or at extreme hydrostatic conditions, were studied. The maximum uplift pressure at bottom of slope and along the reject pond bottom is in the order of 190 psf, which corresponds to about 3 feet of hydrostatic pressure (elevation +99 to +88 feet). Terracon recommend a minimum ballast of two (2) feet of soil compacted to a minimum dry density of 105 on top of the PVC liner to counteract the effect of uplift.

4.11 Utility Pipes

Soils encountered in the borings appear suitable to support the proposed pipelines where applicable, with some limitations. Regarding the pipe subgrade soils, we offer the following recommendations:

- The soils encountered in the borings appear suitable to support the proposed pipeline where applicable.
- Hardpan type soils were encountered at depths of about 10 to 15 feet below ground surface. Hardpan soils are cemented and might need special equipment to excavate and handle. The contractor should anticipate such soil and such equipment need if excavations in the order of 10 to 15 feet are anticipated.

- If unsuitable soils (muck, organics, clayey soils, etc.) are encountered during construction, they should be completely removed below the pipe bottom, replaced with well-draining granular sands with a fines content of 12 percent or less passing the No. 200 U.S. Standard sieve by weight, and compacted to at least 95 percent of the soils' modified Proctor maximum dry density (ASTM D-155), or at least 98 percent of the soils' modified Proctor maximum dry density for paved areas.
- The bedding soil beneath the pipe should be properly shaped to completely support the pipe section and areas should be excavated to accommodate any bells or other raised portions of the pipe to help avoid point loading conditions.
- A minimum separation of 2 feet between the bottom of the compacted subgrade level and the groundwater level is recommended during construction and backfilling operations. A properly designed dewatering system may be required to maintain this minimum separation.
- After the subgrade soils have been prepared as recommended above, the pipe may be installed.

Regarding the pipe backfill soils we offer the following recommendations:

- Compaction of backfilled soils around the pipe should be accomplished in lift thicknesses no thicker than 12 inches.
- Generally, the soils encountered in the borings should be suitable for use as pipe backfill.
- The near surficial site soils appear suitable for use as pipe backfill.
- At least one (1) density test per 300 lineal feet of pipe length per lift, and/or a minimum of two (2) tests, should be performed to verify that the soil has been compacted to at least 95 percent of its modified Proctor maximum dry density (ASTM D-1557), or at least 98 percent of the soils' modified Proctor maximum dry density for paved areas.

If compaction difficulties arise during construction, the Geotechnical Engineer should be consulted to provide further recommendations.

4.12 Earthwork

4.12.1 Site Preparation

We anticipate construction will be initiated by clearing any surface debris that may have accumulated on the site and stripping the topsoil. Stripping depths between our boring locations and across the site could vary and we recommend actual stripping depths be evaluated by a representative of Terracon during construction.

Once stripping is complete, the exposed subgrade should be observed, tested and proofrolled with a minimum of 10 overlapping passes of a medium or heavy weight roller (minimum 10,000

pounds static weight) operating in static mode due to the proximity to existing structures. Proofrolling aids in providing a firm base for compaction of new fill and delineating soft or disturbed areas that may exist at or near the exposed subgrade level as well overall densification of the upper loose sands. Proofrolling should be performed in the presence of a Terracon representative in order to aid in evaluating unstable subgrade areas. Unstable areas observed at this time should be improved as recommended by the engineer based on field conditions and typically includes scarification and recompaction or by undercutting and replacement with suitable compacted fill.

4.12.2 Material Requirements

Compacted structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
General [1]	SP to SP-SM (fines content < 10 percent)	All locations and elevations

1. The in-place sands and sands with silt appear to meet this criterion.

4.12.3 Compaction Requirements

Item	Description
Fill Lift Thickness	12 inches or less in loose thickness when heavy compaction equipment is used in vibratory mode. Lift thickness should be decreased if static compaction is being used, typically to no more than 8 inches, and the required compaction must still be achieved. 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Compaction Requirements [1]	A minimum of 95% of the material's maximum modified Proctor dry density (ASTM D 1557)
Moisture Content	Within ±2 percent of optimum moisture content as determined by the Modified Proctor test, at the time of placement and compaction.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

4.12.4 Grading and Drainage

Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Roof drainage should discharge to the stormwater system or a minimum of 10 feet beyond the footprint of the proposed structures.

4.12.5 Temporary Dewatering

Groundwater was observed at depths ranging from about 2 to 6 feet throughout the site area in the open boreholes at the time of drilling. Seasonal high groundwater levels are estimated to be at or just below the ground surface to 3 feet below the existing ground surface at the boring locations. Based on this information and the proposed embedment depths of the foundations and pipes, dewatering will be required to facilitate construction, backfill and compaction in the dry. Regarding dewatering, we offer the following recommendations:

- Dewatering operations at this site for pipe installation should be accomplished with a properly designed dewatering system operating outside the excavation limits.
- The dewatering system should be adequate to lower groundwater levels to at least 2 feet below the lowest compaction surface and keep it there during backfilling to facilitate excavations in the dry and proper compaction of bedding and backfill soils.
- The Contractor should review the boring profiles prior to implementing the dewatering system to be aware of anticipated soils. Wellpoint dewatering may not be effective in all cases, or in hardpan type soils.
- The construction should be sequenced so that the dewatering system is not turned off until pipes have enough weight placed over it to counteract an uplift force equivalent to the height of standing water above the base of the pipe. The resisting weight of soil over the pipe should be calculated using the buoyant unit weight of the soil.

4.12.6 Earthwork Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of static compaction and/or light construction equipment would aid in reducing subgrade disturbance.

Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and re-compacted prior to floor slab and pavement construction.

As a minimum, all temporary excavations should be sloped or braced as required to comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

4.13 Foundation Construction Consideration

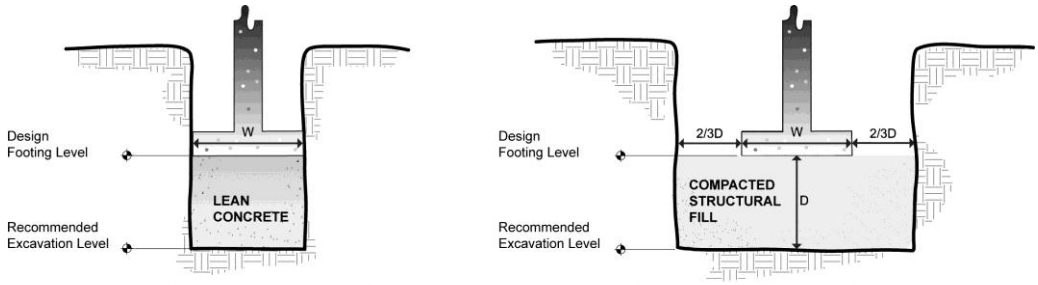
4.13.1 Piping Connection

Due to the sandy subsurface conditions, estimated settlements are expected to be mostly elastic, occurring during and shortly after construction. Also, based on prior experience, we have generally observed settlement of heavy structures to be less than predicted for these soil types. We recommend that the tanks and other structures that include pipe connections to be water-filled and test-loaded, with settlement observations and monitoring, prior to final piping connections, to advance the settlement and minimize post-construction settlement.

4.13.2 Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, the affected soil should be moisture conditioned and recompacted or removed prior to placing concrete. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

Terracon anticipates hand-operated compaction equipment will be utilized, as necessary, in footing cuts, following any mass grading. It should be noted that footing subgrade preparation requires compaction for a depth of 2 feet below foundation bearing elevations for most structures, which in some cases may require overexcavation to achieve. If unsuitable bearing soils are encountered in footing excavations, the excavation should be extended deeper to suitable soils and the footing could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. As an alternative, the footings could also bear on properly compacted backfill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation per the preceding general earthwork specifications, using hand operated compaction equipment in footing cuts. The overexcavation and backfill procedure is described in the following figure.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

5.0 GENERAL COMMENTS

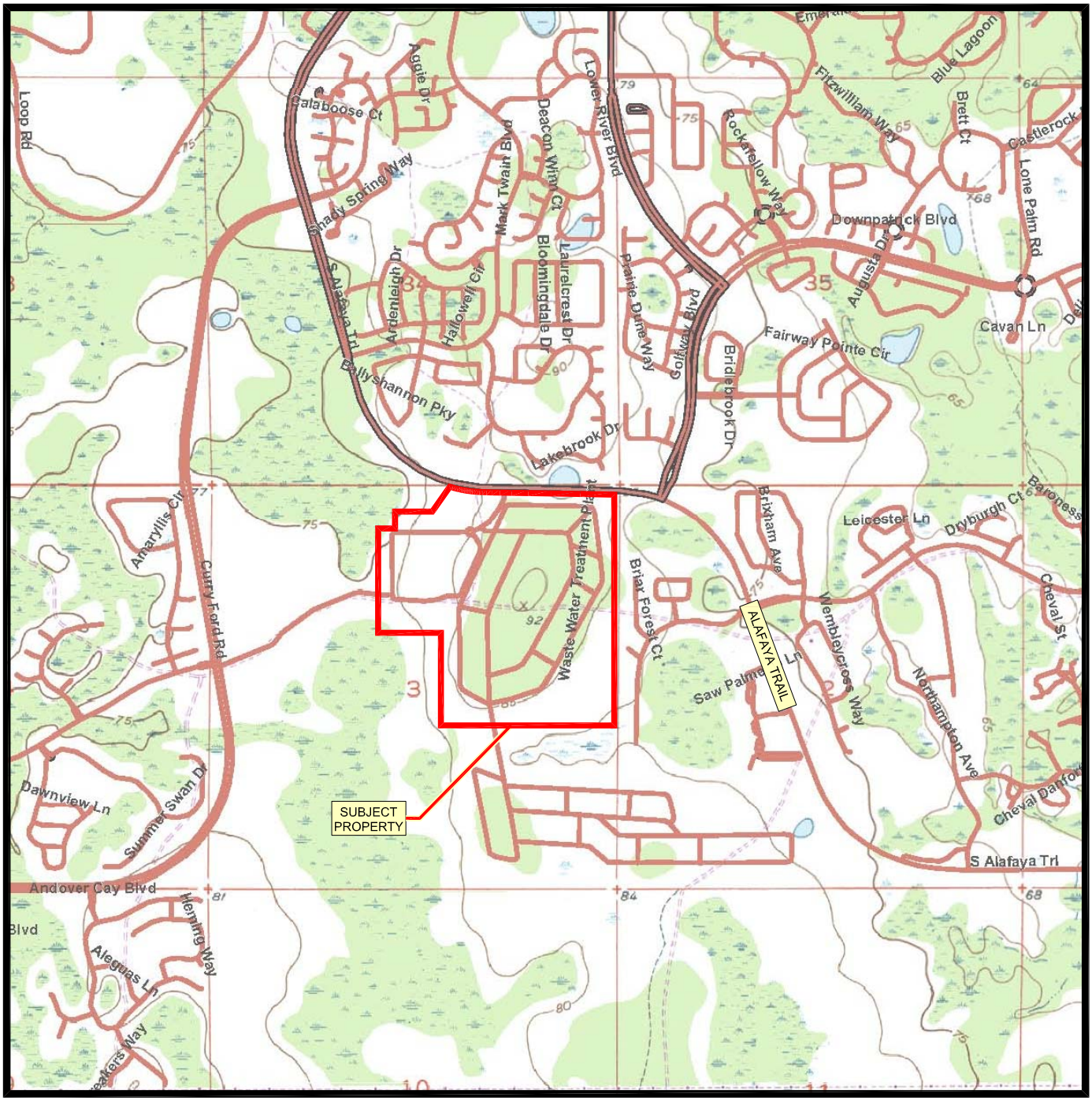
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

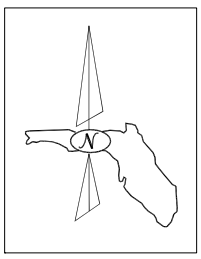
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

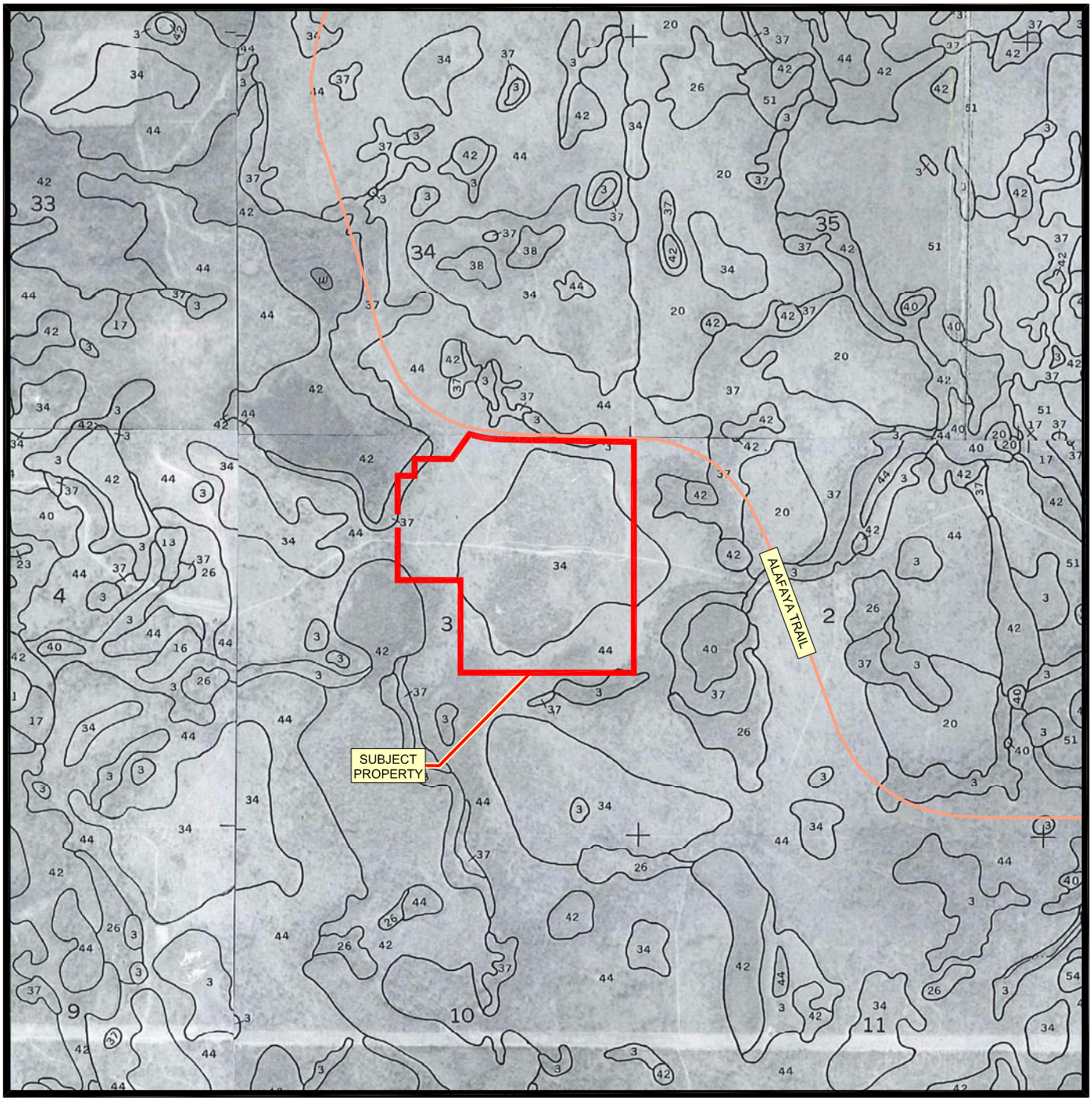


REFERENCE: U.S.G.S. "OVIEDO SW, FLORIDA" QUADRANGLE MAP ISSUED: 1953 REVISED: 1980
SECTION: 3
TOWNSHIP: 23 SOUTH
RANGE: 31 EAST
SCALE: 1" = 2000'

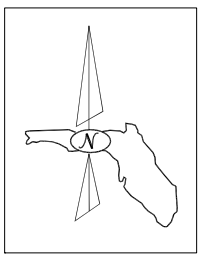


U.S.G.S. QUADRANGLE MAP
EASTERN WATER RECLAMATION FACILITY
PHASE V IMPROVEMENTS
ORANGE COUNTY, FLORIDA

DRAWN: MG	NODARSE A Terracon COMPANY	
CHKD: KCM		
SCALE: 1"=2000'		
DATE: 3-8-12	PROJ. NO: H1115424	EXHIBIT: A-1



REFERENCE: U.S.D.A. ORANGE COUNTY, FLORIDA SOIL SURVEY
ISSUED: AUGUST 1989
SECTION: 3
TOWNSHIP: 23 SOUTH
RANGE: 31 EAST
SCALE: 1" = 2000'

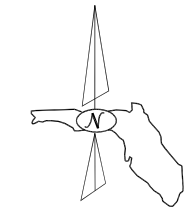


SOIL LEGEND

3	BASINGER FINE SAND, DEPRESSIONAL
34	POMELLO FINE SAND, 0 TO 5 PERCENT SLOPES
37	ST. JOHNS FINE SAND
44	SMYRNA FINE SAND

SOILS MAP
EASTERN WATER RECLAMATION FACILITY
PHASE V IMPROVEMENTS
ORANGE COUNTY, FLORIDA

DRAWN: MG	NODARSE A Terracon COMPANY	
CHKD: KCM		
SCALE: 1"=2000'		
DATE: 3-8-12	PROJ. NO: H1115424	EXHIBIT: A-2



SCALE IN FEET

0 200 400

LEGEND

APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

BORING LOCATION PLAN
EASTERN WATER RECLAMATION FACILITY
PHASE V IMPROVEMENTS
ORANGE COUNTY, FLORIDA

DRAWN: MG	NODARSE A Terracon COMPANY		
CHKD: KCM			
SCALE: NOTED			
DATE: 3-8-12	PROJ. NO: H1115424	EXHIBIT: A-3	

N

SCALE IN FEET

0 100 200

LEGEND

APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

APPROXIMATE LOCATION OF AUGER BORING

BORING LOCATION PLAN
EASTERN WATER RECLAMATION FACILITY
PHASE V IMPROVEMENTS
ORANGE COUNTY, FLORIDA

DRAWN: MG	NODARSE A Terracon COMPANY		
CHKD: KCM			
SCALE: NOTED			
DATE: 3-8-12	PROJ. NO: H1115424	EXHIBIT: A-4	

Apr12, 2012-1:25pm N:\Projects\2011\H1115424\PROJECT DOCUMENTS (Reports-Letters-Drafts to Clients)\Cad\H1115424-Exhibit-A-4.dwg

Field Exploration Description

The boring locations were laid out at the project site by Terracon personnel. The locations indicated on the attached diagram are approximate and were measured by pacing distances and estimating right angles, across vegetated/wooded terrain. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The SPT soil borings were drilled with a truck-mounted or mini rig, rotary drilling rig equipped with a rope and cathead-operated safety hammer. The boreholes were advanced with a cutting head and stabilized with the use of bentonite (drillers' mud). Soil samples were obtained by the split spoon sampling procedure in general accordance with the Standard Penetration Test (SPT) procedure. In the split spoon sampling procedure, the number of blows required to advance the sampling spoon the last 12 inches of an 18-inch penetration or the middle 12 inches of a 24-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N). This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs.

Portions of the samples from the borings were sealed in glass jars to reduce moisture loss, and then the jars were taken to our laboratory for further observation and classification. Upon completion, the boreholes were backfilled with the site soil.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation of the samples.

A CME automatic SPT hammer was used in selected borings to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

LOG OF BORING NO. AB-1

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Storm Drain Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %	Perm. (ft/day)
	FINE SAND WITH SILT gray to brown ▼		SP SM	1	HS						
		5	SP SM	2	HS			14	6		Kv = 21
	8.5										
	10 **SILTY FINE SAND** brown to dark brown	10	SM	3	HS						

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUGER	FOREMAN	MARK
EXHIBIT:	A-6	JOB #	H1115424

LOG OF BORING NO. AB-2

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Storm Drain Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown to brown		SP	1	HS					
	3.5									
	FINE SAND WITH SILT grayish brown to brown	5	SP SM	2	HS			30	11	
	5.5									
	SILTY FINE SAND brown to dark brown		SM	3	HS					
	10	10								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUGER	FOREMAN	MARK
EXHIBIT:	A-7	JOB #	H1115424

LOG OF BORING NO. AB-3

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Storm Drain Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown to brown		SP	1	HS					
			SP	2	HS					
			SP	3	HS					
	4 ▼		SP	4	HS			22	7	
	5 **FINE SAND WITH SILT** brown	5	SM	5	HS					
			SM	6	HS					
	SILTY FINE SAND brown to dark brown		SM	7	HS					
			SM	8	HS					
	10	10	SM	9	HS					
			SM	10	HS					
			SM							

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUGER	FOREMAN	MARK
EXHIBIT:	A-8	JOB #	H1115424

LOG OF BORING NO. AB-4

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Storm Drain Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %	Perm. (ft/day)
	FINE SAND grayish brown to brown		SP	1	HS						
			SP	2	HS						
	4 ▼										
	SILTY FINE SAND brown to dark brown	5	SM	3	HS			15	3		Kv = 38
			SM	4	HS						
	10	10									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUGER	FOREMAN	MARK
EXHIBIT:	A-9	JOB #	H1115424

LOG OF BORING NO. AB-5

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Storm Drain Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	1 **FINE SAND WITH SILT** gray to brown		SP	1	HS					
	2.5		SM	2	HS					
	3.5 **FINE SAND** grayish brown to brown		SP	3	HS			20	5	
	FINE SAND WITH SILT gray to brown	5	SP SM	4	HS					
	SILTY FINE SAND		SM	5	HS					
	10 brown to dark brown	10								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 2.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUGER	FOREMAN	MARK
EXHIBIT:	A-10	JOB #	H1115424

LOG OF BORING NO. AB-6

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Storm Drain Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND WITH SILT		SP	1	HS					
	gray to dark brown ▼		SM	2	HS					
			SP							
			SM	3	HS					
		5	SP							
			SM	4	HS					
			SP							
			SM	5	HS			23	5	
	10	10	SP							
			SM							

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUGER	FOREMAN	MARK
EXHIBIT:	A-11	JOB #	H1115424

LOG OF BORING NO. B-01

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Clarifier No. 11

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %	
	FINE SAND WITH SILT gray to brown, very loose to loose ▼		SP	1	HA		3*				
			SM								
			SP	2	HA		4*				
		5	SM								
	6		SP	3	HA		5*				
	JETTED FROM 6' TO 12' FOR UTILITIES		SM								
		10									
	12										
	13.5 **FINE SAND WITH SILT** gray to brown, loose		SP	4	SS		9	27	5		
			SM	5	SS		14				
	SILTY FINE SAND brown to dark brown, medium dense	15	SM								
	-hardpan										
		20	SM	6	SS		24				
	23.5										
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, medium dense to very dense	25	SP	7	SS		50/6"				
			SM								
			SP	8	SS		41				
		30	SM								
			SP	9	SS		14				
		35	SM								
	38.5										
	SILTY FINE SAND brown to dark brown, medium dense	40	SM	10	SS		13				
	43.5										
	SILTY FINE SAND gray to greenish gray, very loose	45	SM	11	SS		2				
	47		SM	12	ST			33	37		LL = 33 PI = 9
	FINE SAND WITH SILT gray to brown, loose to dense		SP	13	SS		7				
			SM	14	SS		24				
		50									
	Continued Next Page										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL ▽	▼ 2	WD	
WL ▼	▼		
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-12	JOB #	H1115424

LOG OF BORING NO. B-01

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND WITH SILT gray to brown, loose to dense	55	SP SM	15	SS		37			
		60	SP SM	16	SS		24			
		65	SP SM	17	SS		29			
		70	SP SM	18	SS		19			
	73.5									
	75 **SILTY FINE SAND** greenish gray, medium dense	75	SM	19	SS		23			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 2	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-12	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-02

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Clarifier No. 11

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %	
	FINE SAND grayish brown to brown, very loose to loose		SP	1	HA		2*				
			SP	2	HA		4*				
	4 ▼										
	SILTY FINE SAND brown to dark brown, loose	5	SM	3	HA		3*				
	6										
	JETTED FROM 6' TO 12' FOR UTILITIES	10									
	12										
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, medium dense to dense	15	SM	4	SS		18				
			SM	5	SS		25				
		20	SM	6	SS		40				
		25	SM	7	SS		36				
	28.5										
	FINE SAND WITH SILT orange-brown, dense	30	SP SM	8	SS		32				
	33.5										
	SILTY FINE SAND brown to dark brown, medium dense	35	SM	9	SS		21				
		40	SM	10	SS		25				
	43.5										
	SILTY CLAY TO CLAYEY SILT tan, loose	45	CH	11	SS		6	60	61		LL = 52 PI = 30
	48.5										
		50	SC	12	SS		9				

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	2-13-12		
BORING COMPLETED	2-13-12		
RIG AUTO HAM.		FOREMAN	DOUG
EXHIBIT:	A-13	JOB #	H1115424

LOG OF BORING NO. B-02

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	CLAYEY FINE SAND tan, loose									
	53.5 **FINE SAND WITH SILT** tan, loose to dense	55	SP SM	13	SS		8	27	10	
		60	SP SM	14	SS		29			
		65	SP SM	15	SS		31			
		70	SP SM	16	SS		20			
	73.5									
	75 **SILTY FINE SAND** tan, medium dense	75	SM	17	SS		28			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	2-13-12		
BORING COMPLETED	2-13-12		
RIG AUTO HAM.		FOREMAN	DOUG
EXHIBIT:	A-13	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-03

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Clarifier No. 11

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown to brown, very loose to loose		SP	1	HA		1*			
			SP	2	HA		4*			
	4 ▼									
	FINE SAND WITH SILT 6 gray to brown, loose	5	SP SM	3	HA		4*			
	JETTED FROM 6' TO 12' FOR UTILITIES	10								
	12									
	13.5 **FINE SAND WITH SILT** gray to brown, medium dense		SP	5	SS		21			
			SM	6	SS		30	27	10	
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, desne to very dense	15	SP SM							
		20	SP SM	7	SS		66			
		25	SP SM	8	SS		61			
	28.5									
	FINE SAND WITH SILT orange-brown, medium dense to dense	30	SP SM	9	SS		28			
		35	SP SM	10	SS		30	31	9	
	38.5									
	SILTY FINE SAND tan, loose to medium dense	40	SM	11	SS		11			
		45	SM	12	SS		7			
		50	SM	13	SS		9			

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL ▽		▼ 3.5	WD
WL ▼		▼	
WL			

NODARSE A Terracon COMPANY

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-14	JOB #	H1115424

LOG OF BORING NO. B-03

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	SILTY FINE SAND tan, loose to medium dense									
		55	SM	14	SS		16			
	58.5 **FINE SAND WITH SILT** gray to brown, medium dense to very dense	60	SP SM	15	SS		21			
		65	SP SM	16	SS		28			
		70	SP SM	17	SS		44			
	75	75	SP SM	18	SS		51			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-14	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-04

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Clarifier No. 11

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown, very loose ▼		SP	1	HA		1*			
	4		SP	2	HA		3*			
	FINE SAND WITH SILT gray to brown, very loose	5	SP SM	3	HA		3*			
	6 **JETTED FROM 6' TO 12' FOR UTILITIES**	10								
	12									
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, medium dense		SM	5	SS		10			
		15	SM	6	SS		16			
	18.5									
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	20	SP SM	7	SS		72			
		25	SP SM	8	SS		60			
		30	SP SM	9	SS		61			
	33.5									
	SILTY FINE SAND tan, very loose to loose	35	SM	10	SS		WR	31	15	
		40	SM	11	SS		8			
	43.5									
	FINE SAND WITH SILT gray, medium dense	45	SP SM	12	SS		20			
	48.5									
		50	SM	13	SS		24			

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-15	JOB #	H1115424

LOG OF BORING NO. B-04

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %	
	SILTY FINE SAND tan, medium dense	55	SM	14	SS		24				
		60	SM	15	SS		25				
	63.5 **FINE SAND WITH SILT** tan to grayish brown, medium dense	65	SP SM	16	SS		19				
		70	SP SM	17	SS		25				
	73.5 **SILTY FINE SAND** greenish gray, loose	75	SM	18	SS		8	35	26		NP
	78.5 **FINE SAND WITH SILT** gray, trace shell fragments, medium dense to dense	80	SP SM	19	SS		26				
		85	SP SM	20	SS		30				
	88.5 **SILTY FINE SAND** gray, trace shell fragments, dense	90	SM	21	SS		31	38	28		
		95	SM	22	SS		32				
	100	100	SM	23	SS		31				

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-15	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-05

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Pre-Treatment Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown, loose to medium dense		SP SM	2	HA					
		5	SP	3	SS		5			
			SM SP	4	SS		9			
			SM SP	5	SS		10			
		10	SM							
		13.5								
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	15	SP SM	6	SS		57			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-7-11		
BORING COMPLETED	12-7-11		
RIG	TRUCK	FOREMAN	JOHN C
EXHIBIT:	A-16	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-06

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Pre-Treatment Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, loose		SP	1	HA					
			SP	2	HA					
		5	SP	3	SS		9			
			SP	4	SS		8			
			SP	5	SS		7			
		10								
	13.5									
	FINE SAND WITH SILT (HARDPAN) reddish brown to dark reddish brown, dense	15	SP SM	6	SS		30			
		20	SP SM	7	SS		39			
	25	25	SP SM	8	SS		38			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			3-28-12
BORING COMPLETED			3-28-12
RIG	MINI	FOREMAN	MARK C
EXHIBIT:	A-17	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-07

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Pre-Treatment Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, medium dense ▼		SP	1	HA					
			SP	2	HA					
		5	SP	3	SS		18			
			SP	4	SS		11			
	8									
	FINE SAND WITH SILT brown, medium dense		SP SM	5	SS		12			
		10								
	13.5									
	FINE SAND WITH SILT (HARDPAN) dark reddish brown, medium dense to dense		SP SM	6	SS		25			
		15								
			SP SM	7	SS		39			
		20								
	25									
		25	SP SM	8	SS		36			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			3-28-12
BORING COMPLETED			3-28-12
RIG	MINI	FOREMAN	MARK C
EXHIBIT:	A-18	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-08

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Aquadisk Filter

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown	4	SP SM	2	HA					
	FINE SAND light brown, medium dense	5	SP	3	HA					
			SP	4	SS		20			
			SP	5	SS		19			
		10								
		13.5								
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, medium dense to very dense	15	SP SM	6	SS		57	24	6	
		20	SP SM	7	SS		55			
		25	SP SM	8	SS		28			
		30	SP SM	9	SS		27			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-1-11
BORING COMPLETED			12-1-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-19	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-09

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Chlorine Contact Tank

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown, medium dense		SP SM	2	HA					
		5	SP SM	3	HA					
			SP SM	4	SS		19			
			SP SM	5	SS		23			
		10	SP SM							
	13.5									
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, medium dense to very dense		SP SM	6	SS		28			
		15								
			SP SM	7	SS		51			
		20								
			SP SM	8	SS		61			
		25								
	30		SP SM	9	SS		47			
		30								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ N/E	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-1-11
BORING COMPLETED			12-1-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-20	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-10

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Chlorine Contact Tank

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown ▼		SP	1	HA					
			SP	2	HA					
	6	5	SP	3	HA					
	FINE SAND WITH SILT gray to brown, loose		SP SM	4	SS		5			
		10	SP SM	5	SS		6			
	13.5									
	SILTY FINE SAND brown to dark brown, medium dense	15	SM	6	SS		14			
	18.5									
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	20	SP SM	7	SS		61			
		25	SP SM	8	SS		47	24	9	
	28.5									
	30 **FINE SAND WITH SILT** light brown, medium dense	30	SP SM	9	SS		20			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-2-11
BORING COMPLETED			12-2-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-21	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-11

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Chlorine Contact Tank

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown	4	SP SM	2	HA					
	SILTY FINE SAND brown to dark brown	6	SM	3	HA					
	FINE SAND WITH SILT brown, trace root matter, loose	5	SP SM	4	SS		4			
		10	SP SM	5	SS		7			
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, dense to very dense	13.5								
		15	SP SM	6	SS		60			
		20	SP SM	7	SS		43			
		25	SP SM	8	SS		41			
		30	SP SM	9	SS		38			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ N/E	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-2-11
BORING COMPLETED			12-2-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-22	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-12

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Reject Pump Station

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown	4	SP SM	2	HA					
	SILTY FINE SAND brown to dark brown	6	SM	3	HA					
	FINE SAND light brown to brown, loose to medium dense	5	SP	4	SS		10			
			SP	5	SS		9			
		10								
		13.5								
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, dense to very dense	15	SP SM	6	SS		38			
		20	SP SM	7	SS		59			
		25	SP SM	8	SS		41			
		30	SP SM	9	SS		39			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-1-11
BORING COMPLETED			12-1-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-23	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-13

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed West Electrical Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown	6	SP SM	2	HA					
		5	SM	3	HA					
	SILTY FINE SAND brown to dark brown, medium dense	13.5	SM	4	SS		14			
		10	SP SM	5	SS		13			
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	15	SP SM	6	SS		50/5"			
		20	SP SM	7	SS		50/6"			
		25	SP SM	8	SS		50/6"			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ N/E	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-2-11
BORING COMPLETED			12-2-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-24	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-14

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed West Electrical Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown	6	SP SM	2	HA					
		5	SM	3	HA					
	SILTY FINE SAND brown to dark brown, medium dense	13.5	SM	4	SS		14			
		10	SP SM	5	SS		8			
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	15	SP SM	6	SS		57			
		20	SP SM	7	SS		50/5"			
		25	SP SM	8	SS		50/6"			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 6	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-2-11
BORING COMPLETED			12-2-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-25	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-15

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Supplemental Carbon Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown, loose	2	SP	1	SS		6			
	FINE SAND WITH SILT gray to brown, loose ▼		SP SM	2	SS		8			
		5	SP SM	3	SS		7			
			SP SM	4	SS		8			
			SP SM	5	SS		8			
		10	SP SM							
	13.5									
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, desne to very dense	15	SP SM	6	SS		65			
			SP SM	7	SS		47			
		20								
	25	25	SP SM	8	SS		43			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-7-11		
BORING COMPLETED	12-7-11		
RIG	TRUCK	FOREMAN	JOHN C
EXHIBIT:	A-26	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-16

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Supplemental Carbon Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown, loose ▼		SP SM	2	HA					
		5	SP	3	SS		6			
			SM SP	4	SS		7			
	FINE SAND brown, medium dense	8	SM SP	5	SS		16			
		10								
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, medium dense to dense	13.5	SM	6	SS		22			
		15								
		20	SM	7	SS		29			
		25	SM	8	SS		38			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-7-11		
BORING COMPLETED	12-7-11		
RIG	TRUCK	FOREMAN	JOHN C
EXHIBIT:	A-27	JOB #	H1115424

LOG OF BORING NO. B-17

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Supplemental Carbon Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	4 ▼	SP	1	HA					
			SP	2	HA					
	SILTY FINE SAND brown to dark brown, medium dense	8	SM	3	HA					
			SM	4	SS		12			
	FINE SAND WITH SILT gray to brown, medium dense	13.5	SP SM	5	SS		13			
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, very dense	18.5	SM	6	SS		50/6"			
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	23.5	SP SM	7	SS		50/5"			
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, very dense	25	SM	8	SS		50/6"			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-5-11		
BORING COMPLETED	12-5-11		
RIG AUTO HAM.		FOREMAN	DOUG
EXHIBIT:	A-28	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-18

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Secondary Effluent Diversion Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown, very loose	2	SP	1	HA		3*			
	FINE SAND WITH SILT gray to brown, very loose to medium dense	6	SP SM	2	HA		2*			
	SILTY FINE SAND brown to dark brown, medium dense	13.5	SP SM	3	SS		16			
			SM	4	SS		13			
			SM	5	SS		16			
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, dense	18.5	SM	6	SS		32			
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	25	SP SM	7	SS		76			
			SP SM	8	SS		53			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	MINI	FOREMAN	MARK C
EXHIBIT:	A-29	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-19

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Secondary Effluent Diversion Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown, loose ▼		SP SM	2	HA					
		5	SP SM	3	HA					
			SP	4	SS		6			
		8	SM SP	5	SS		8	17	4	
	FINE SAND brown, loose	10								
		13.5								
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, medium dense to dense	15	SP SM	6	SS		25			
		20	SP SM	7	SS		35			
		25	SP SM	8	SS		36			
		25								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-2-11
BORING COMPLETED			12-2-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-30	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-20

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed Secondary Effluent Diversion Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown	4	SP SM	2	HA					
	FINE SAND light brown, medium dense	5	SP	3	HA					
		8	SP	4	SS		10			
	FINE SAND WITH SILT gray to brown, medium dense	10	SP SM	5	SS		10			
		13.5								
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, dense to very dense	15	SP SM	6	SS		36			
		20	SP SM	7	SS		33			
		25	SP SM	8	SS		66			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 5.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-2-11
BORING COMPLETED			12-2-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-31	JOB #	H1115424

LOG OF BORING NO. B-21

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Proposed RAS/WAS Pump Station

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown, loose	2	SP	1	HA		4*			
	FINE SAND WITH SILT gray to brown, loose	4	SP SM	2	HA		4*			
	SILTY FINE SAND brown to dark brown, medium dense	5	SM	3	SS		8			
		8	SM	4	SS		11			
	FINE SAND WITH SILT gray to brown, medium dense	10	SP SM	5	SS		11			
		13.5								
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, dense	15	SM	6	SS		38			
		20	SM	7	SS		43			
		23.5								
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, very dense	25	SP SM	8	SS		59			
		28.5								
	SILTY FINE SAND orange-brown, trace cemented sands, dense	30	SM	9	SS		34			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	MINI	FOREMAN	MARK C
EXHIBIT:	A-32	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-22

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed RAS/WAS Pump Station

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND WITH SILT gray to brown, very loose to medium dense		SP SM	1	HA		4*			
			SP SM	2	HA		2*			
	6	5	SP	3	SS		14	19	5	
	SILTY FINE SAND brown to dark brown, medium dense 8		SM SM	4	SS		17			
	FINE SAND WITH SILT gray to brown, medium dense		SP SM	5	SS		16			
	13.5	10								
	SILTY FINE SAND (HARD PAN) orange-brown to dark reddish brown, dense	15	SM	6	SS		36			
		20	SM	7	SS		43			
	23.5									
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, medium dense	25	SP SM	8	SS		28			
	28.5									
	30 **SILTY FINE SAND** orange-brown, trace cemented sands, medium dense	30	SM	9	SS		24			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-8-12
BORING COMPLETED			2-8-12
RIG	MINI	FOREMAN	MARK C
EXHIBIT:	A-33	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-23

CLIENT **AECOM Technical Services, Inc**

SITE **Facility Improvements**
Orlando, Florida

PROJECT **Eastern Water Reclamation Facility**

Boring Location: Proposed Secondary Effluent Diversion Structure

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND grayish brown	2	SP	1	HA					
	FINE SAND WITH SILT gray to brown, loose ▼		SP SM	2	HA					
		5	SP SM	3	HA					
			SP SM	4	SS		7			
			SP SM	5	SS		9			
		10	SP SM							
	13.5									
	FINE SAND WITH SILT (HARDPAN) orange-brown to dark reddish brown, dense		SP SM	6	SS		48			
		15								
			SP SM	7	SS		39			
		20								
	25		SP SM	8	SS		45			
		25								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▼	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			12-1-11
BORING COMPLETED			12-1-11
RIG	MINI	FOREMAN	TRAVIS
EXHIBIT:	A-34	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-24

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Existing Reject Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, loose to medium dense		SP	1	HA					
			SP	2	HA					
		5	SP	3	HA					
			SP	4	SS		9			
			SP	5	SS		13			
		10								
	15	15	SP	6	SS		21	21	2	

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 6	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-5-11		
BORING COMPLETED	12-5-11		
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-35	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-25

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Existing Reject Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, loose to medium dense ▼		SP	1	SS		16			
			SP	2	SS		7			
		5	SP	3	SS		19			
			SP	4	SS		17			
			SP	5	SS		19			
		10								
	15	15	SP	6	SS		27			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 3	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			3-28-12
BORING COMPLETED			3-28-12
RIG	MINI	FOREMAN	MARK C
EXHIBIT:	A-36	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

LOG OF BORING NO. B-26

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Existing Reject Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, loose to medium dense		SP	1	HA					
			SP	2	HA					
		5	SP	3	HA					
			SP	4	SS		7			
			SP	5	SS		10			
		10								
	15	15	SP	6	SS		13			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-5-11		
BORING COMPLETED	12-5-11		
RIG AUTO HAM.		FOREMAN	DOUG
EXHIBIT:	A-37	JOB #	H1115424

LOG OF BORING NO. B-27

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Existing Reject Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, loose ▼		SP	1	HA					
			SP	2	HA					
		5	SP	3	HA					
			SP	4	SS		5			
			SP	5	SS		4	23	5	
		10								
	13.5									
	15 **FINE SAND WITH SILT** gray to brown, medium dense	15	SP SM	6	SS		10			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL ▽	▼ 5	WD	
WL ▼	▽		
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-5-11		
BORING COMPLETED	12-5-11		
RIG AUTO HAM.		FOREMAN	DOUG
EXHIBIT:	A-38	JOB #	H1115424

LOG OF BORING NO. B-28

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Existing Reject Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown, loose to medium dense ▼		SP	1	SS		4			
			SP	2	SS		5			
		5	SP	3	SS		18			
			SP	4	SS		23			
			SP	5	SS		25			
		10								
	13.5									
	15 **FINE SAND WITH SILT** gray to brown, medium dense	15	SP SM	6	SS		29	16	5	

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 4	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED	12-5-11		
BORING COMPLETED	12-5-11		
RIG AUTO HAM.		FOREMAN	DOUG
EXHIBIT:	A-39	JOB #	H1115424

LOG OF BORING NO. B-29

CLIENT
AECOM Technical Services, Inc

SITE
Facility Improvements
Orlando, Florida

PROJECT
Eastern Water Reclamation Facility

Boring Location: Existing Reject Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FINES CONTENT %	TESTS ORGANIC CONTENT, %
	FINE SAND light gray to brown		SP	1	HA					
			SP	2	HA					
	4	5	SP SM	3	HA			3	8	
	FINE SAND WITH SILT brown to dark brown, medium dense ▼		SP SM	4	SS		10			
			SP SM	5	SS		13			
		10								
	15	15	SP SM	6	SS		16			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 7.5	WD
WL	▼	▽	
WL			

NODARSE
A Terracon COMPANY

BORING STARTED			2-6-12
BORING COMPLETED			2-6-12
RIG	AUTO HAM.	FOREMAN	DOUG
EXHIBIT:	A-40	JOB #	H1115424

BOREHOLE 99 H1115424 - 8-7-12.GPJ TERRACON.GDT 8/7/12

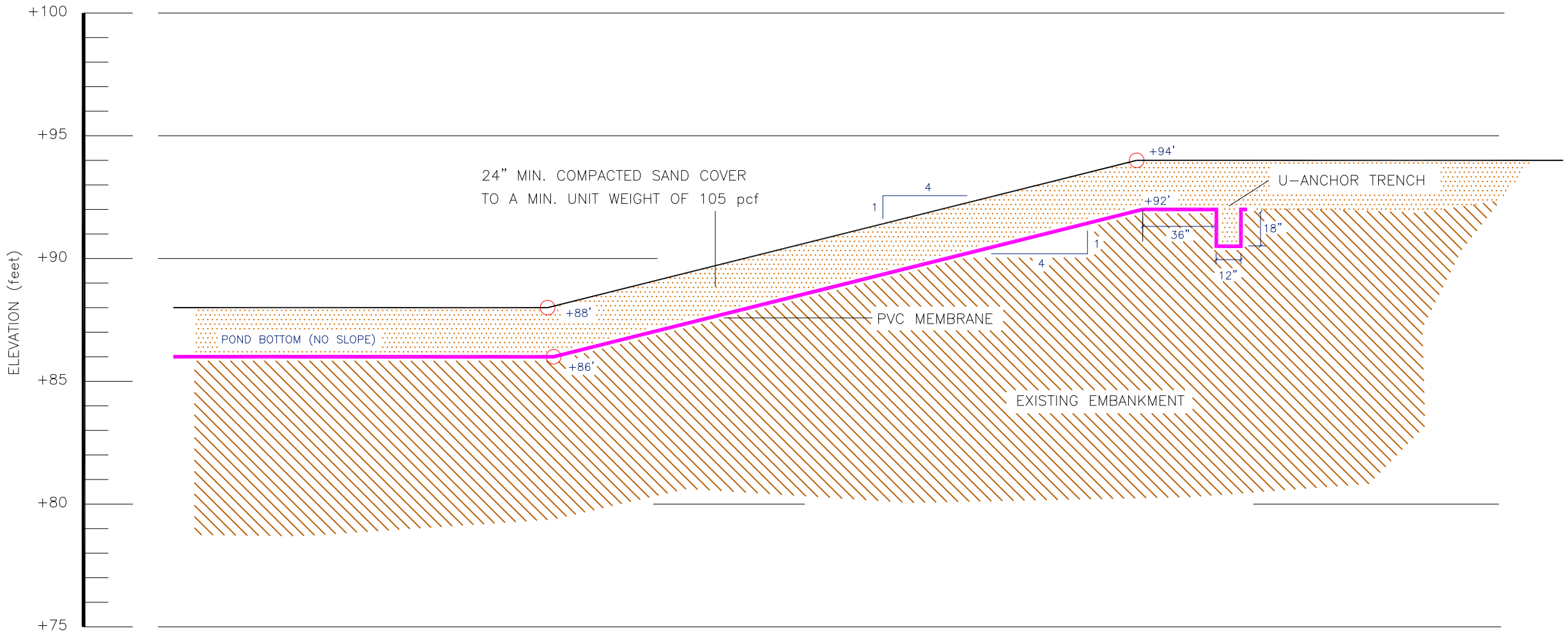
Soil Survey Descriptions

3 – Basinger fine sand, depressional. This soil type is nearly level and poorly drained. It is typically found in shallow depressions and sloughs along edges of freshwater marshes and swamps. In its natural state, water stands on the surface of this soil type for 6 to 9 months during most years and is within 12 inches of the surface for the rest of the year. This soil type is sometimes associated with a surficial organic layer, typical thickness of 7 inches, typical organic contents of between 1 and 8 percent. Typical permeability rates for this soil type generally range from 6 to 20 inches per hour (12 to 40 feet per day) throughout the defined profile of 80 inches (6.7 feet).

34 – Pomello fine sand, 0 to 5 percent slopes. This soil type is nearly level to gently sloping and moderately well drained. It is typically found on low ridges and knolls on the flatwoods. In its natural state and during years of normal rainfall, this soil type has a seasonal high water table at a depth of between 20 and 40 inches (1.7 and 3.3 feet) for 1 to 4 months, receding to a depth of 40 to 60 inches (3.3 to 5.0 feet) during dry periods. Typical permeability rates for this soil type are greater than 20 inches per hour (40 feet per day) between the surface and a typical depth of 40 inches.

37 – St. Johns fine sand. This soil type is nearly level and poorly drained. It is typically found on broad flats on the flatwoods. In its natural state and during years of normal rainfall, this soil type has a seasonal high water table within 10 inches (0.8 feet) of the surface for 6 to 12 months, receding to a depth of 10 to 40 inches (0.8 to 3.3 feet) for more than six months. This soil type is predominantly sandy from the surface to a depth of 24 inches (2.0 feet), and again from a depth of 44 inches (3.7 feet) to the maximum defined depth of 80 inches (6.7 feet). Between depths of 24 and 44 inches (2.0 and 3.7 feet), this soil type exists as fine sand with silt to silty sand. Typical permeability rates for this soil type generally range from 6 to 20 inches per hour (12 to 40 feet per day) throughout the defined profile of 80 inches (6.7 feet), except between depths of 24 and 44 inches where permeability generally ranges from 0.2 to 2 inches per hour (0.4 to 4 feet per day).

44 – Smyrna fine sand. This soil type is nearly level and poorly drained. It is typically found on broad flatwoods. In its natural state and during years of normal rainfall, this soil type has a seasonal high water table within 10 inches (0.8 feet) of the surface, receding to a depth of 10 to 40 inches (0.8 to 3.3 feet) for more than six months. Typical permeability rates for Smyrna fine sand generally range from 6 to 20 inches per hour (12 to 40 feet per day); between typical depths of 17 inches and 27 inches (1.4 and 2.3 feet) the permeability rates range from 0.6 to 6 inches per hour (1.2 to 12 feet per day).



PVC POND LINER DETAIL
EASTERN WATER RECLAMATION FACILITY
PHASE V IMPROVEMENTS
ORANGE COUNTY, FLORIDA

DRAWN: SW	NODARSE A Terracon COMPANY	
CHKD: AMR S.		
SCALE: NOTED		
DATE: 8-9-12	PROJ. No. H1115424	EXHIBIT: A-42

APPENDIX B
SUPPORTING INFORMATION

Laboratory Testing

During the field exploration, a portion of each recovered sample was sealed in a glass jar and transported to our laboratory for further visual observation and laboratory testing. Selected samples retrieved from the borings were tested for moisture (water) content, fines content (soil passing a US standard #200 sieve), Atterberg limits, and laboratory permeability. Those results are included in this report and on the respective boring logs. The visual-manual classifications were modified as appropriate based upon the laboratory testing results.

The soil samples were classified in general accordance with the appended General Notes and the Unified Soil Classification System based on the material's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is shown on the boring logs and a brief description of the Unified Soil Classification System is included in Appendix C. The results of our laboratory testing are presented in the Laboratory Test Results section of this report and on the corresponding borings logs.

Permeability testing was performed on undisturbed samples obtained from adjacent to Boring AB-1 and Boring AB-4, from between depths of 3 and 3.5 feet below existing grade respectively, the presumed subgrade soils for the proposed stormwater management pond. The undisturbed samples were measured for approximate in-place relative density of the sampled soil, and water was allowed to flow into the soil sample until the sample was apparently saturated. Once saturated, water flow was halted and incremental drops in the supply water level were timed.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-$^3/_8$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB	Wash Boring or Mud Rotary

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling	ESH:	Estimated Seasonal High Groundwater
DCI:	Dry Cave in	BCR:	Before Casing Removal	ESL:	Estimated Seasonal Low Groundwater
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 – 1	Very Soft
500 – 1,000	2 – 4	Soft
1,000 – 2,000	4 – 8	Medium Stiff
2,000 – 4,000	8 – 15	Stiff
4,000 – 8,000	15 – 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

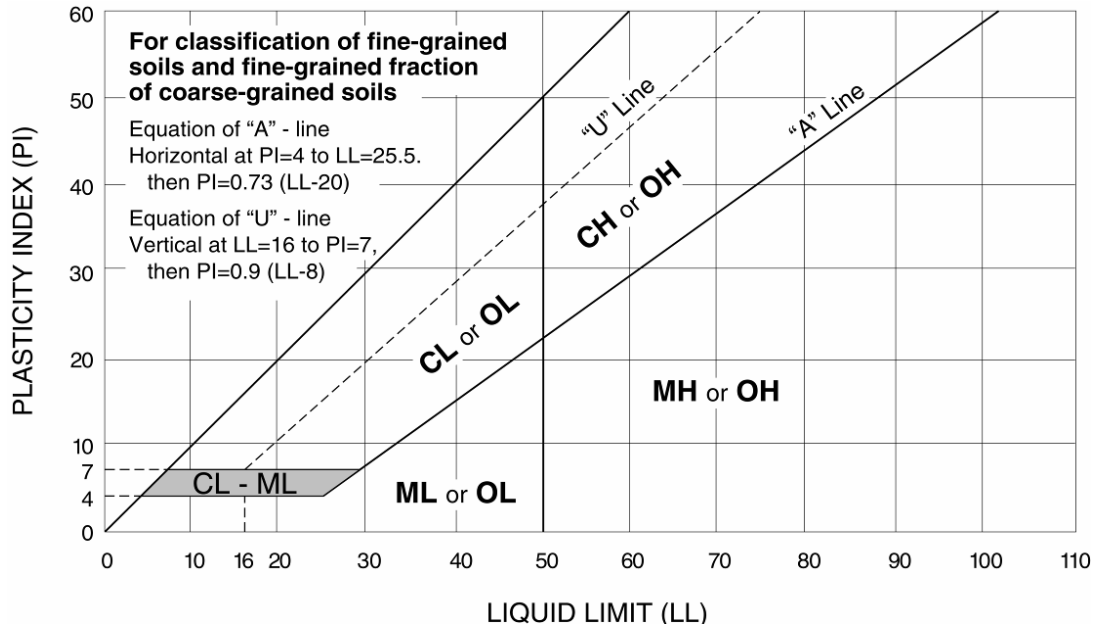
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



NODARSE
A Terracon COMPANY

Exhibit C-2

Attachment C:

Orange County SCADA H-21 Appendix

Processor	Intel Xeon E3-1505M v6 (Quad Core Xeon 3.00GHz, 4.00GHz Turbo, 8MB 45W, w/Intel HD Graphics 630	[379-BCRK] / E31505M	1
Operating System	Windows 10 Pro 64bit English, French, Spanish	[619-AHKN] / 10P64M	1
Microsoft Office	Microsoft Office Professional 2016	[658-BDMR] / OFCPR16	1
E-Star	No Energy Star	[387-BBDO] / NOESTAR	1
Adobe and Dropbox Productivity Software	Dropbox Advanced- Digital Delivery	[634-BKIT] / DBADVC	1
Dell Data Security for Small and Medium Business	None		1
Graphics Card	Nvidia Quadro P5000 w/16GB GDDR5	[490-BDKG][490-BDKK] / P5000	1
Display	17.3" UltraSharp™ FHD IPS(1920x1080) AG LED-backlit w/Prem Pan Grnt (72% color gamut) w/Cam & Mic	[319-BBEC][391-BDCH] / FHDNCM	1
Memory	64GB (4x16GB) 2400MHz DDR4 ECC SDRAM	[370-ADKJ] / 64G4EC	1
Hard Drive	1TB M.2 PCIe Solid State Drive Class 40	[400-AOSG] / 1TBC4	1
2nd Hard Drive	Additional M.2 PCIe 1TB SSD Class 40	[401-AAVK] / 1TBXG4	1
3rd Hard Drive	Additional 1TB M.2 PCIe NVMe SSD Class 50 Hi-Performance (with Interposer card drive), MPWS	[401-AAVC] / 1TBHP	1
RAID Configuration	RAID 0	[780-BBCK] / RAID0	1
Systems Management	No Out-of-Band Systems Management	[631-ABEL] / NOVPRO	1
Keyboard	Internal Dual Pointing Backlit Keyboard, English	[580-AFTO][580-AFTU] / KENBL06	1

Wireless	Dell Wireless™ 1820 802.11AC Dual-Band Wireless + BT 4.1 Card (2x2)	[555-BDDK] / 1820	1
Dell Precision Optimizer Software	Dell Precision Optimizer	[640-BBES] / OPTMZR	1
Dell Data Security Encryption	Dell Data Guardian, Enterprise Edition, 5 Years	[525-0088][812-2592] / SLEEO5Y	1
Dell Threat Protection and Endpoint Security Suite	Dell Data Protection Endpoint Security Suite, 5 yr	[525-0051][802-5258] / DESS5Y	1
Diagnostic CD / Diskette	Resource DVD	[430-XYLJ] / DVD	1
Operating System Recovery Options	Windows 10 OS Recovery 64bit – USB	[620-ABBW] / M10PU6M	1
Palm Rest Options	Palm Rest with Full Scan FIPS fingerprint reader, smart card and NFC	[346-BCFB] / PLMFSCF	1
Primary Battery	6 Cell (91 Whr) Long Life Cycle Lithium Ion Polymer Battery	[451-BBUV] / 6C3YR	1
Mobile Broadband	No Mobile Broadband	[556-BBDZ] / NOMBB	1
Accessories	Dell Docking Spacer	[452-BBDB] / SPACER	1

Software & Accessories

	Selection	SKU / Product Code	Quantity
Monitors	Dell 24 Ultra HD 4K Monitor - P2415Q Dell 24 Ultra HD 4K Monitor – P2415Q	dell-p2415q-monitor	1
Power Supply	240W AC Adapter 7.4mm	[450-AFXO] / 240W	1

Support & Services

Option	Selection	SKU / Product Code	Quantity
Warranty	5 Years ProSupport Plus with Next Business Day Onsite Service	[804-5016][804-5061][804-5069][804-5077][804-5097] / PPN5	1
Accidental Damage Services	None		1
Extended Battery Services	2 Years Extended Battery Service for Years 2 and 3 of System Life	[988-5552] / EXTBAT2	1
Keep Your Hard Drive	None		1
Deployment Services	None		1
Absolute Computrace	None		1
Data Recovery Services	5 Years, Hard Drive Data Recovery Service	[988-0014] / HDREC5	1
Configuration Services - OS Imaging	None		1
Configuration Services - BIOS Configurations & Labels	ProSupport Plus Client label without company name	[365-0896][377-8262] / PROPLUS	1

Keyboards & Mice:
Dell Wireless Mouse Laser,
Product Code: WM615

Software solutions:
Autodesk:
Autodesk AutoCAD 2016 Perpetual License
Autodesk AutoCAD 2016 1 Year Subscription
Adobe: Adobe Creative Suite 6 Master Collection
Adobe Lightroom 6

VMWare:
VMWare Workstation 11

Office Productivity Software:
Microsoft® Windows 7 Professional 64-bit
Microsoft® Office Professional 2016, English
Microsoft® Visio Professional 2016, English
Microsoft® Project Professional 2016, English

Additional Adapters, Batteries and Cables:
Dell AC Adapter 240Watt with 6 ft Power Cord
Product Code: 3319053
SKU: 3319053

Dell Business Thunderbolt Dock - TB16 with 240W Adapter
Manufacturer Part 3GMVT
Dell Part 452-BCNU

Promise Pegasus3 PC Edition R4 - Hard drive array - 12 TB - 4 bays (SATA-600) - HDD 3 TB x 4 - Thunderbolt 3 (external)
Manufacturer Part P3R4HD12WUS
Dell Part A9555550

Attachment D:

Disk Filter Pre-Purchase Specifications

Orange County Utilities

Northwest Water Reclamation Facility & Eastern Water Reclamation Facility Disk Filters

Pre-Purchase Bid Documents

Prepared By:

AECOM

60316063

Filter Pre-Purchase – Bid Issue
December 2016

ORANGE COUNTY UTILITIES
NORTHWEST WATER RECLAMATION FACILITY &
EASTERN WATER RECLAMATION FACILITY
DISK FILTERS
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SECTION 01010 SUMMARY OF WORK

PART 1 - GENERAL

A. Work Under This Contract

The project will provide 30 MGD & 36 MGD of filtration capacity at the Eastern Water Reclamation Facility (EWRF) and Northwestern Water Reclamation Facility (NWRF), respectively. The Disk Filter Improvements at the EWRF will enable rerating the EWRF from 19 MGD to 24 MGD, based upon an annual average daily flowrate (AADF). The scope of work for this project is to procure disk filter units which will be installed under a separate project. The disk filters will be fabricated, stored and delivered to each site in preparation for installation under a separate contract.

The term “Manufacturer”, “Disk Filter Manufacturer”, or “Vendor” used in these specifications shall refer to the party responsible for the manufacture, storage, delivery, and startup of the disk filter units as specified herein. The term “Contractor” in these specifications shall refer to a general contractor which will be retained by the Owner to install the disk filter units as part of a separate contract.

The Disk Filter Manufacturer shall provide the following as shown on the drawings and technical specifications:

1. Furnish six (6) 6.0 MGD disk filter units at the NWRF; Process 065. Disk filters at the NWRF will be installed in an existing concrete structure by others. Disk filter units shall include filter units, control panels, backwash pumps, valves, appurtenances and backwash piping mounted to the filter skid. Filters shall be constructed per Specification 11399 and to match the elevations shown in the Drawings. Filters shall be constructed and delivered to the NWRF site located at 701 W. McCormick Road Apopka, FL 32703.

2. Storage, maintenance, and delivery of the disk filters to the NWRF site as described in Section 11399.

3. Startup, training and testing services for the NWRF filters following filter installation by others.

4. Furnish five (5) 6.0 MGD disk filter units at the EWRF; Process 570. Disk filter units shall include filter

units, control panels, backwash pumps, valves appurtenances, and backwash piping mounted to the filter skid. Filters shall be constructed per Specification 11399 and to match the elevations shown in the Drawings. Filters shall be constructed and delivered to the EWRF site located at 1621 S. Alafaya Trail Orlando, FL 32828.

5. Storage, maintenance, and delivery of the disk filters to the EWRF site as described in Section 11399.

6. Programming of proposed filter control panels. The proposed filter control panels shall be equipped to connect to the existing NWRF and EWRF SCADA system.

7. Furnish disk filter spare parts per Specification Section 11399.

8. Warranty of disk filters as described in Specification Section 11399.

B. Work Performed by Others

1. Installation of the disk filter units at both the NWRF and EWRF sites.

2. Construction of the proposed concrete structure at the EWRF site.

3. Electrical, instrumentation, and control system improvements and modifications with the exception of the disk filter control panels.

4. All piping, valves, and appurtenances other than those defined as part of the disk filter unit.

5. Stairways, Miscellaneous metals, metal grating, chemical injection assemblies, emergency eyewash/showers

C. Training

1. Submit a construction submittal with the format, trainers and course material and specify whether training will be hands on or in a classroom setting for review and acceptance by the Owner and Engineer.

2. Vendor shall prepare a list of all equipment and electrical installations for owner to review and choose training.

3. The Vendor shall coordinate with the Contractor regarding training. Unless otherwise specified, a minimum of 2 days of training shall be provided by the Vendor for each piece of equipment

supplied, including all electrical installations and testing equipment. Contractor shall video and audio record to a DVD all training given to operations staff, a copy of the DVD will be supplied to the County. The Vendor/Contractor shall submit a C.A.R (Construction Assistance Request) form seven days prior to beginning of training. Coordinate training schedule with Owner. Owner shall approve training schedule to ensure critical staff is available during training. Video equipment shall be accompanied with independent microphone for instructor to speak into for audio recording.

D. Intended Mode of Operation

EWRF - Secondary effluent will flow from the existing Phase V Filter Splitter Box (Process 360) to the proposed EWRF disk filters (Process 570). Secondary effluent will then be split to the five (5) EWRF disk filter units as necessary based on flow using the actuated filter influent valve associated with each filter. Filtered effluent will then be directed to the existing Phase V Chlorine Contact Basin (Process 580). Each filter control panel will initiate a backwash based upon a high level setpoint. Each filter will remain in operation during filter backwash. Should the overflow level switch of any filter be activated, the filter control panel shall provide an alarm to SCADA for operator intervention.

NWRF - Secondary effluent will flow from the existing secondary clarifiers to the proposed NWRF disk filters (Process 065). Secondary effluent will then be split to the six (6) NWRF disk filter units as necessary based on flow using the actuated filter influent valve associated with each filter. Filtered effluent will then be directed to the existing chlorine contact basins (Process 070 & 090). Each filter control panel will initiate a backwash based upon a high level setpoint. Each filter will remain in operation during filter backwash. Should the overflow level switch of any filter be activated, the filter control panel shall provide an alarm to SCADA for operator intervention.

E. Demolition

1. Demolition for installation of the disk filters shall be performed under separate contract.

F. Mutilation

All damage or mutilation of concrete structures, equipment, pipes, ducts, fixtures, etc., shall be properly repaired by the Vendor at no expense to the County.

G. Electrical Interlocks

Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, the Vendor shall provide wiring diagrams and coordinate between the various subcontractors and suppliers so that proper wiring of the equipment involved is effected.

H. Containers for Spare Parts

1. Spare parts shall be packaged in sealed, rotationally moulded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Vendor shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

2. Pertaining to general inventory of all containers, the Vendor shall provide a general ascending alpha-numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

3. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum; Process description and Process number, equipment description, equipment tag, Manufacturer's information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

4. The Vendor shall provide an electronic log in MS Excel of all containers which include the following at a minimum; container alpha-numerical designation, content description, site storage location, O&M Manual volume subsection reference.

5. A copy of all inventory and manufactures product information data sheets shall be provided within a file pocket attached within the container.

6. Containers shall be positioned on site as designated by the Owner's Representative

PART 2 - PRODUCTS

A. Manufacturers and Materials

At a minimum, all manufacturers and materials shall conform to the current Orange County Utilities List of Approved Manufacturers and Materials.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01025 MEASUREMENT AND PAYMENT

A. Payment

1. Work under this contract will be paid for on a lump sum basis as described on the Bid Schedule. The amount of payment will be as defined in the Contract.

2. The quotations for the work are intended to establish a total price cost for completing the work in its entirety.

3. Additions, deletions, modifications or changes to the work as defined by this contract will be performed by change order according to the General Conditions.

B. General

1. All work under this contract shall be included in the lump sum amount listed on the Bid Schedule.

2. Any items not shown or omitted that are required for a complete installation shall be furnished by the Disk Filter Manufacturer at no additional cost to the County.

3. The prices shall include all labor, materials, tools, and equipment required to complete the work.

4. Payment for lump sum items shall be on a percentage of completion of the particular item basis.

C. Description of Lump Sum Pay Items – EWRF/NWRF Disk Filter Purchase

Described below is a brief summary of the work to be accomplished for the amount in the Bid Schedule. The amount will include shop drawings, sample submittals, record drawing submittals, O&M manual submittals, clean-up, start-up, testing, and placing in operation. The summary is not intended to describe all items in detail, but to clarify the items on which the price is to be based. The summary does not relieve the Disk Filter Manufacturer of his responsibility to supply all items complete.

Description of Base Bid Pay Items:

1. Base Bid Item No. 1 (NWRF Disk Filter System) - This includes all labor, materials, supplies and equipment to furnish and deliver new disk filters located at the NWRF site. This lump sum bid item is for the following

elements as generally defined within the Contract Documents;

a. Six (6) new disk filter tanks, disk filters, and supports.

b. Backwash system for each filter unit including backwash manifold, backwash pumps, backwash piping, valves, and appurtenances, and backwash drive mechanism.

c. Filter instrumentation and control panel, control panel programming and licensing for each filter unit.

d. Conduit, wiring, and junction boxes located on the disk filter skids.

e. Manufacturer inspection, testing, training, and warranty.

f. Performance and supply bond, if required. Refer to Section 11399.

2. Base Bid Item No. 2 (EWRF Disk Filter System) - This includes all labor, materials, supplies and equipment for constructing the new disk filters located at the EWRF site. This lump sum bid item is for the following elements as generally defined within the Contract Documents;

a. Five (5) new disk filter tanks, disk filters, and supports.

b. Backwash system for each filter unit including backwash manifold, backwash pumps, backwash piping, valves, and appurtenances, and backwash drive mechanism.

c. Filter Instrumentation, control panel, and control panel programming and licensing for each filter unit.

d. Conduit, wiring, and junction boxes located on the disk filter skids.

e. Manufacturer inspection, testing, training, and warranty.

f. Performance and supply bond, if required. Refer to Section 11399.

D. Additive Bid Items

1. Additive Bid Item No.1 (NWRF 2 Year Additive Equipment Warranty increasing the Base Bid 3 Year Equipment Warranty up to 5 Years for all equipment and materials supplied in this bid):

   a. Additive Equipment Warranty – This lump sum alternative bid item shall be for a two (2) year extension of the NWRF disk filter equipment warranty supplied on the project. For the equipment identified within the Contract Documents for a warranty duration of three (3) years from the date of delivery and acceptance of the installed equipment, or no later than 240 calendar days after issuance of the Purchase Order by Orange County, the alternative bid item shall encompass an additional two (2) years for extension of the warranty and preventative maintenance service duration, providing total of five (5) years from the date of delivery and acceptance (no later than June 1st 2017) of the installed equipment.

2. Additive Bid Item No.1 (EWRF 2 Year Additive Equipment Warranty increasing the Base Bid 3 Year Equipment Warranty up to 5 Years for all equipment and material supplied in this bid):

   a. Additive Equipment Warranty – This lump sum alternative bid item shall be for a two (2) year extension of the EWRF disk filter equipment warranty supplied on the project. For the equipment identified within the Contract Documents for a warranty duration of three (3) years from the date of delivery and acceptance of the installed equipment, or no later than 240 calendar days after issuance of the Purchase Order by Orange County, the alternative bid item shall encompass an additional two (2) years for extension of the warranty and preventative maintenance service duration, providing total of five (5) years from the date of delivery and acceptance (no later than June 1st 2017) of the installed equipment.

END OF SECTION

SECTION 01300 SUBMITTALS

A. General

1. This section includes the submissions of shop drawings, samples, operation and maintenance manuals and record drawings. There are other requirements in the Contract documents for submittals that are not addressed herein.

2. The submittal shall contain a copy of the pertinent specification Section(s) respective to that submittal, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Disk Filter Manufacturer, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Disk Filter Manufacturer with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Accompanying a copy of the pertinent specification Section(s) as noted in Part A.2, the submittal shall contain a copy of the contract mechanical process, structural, electrical and instrumentation drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

4. Submittals shall be identified per the respective specification Sections which the elements are specified within, e.g. 11399 Disk Filters and Appurtenances.

5. The Disk Filter Manufacturer shall group all elements specified within a respective specification Section into a singular submittal per that specification Section. For certain specification Sections with a large volume of content, the Disk Filter Manufacturer may provide no more than three (3) submittals for inclusive content within a singular specification Section.

6. Shop drawings and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at times convenient to the Engineer and at the Disk Filter Manufacturer's expense, based on the Engineer's then prevailing rates. The Disk Filter Manufacturer shall reimburse the Owner for all such fees invoiced to the Owner by the Engineer. Submittals are required until accepted. Any need for more than one (1) resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Disk Filter Manufacturer to extension of the Contract Time.

7. Partial submittals will not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Disk Filter Manufacturer and will be considered "Not Accepted" until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Disk Filter Manufacturer to the areas that are incomplete.

8. Identify submittals with the name of the project, date, and accompany each lot submitted with a letter of transmittal referring to the name of the project, the specification page number, and/or drawing number, and tag number for identification for each item. Submittals for each type of work shall be numbered per specification consecutively, and the numbering system shall be retained throughout all revisions.

9. In all submittals and schedules, allow 30 days for the Engineer's review of each shop drawing submittal or resubmittal.

10. Resubmittals will be handled in the same manner as first submittals. On resubmittals, the Disk Filter Manufacturer shall identify all revisions made to the

submittals, either in writing on the letter of transmittal or on the shop drawing by use of revision triangles or other similar methods. The resubmittal shall clearly respond to each comment made by the Engineer on the previous submission. Additionally, the Disk Filter Manufacturer shall direct specific attention to any revisions made other than the corrections requested by the Engineer on previous submissions.

B. Shop Drawings

1. Prepare shop drawings in accordance with Article 9 of the General Conditions and send to the Engineer carriage prepaid. Submit shop drawings and product data for all materials and equipment to be incorporated into the Work.

2. The term "shop drawing" as used herein includes fabrication, erection and installation, layout, and setting drawings, manufacturer's drawings, descriptive literature, catalogs and brochures, performance and test data, mix design, wiring and control diagrams, all other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems, and the positions thereof conform to the Contract requirements. As used herein, the term "manufactured" applies to standard units usually mass-produced; and "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements.

3. Shop Drawings shall be prepared and submitted with identification per specification section wherein the elements are specified, e.g. 15100-001A for Manual, Check, and Process Valves.

4. Multiple shop drawings shall not be submitted for individual respective elements within a single specification section. One shop drawing shall be prepared per specification section in order to encompass all elements within that specification. For large specification sections, a group of no greater than three shop drawings shall be prepared for those sections.

5. Shop drawings shall establish the actual detail of all manufactured or fabricated items, indicate proper relation of adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate

minor changes of design or construction to suit actual conditions. Shop drawings shall be drawn to scale and shall be completely dimensioned.

6. If shop drawings cover more than one piece of equipment or components, the shop drawing shall show the entire assembly and the relationship and connections between all components.

7. Supply short and long term storage procedures on all equipment submitted.

8. Coordinate the shop drawings from different manufacturers and supplies so that all equipment and material will fit and work together.

9. The contract drawings are diagrammatic and are intended to indicate general arrangement of equipment, ducts, conduits, piping, and fixtures. The Disk Filter Manufacturer shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposes to supply both as pertains to his own work and any work affected under other parts, headings, or divisions of drawings and specifications. Changes shall be reviewed in advance by the Engineer.

10. Shop drawings, including manufacturer's literature, catalog cuts, or other printed material shall be entitled with the name of the project on each sheet and shall otherwise be identified by listing the particular Division, Section, Article, or reference of the work pertaining thereto. Differing items shall not be submitted on the same sheet. For acceptance of differing items, any deviations shall be highlighted and annotated.

C. Samples

Submit physical examples to illustrate materials, equipment, or workmanship and to establish standards by which work is to be evaluated.

D. Equipment Operation and Maintenance Manuals

1. Provide installation, operation, and maintenance manuals from manufacturers and suppliers. Submit three (3) hard copies and one (1) electronic copy of manuals to the RPR within 30 days after review of shop drawings, product data, and samples and not later than the date of

shipment of each item of equipment to the project site. Electronic copies shall be submitted in “PDF” format.

2. Provide manuals for each piece of equipment including individual components and subsystems of complete assemblies. Line out all non-applicable text and illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

3. The manual shall contain the following:

   a. Manufacturer's identification, including order number, model, and serial number.

   b. Blue line prints or reviewed shop drawings and diagrams of all systems, including temperature control system.

   c. Certified equipment drawings or reviewed shop drawing data clearly marked for equipment furnished.

   d. Complete operating and maintenance instructions for each and every items of equipment, setting forth in detail and step-by-step the procedure for starting, stopping, operating and maintaining the entire system as installed. A schedule of recommended maintenance intervals shall also be included.

   e. Complete parts list of all replaceable parts, their part numbers, and the name and address of their nearest vendor.

   f. A complete valve tag list including the name and function of the pipe in which the valve is mounted.

   g. Any special emergency operating instruction and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

   h. All manufacturer's equipment guarantees and warranties.

4. Brochures shall be loose leaf with durable plastic or fiberboard covers. Each sheet shall be reinforced to prevent tearing from continued use, and each brochure

shall have the following information clearly printed on its cover:

a. Project name, name of County and address.

b. Name and address of Engineers.

c. Major equipment vendors' names and telephone numbers.

5. In addition to these written instructions, fully and carefully instruct the County or his selected representatives as to the proper care and maintenance of each system and its equipment, and provide signed statements from personnel receiving such instructions to the Engineer.

6. Submit complete manuals at least two weeks before the date of the instruction.

7. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions required by the Disk Filter Manufacturer to install, test, and start up equipment.

E. Disk Filter Operation and Maintenance Manual

The Disk Filter Manufacturer is required to retain a Professional Engineer that is licensed in the State of Florida in order to prepare an Operations and Maintenance Manual for the new disk filter improvements. The Operations and Maintenance Manual shall meet the requirements and criteria noted within Rule 62-620 FAC and for preparation of Form 62-620.910(13) for the Notice of Availability of Record Drawings and Final Operations and Maintenance Manuals. The Engineer shall prepare a draft O&M Manual that will be submitted to Orange County Utilities for final review and acceptance.

F. Compilation of Manufacturer’s Warranties & Certification Letters

The Disk Filter Manufacturer shall provide and compile all documentation and pertinent information regarding all warranties on the disk filter improvements into compilation notebook(s). The warranties shall be collated in a series of notebooks that shall be indexed by equipment tag number, unit processes and/or other pertinent organizational method as directed by Orange County Utilities. The notebooks shall include a singular table which shall document the commencement and expiration dates of all warranties on the

project. The table shall be electronically transmitted to Orange County Utilities in MS Excel format. The information shall be formatted in a manner, as directed by the Orange County Utilities EWRF Operations staff, for input and incorporation into the County's Maximo Asset Management software. The warranties shall be accompanied by the manufacturer's certification letters that are supplied to the County for each respective piece of equipment furnished. The letters provide certification from the manufacturer that the equipment was properly installed in accordance with the contract documents, manufacturer's requirements and is operating properly at commencement of service. The letters shall be provided in the same divider as the warranty information.

G. Maximo Asset Management Software – Equipment Data

The Disk Filter Manufacturer shall prepare an MS Excel based spreadsheet in a format as provided or directed by the Orange County Utilities EWRF Operations staff, for pertinent specification data from all equipment furnished within the Project for input into the County's Maximo Asset Management software.

END OF SECTION

SECTION 01664 SYSTEM START-UP AND TESTING

PART 1 - GENERAL

A. Description

1. This section includes system start-up and System Testing. Substantial completion for various portions of the work will be required prior to starting work on other portions of the project.

2. The system startup and testing of the disk filters at the NWRF and EWRF facility shall take place following installation of the filters by the Owner's contractor under separate contract. Contractor as described in Section 01664 shall refer to the Owner's Disk Filter installation contractor which will be retained under separate contract. The term Manufacturer within Section 01664 shall refer to the Disk Filter Manufacturer under this contract. The Manufacturer shall coordinate with the Contractor for system startup and testing as described herein. The Disk Filter Manufacturer shall coordinate with the Contractor for integration of the disk filter control panels into the existing EWRF and NWRF control networks.

3. Prior to requesting issuance of the Certificate of Substantial Completion for any portion of work, complete system start-up and System Testing as specified herein, must be completed to the satisfaction of the Owner.

4. At least 90 days prior to initiation of the start-up for each process as described below, submit a detailed start-up plan and schedule of operational circumstances described below. It is the intent of this section that the entire system as described below be operated and tested under actual operating conditions prior to acceptance. The start-up plan must be accepted by Owner and Engineer prior to initiation of start-up.

5. For issuance of substantial completion for each major respective process, the Disk Filter Manufacturer is to perform system start-up and System Testing procedure for the following major facilities. Some of the major facilities are necessary to be tested prior to performing start-up and System Testing of other facilities. At a minimum the Disk Filter Manufacturer is required to perform an individual system start-up and System Testing procedure for the following major facilities.

6. Tertiary Treatment

   (1) NWRF Disk Filters: Process 065 Disk Filters including but not limited to the following:
       (a) Cloth Disk Filters and Filter Vessels
       (b) Backwash/Waste System
       (c) Electric Actuated Valves
       (d) All electrical control panels, and starters, etc.
       (e) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

   (2) EWRF Disk Filters: Process 570 Disk Filters including but not limited to the following:
       (a) Cloth Disk Filters and Filter Vessels
       (b) Backwash/Waste System
       (c) Electric Actuated Valves
       (d) All electrical control panels, and starters, etc.
       (e) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

7. For those major facilities identified within Part 1.A.6 as designated for an independent facility System Start-up and System Testing procedure as required for issuance of substantial completion, it is intended that each major facility be placed in operation by accomplishing the following three general procedures:

   a. Preliminary Matters - field testing of individual components and equipment during the Contract Time, which may be accomplished one at a time and is to be performed as specified per the individual respective components' specification.

   b. System Start-up - Starting the facility under operational conditions and showing it will work for a specified length of time, which shall be accomplished before System Testing. Unless otherwise noted, System Start-Up shall be conducted utilizing plant effluent, have a minimum duration of 48 consecutive hours, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not

limited to overflows, problems or stoppages required to make corrective measures.

c. System Testing - proving that the entire Work will function properly as a system, each individual component will operate within the system and that the system will function to meet the specified standards over a stated period of time. Unless otherwise noted, shall be conducted utilizing the intended media to be processed, have a minimum duration of 7 consecutive days, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures. Verification that the disk filter control panels will communicate with the EWRF and NWRF control networks shall be performed.

8. For those facilities not identified within Part 1.A.6 as designated for an independent facility System Start-up and System Testing procedure, the Disk Filter Manufacturer is perform System Start-Up and System Testing following the procedure outlined herein.

B. Submittals

1. At least 90 days prior to each facility's system start-up, submit a system start-up and System Testing program to the Engineer for review.

a. The plan shall be a comprehensive report that includes detailed activities and coordination required to implement the requirements of this specification. The report shall include at a minimum preliminary matters, system start-up and System Testing for both the wastewater process equipment and the electrical equipment.

b. The report shall include a detailed schedule for the sequence of all operations that the Disk Filter Manufacturer will perform for the System Testing specified herein.

c. Identify the Owner's activities required for the system start-up and System Testing. Schedule a meeting with Owner and Engineer to review draft start-up plan at least 60 days prior to initiating start-up activities. Revise draft plan to incorporate comments from Owner and Engineer and

re-issue start-up plan at least 30 days prior to initiating start-up activities.

PART 2 - PRODUCTS

A. Water, Fuel, Chemicals and Electricity

The Contractor is responsible to supply all fuel, chemicals and electricity as necessary to perform all the system start-up and System Testing. At no cost to the Contractor, the Owner will provide the supply for all potable water, reclaimed water, or effluent or non-potable water. The Contractor is responsible to meter the volume of reclaimed water to be utilized. The Contractor is responsible to provide the temporary pumping and conveyance facilities for the reclaimed water. The Disk Filter Manufacturer shall coordinate with the Contractor to ensure all necessary components are available for startup and system testing.

B. Laboratory System Testing Services

The Vendor is responsible to supply all services related to sample collection and laboratory System Testing services. The Vendor shall utilize a laboratory certified in the State of Florida. The certified laboratory is responsible to perform all the laboratory System Testing and produce the laboratory System Testing reports as required herein.

C. Electrical Test Recorders

Vendor shall install 24-hour test recorders to each motor starter for the purpose of the tests only and remove them after completion of System Testing.

D. Temporary Pumping and Piping Facilities

1. The Contractor is responsible to supply a complete pumping and piping system to convey all fluids to the various facilities being tested should it be required. The Disk Filter Manufacturer shall coordinate with the Contractor to identify any necessary pumping and piping requirements.

2. The Contractor is responsible for temporary pumping systems as required to empty and refill the structures to be improved. The Contractor is responsible for temporary pumping systems as required to simulate the process performance criteria noted within the Contract Documents.

3. Additional temporary pumping may be required for other processes. The Contractor will be responsible for all temporary pumping and piping systems for completion of the work described within the Contract Documents.

PART 3 - EXECUTION

A. Preliminary Matters

1. Conduct all field inspections as defined in the individual specification sections, installation checks, hydrostatic tests, performance tests, and necessary corrections required, to demonstrate that individual components of the Work have been properly erected and found to operate in accordance with the Contract Documents, so that they can be utilized for their intended purposes.

2. Remove all electrical jumpers, bypasses or other items connected to the equipment, which are not intended to remain in the facility and are not required by the specifications. Demonstrate that each component is operating under its own control as designated.

3. Confirm that all electrical circuits are energized in the automatic position, that valves and gates are set to their normal position and that the flow path through the Work is unobstructed.

C. Start-Up System Testing

1. Provide personnel and equipment except as stated in paragraph entitled "Interface Between Contractor and Owner" during the start-up System Testing period to perform the start-up System Testing tasks.

2. Prior to commencing system start-up and by utilizing the CAR procedure a minimum of fourteen (14) days in advance of the work, coordinate system start-up activities with the Owner's operating personnel and the Engineer.

3. Initiate component start-up in accordance with the manufacturer's operation and maintenance manual.

4. Coordinate with Owner for any adjustments desired or operational problems requiring debugging.

5. Make adjustments as necessary.

6. During this start-up System Testing period, a representative of the manufacturer of each major piece of equipment shall visit the site for at least one day to inspect the equipment and certify to the Engineer and Owner in writing that the equipment has been installed properly and is operating properly.

7. During the start-up System Testing period, operate the facilities in a manner to test alarms, controls, and interlocks. Repair or replace equipment that does not respond to the interlocks, alarms and controls designed. The work must operate successfully during this System Testing period in the manner intended. If the work does not operate successfully, correct the problem and start the test over.

8. Test all motors for vibration by measuring the vibration on the shaft adjacent to the bearings. If a vibration level is specified in the technical specifications for a particular piece of equipment, assure that the equipment complies with the specified level. Repair, realign or replace equipment until the measured vibration is less than the specified maximum vibration level. Submit vibration test reports to Engineer for review.

9. The system start-up will be deemed to be completed after:

    a. All structures have been filled with Secondary effluent.

    b. All adjustments and operational scenarios as desired by the Owner have been made and simulated, respectively.

    c. Secondary Effluent has flowed through the new and modified unit processes at the processes rated capacity for at least 48 consecutive hours without overflows, problems or stoppages to make corrective measures. The effluent may be obtained from the existing plant flow. Flow rate should be varied from minimum to peak hour flow during the course of 48 hours.

    d. Unless otherwise noted, System Testing shall be conducted utilizing plant secondary effluent, have a minimum duration of 48 hours, at that processes' rated capacity and operate successfully to the acceptance of the Owner without instances including

but not limited to overflows, problems or stoppages required to make corrective measures.

e. Demonstrate that the control and/or monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings.

D. System Testing

1. General System Testing requirements;

a. After completion of the start-up System Testing, perform the System Testing of the filter improvements in the presence of the Engineer and Owner. A successful system test must be completed before substantial completion may be issued. Provide all personnel and equipment except as stated in the paragraph entitled "Interface Between Contractor and Owner" as necessary during the System Testing period to complete the tasks. The Owner will direct the Contractor relative to required unit operation and performance under the varying operating conditions.

b. During the system test period, operate the facilities in a manner to test alarms, controls, and interlocks. Repair or replace equipment that does not respond to the interlocks, alarms, and controls designed.

c. During the System Testing, test the pumps:

(1) Operate the backwash/waste pumps for a full backwash cycle of all filter disks, during which time no repairs or adjustments shall be required. Assure that pumps operate as designed and specified in response to filter level controls, cavitation, and damage to impellers and shafts. Repair, replace, or realign motors, shafts, and impellers and retest.

(2) Where field tests are required for pumps and no meters are in the associated piping, provide temporary meters and flow recorders.

d. During the System Testing, test all motors for vibration by measuring the vibration on the shaft adjacent to the bearings. If a vibration level is specified in the technical specifications for a

particular piece of equipment, assure that the equipment complies with the specified level. Repair, realign, or replace equipment until the measured vibration is less than the specified maximum vibration level.

e. During the System Testing period, operate the Work and cause various operational circumstances to occur, as instructed by designated plant operating personnel. At a minimum, these circumstances will include average and peak daily flows, random equipment failures and tank overflows, surcharges, and bypasses. Acceptability of the Work's performance will be based on the work performing as specified under these actual and simulated operating conditions and producing an effluent as defined in the contract documents. The intent of the start-up System Testing is for the Disk Filter Manufacturer and 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 acceptance.

f. The System Testing for each process flow stream and instrumentation system will be conducted utilizing the intended media to be processed (i.e. raw wastewater, mixed liquor, secondary effluent, etc). The Work must operate successfully in the manner intended using raw wastewater, mixed liquor, secondary effluent, etc as the media. If the work does not operate successfully, correct the problem(s) and start the test over from day one.

g. Unless otherwise noted, System Testing shall be conducted utilizing the intended media to be processed, have a minimum duration of 7 consecutive days, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures.

2. Specific Requirements for the Disk Filters (Process 065 & 570);

a. Secondary Effluent will be used during testing and routed to the new disk filters. Performance data including filter flow, filter influent, and filter effluent TSS. Performance data for each filter

vessel shall be provided at average and maximum flows.

b. Each filter vessel shall perform a full backwash/waste cycle. Backwash/waste flow shall be measured for compliance with the manufacturer's required backwash flows. Backwash shall be initiated automatically via level control in the filter vessel. All pumps and actuated valves shall operate properly during backwash/waste testing.

E. Interface Between Disk Filter Manufacturer, Contractor, and Owner

It is the intent of this section that, during Preliminary Matters, and the System Start-Up and System Testing:

1. During System Testing, the Disk Filter Manufacturer and Contractor will assist the Owner by performing all work to test, operate and maintain the plant (turning on/off pumps, opening/closing valves, etc.), assuming a 24 hour working day, seven days a week, starting the date a system test is initiated on any respective process.

2. The Owner will furnish certified operators in compliance with FDEP rules.

3. The Contractor and/or Vendor shall submit a C.A.R. for correspondence with the Owner and will not perform any activities without first consulting with Owner.

F. Instrumentation and Controls System Testing

1. The Disk Filter Manufacturer and Contractor are to perform the Operational Readiness Test (ORT), Functional Demonstration Test (FDT) and Performance Acceptance Test (PAT) in conjunction with the Preliminary Matters, System Start-Up and System Testing procedures, respectively.

END OF SECTION

SECTION 11399 DISK FILTERS AND APPURTENANCES

PART 1 - GENERAL

A. Description

1. Furnish and deliver tertiary disk filters units to both the NWRF and EWRF sites. The NWRF site will receive six (6) disk filter units and the EWRF site will receive five (5) disk filter units. A disk filter unit shall consist of the items listed in Part 2 A. of this specification. Disk filters shall be installed under separate contract. The disk filter manufacturer shall also provide testing and startup services once the disk filters have been installed under this contract.

B. References

1. American Society for Testing and Materials International (ASTM):

   a. A48: Specification for Gray Iron Castings.

   b. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

2. National Electrical Manufacturers Association (NEMA):

   a. MG1: Motors and Generators.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer’s catalog data and descriptive literature and detail drawings showing all disk filter equipment, parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each piece of equipment by tag number to which the catalog data and drawings pertain. Mark out inapplicable options.

3. Submit dimensional sketches of all equipment supplied. Show arrangement of equipment components including drive

and motor, weirs, pumps, valves, instruments, piping connections, and supports.

4. Submit weight of equipment mounted on base and weights of all components.

5. Hydraulic performance data showing the relationship of head loss versus flow. Data based upon other manufacturer's data is not acceptable.

6. Submit performance data as specified below.

7. Shop and field inspection reports.

8. Submit motor data as specified in Section 16150.

9. Submit electrical drawings. Show wiring, controls, interlocks, terminals, and disconnects. Label each terminal, showing which control or electrical power wire connects to each terminal.

10. Provide elevation views of interior and exterior of all panels.

11. Submit list of spare parts to be supplied with the project in accordance with this specification.

12. Operation and Maintenance Manuals per Section 01300 with installation instructions, operation and start-up procedures including lubrication requirements and a complete bill of materials for all equipment.

13. Submit six (6) copies of a written report prepared by the manufacturer certifying that the equipment has been properly installed, lubricated, and test run.

14. Qualification/Installations meeting the requirements of Section 11399 Part 1. F.

    a. Provide current (verified) contact information for each installation.

    b. Provide number of filter units and average daily flow and peak flow per filter unit per facility.

    c. Provide design and peak loading rates (gpm/sf) for peak hour and average day flow rates.

D. Quality Assurance

1. Equipment specified shall be the product of one manufacturer.

2. Obtain filters, panels, backwash pumps, valves and controls regardless of manufacturer, as a complete integrated package to ensure proper coordination, compatibility and operation of the system.

3. Equipment specified shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

4. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

5. Shop tests as specified.

E. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. Two (2) labor days for each service listed in the subsection on "Service Conditions" to check the installation and advise during start-up, testing, and adjustment of the equipment.

2. Three (3) labor days (one (1) day for each shift, plus additional day) to instruct the County's personnel in the operation and maintenance of the equipment. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Refer to Section 01010 for additional requirements.

3. If equipment proposed is heavier or taller, different width, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

    a. If equipment is heavier than specified, provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

4. Electrical Equipment Labeling Requirements

   a. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field verified or factory UL certified prior to equipment acceptance and use.

5. Provide fabrication in compliance with all applicable ASTM standards or equivalent international standards.

6. Factory welding to use shielded arc, inert gas, MIG or TIG method.

   a. Filler wire: Add to all welds to provide for a cross section equal to or greater than the parent metal. If two different thickness materials are joined, the weld is equal to the thinner of the two materials.

   b. Butt welds: Fully penetrate to the interior surface and gas shielding to interior and exterior of the joint. Butt welds that are accessible to both sides shall be welded on both sides in lieu of gas backing.

F. Qualification

The disk filter manufacturer is required to prove satisfactory experience in the design and manufacturing of disk filter systems. Prior to submitting shop drawings, submit data, records, contact names and numbers for all appropriate references.

The Manufacturer of the disk filter equipment must have disk filter units installed at two (2) separate facilities within the United States which have been in continuous operation for a period of five (5) years (at the time of bid) with a minimum average daily flow of 3 MGD per filter unit. The peak hydraulic loading rate for the installed disk filters used as references shall be 6.50 gpm/sf. Should the manufacturer not be able to meet the experience/installation requirements the manufacturer shall provide a five year performance bond for 100% of the equipment cost, a supply bond and a five year extended warranty including parts and labor. Should a performance bond and supply bond be necessary they shall be included in the base bid item for each set of filters. Refer to Section 01025.

G. Delivery, Storage and Handling

1. The disk filters purchased as part of this contract are to be installed under separate contract. Fabrication, storage, maintenance during storage, and delivery of the disk filters shall be the responsibility of the Disk Filter Manufacturer.

2. Following fabrication of the NWRF and EWRF disk filters the Disk Filter Manufacturer shall store the filters at a facility determined by the Manufacturer until such time that the NWRF and EWRF sites have been prepared for their installation. Delivery shall be no later than than 240 calendar days after issuance of the Purchase Order by Orange County.

3. Storage under this contract shall include all manufacturers' recommended maintenance procedures in order to maintain the filters in good working condition and maintain all warranties.

4. Once the NWRF and EWRF sites have been prepared for filter installation (by the filter installation Contractor under separate contract) the Disk Filter Manufacturer shall deliver the disk filters to the NWRF and EWRF sites for installation by the Owner's installation Contractor. The filter delivery costs shall be the responsibility of the Disk Filter Manufacturer.

PART 2 - PRODUCTS

A. System Description

1. Disk filter system capacities and operating data are indicated in the Performance Data in Part 3 D. of this specification.

2. Filters units shall consist of the following: tank assembly, basin mounting brackets and hardware, centertube with cloth media disks, drive mechanism, backwash/sludge discharge pumps and actuated valves, pressure transmitter, vacuum transmitter (if applicable), level switches, filter control panels with sunshade and other components as specified herein.

3. The disk filters for both the NWRF and EWRF facilities have been designed to meet the requirements of the existing plant hydraulics. The following disk filter components shall be constructed to match the elevations

shown on the drawings such that the hydraulic conditions are met:

a. Influent Pipe Centerline Elevation

b. Influent Weir Elevations

c. Overflow Weir Elevation

d. Overflow Outlet Centerline Elevation

e. Outlet Weir Elevation

f. Outlet Pipe Centerline Elevation

B. Manufacturers

1. Aqua-Aerobics Systems, Inc. (Manufacturer A)

2. Alfa Laval Ashbrook Simon-Hartley (Manufacturer B)

3. Five Star Filtration (Manufacturer C)

4. No “or equal” manufacturers will be considered.

C. Disk Filter Construction

1. Materials

a. Hardware: Type 316 stainless steel

b. The disk filter tank and all structural shapes (angles, tubes, channels, etc.) shall be constructed from Type 304 stainless steel. Tank shall have a minimum thickness of 1/4”.

c. The disk filter tank shall include a method of internal access to the tank. The access shall be integral to the tank such as a ladder rungs welded into the corner of the tank.

d. Back-wash pump casing: Gray Iron No. 30 and impeller of Ductile Iron or stainless steel.

e. Back-wash piping and fittings 3 inches and smaller shall be threaded Type 304 stainless steel in accordance with Section 15276. Backwash piping and fittings 4 inches and larger shall be ductile iron in accordance with Section 15240

f. Flange hardware including bolts, nuts and washers: AISI 316, anti-seizing.

2. Filters

a. Provide the filters designed and built to withstand all static and hydraulic forces that may occur during fabrication, shipping, operation and maintenance. Provide all structural and functional parts sized for the loads encountered during operation and maintenance.

3. Backwash System

a. Provide a disk backwash system for each filter which consists of two (2) backwash pumps per filter, electric actuated backwash valves, backwash cleaning shoes, backwash manifold, pump check and isolation valves, and associated piping, fittings, and appurtenances.

b. Backwash system design shall be the manufacturer's recommended backwash system and consist of either rotating the media disk around a fixed backwash shoe, rotating a backwash manifold around a fixed disk, or passing the backwash manifold linearly across the filter disks.

c. Backwash manifold shall be constructed from 304 stainless steel. All other components of the backwash system shall be constructed of corrosion resistant materials suitable for long term service for wastewater as described in the Service Conditions below.

d. Backwash piping and manifold shall be mounted to the filter tank using 304 stainless steel pipe supports.

e. Provide each filter with two backwash pumps, manufactured by Gorman Rupp, Grundfos, or WEMCO.

f. Pump Motor: Continuous-duty motor with leads to a conduit box for outdoor operation. Motors shall be of the type identified in Section 11399 Part 3 D. and in accordance with section 16150.

g. Each backwash pump shall be equipped with a either a ball valve or a butterfly valve for isolation on both the suction and discharge of the pump. Either a

316 stainless steel spring loaded ball check valve or a cast iron swing check valve shall be provided on the discharge of all backwash pumps. A separate check valve shall not be required if the backwash pump is equipped with an integral check valve on it. Pressure gauges shall be provided on both the suction and discharge of each backwash pump.

h. Pressure gauges shall be bourdon tube with with a 4 1/2″ gauge and an accuracy of plus or minus 2.0 percent of span or better. Gauges shall have a phenolic shock resistant or 316 stainless steel. Bourdon tube shall be 316 stainless steel. Window shall be clear acrylic or shatter proof glass. Connection shall be 1/2 in. NPT. All pressure gauges shall be provided with 316 SS diaphragm seals with threaded connections. Acceptable pressure gauge manufacturers are Dwyer, Ashcroft, or Wika.

i. Unions or flanges shall be provided on the suction and discharge of each backwash pump to facilitate pump removal.

j. Normal filter operation shall not be interrupted during backwash and sludge waste operations.

4. Drive Mechanism

a. Provide a drive mechanism that will either rotate the disk centershaft, rotate the backwash manifold, or operate the linear backwash manifold to facilitate backwashing of the filter discs.

b. Provide gearboxes and motors installed above the water level at a location that is accessible for maintenance.

c. Gear motor: Output rpm as specified, 3-phase, 60 Hertz, 460 volt, continuous-duty motor with leads to a conduit box.

d. Service Factor: 1.15 based on motor nameplate rating

5. Motor

a. Provide in accordance with Section 16150 and the following.

b. Horsepower rating of motors: Greater than the maximum brake horsepower under all operational

conditions without operating in the service factor.

c. In addition to the requirements for bearings specified under Electric Motors in Section 16150, provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

d. Operate without overheating at the speeds specified and indicated.

e. Service Factor: 1.15

f. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

g. Rating: 460V, 3-phase, 60 Hertz.

h. (NTS: Edit ambient temperature and altitude to suit project site conditions.)

6. Gear Reducer

a. Provide parallel shaft or right angle arrangement classified for AGMA Class I duty.

b. Provide ASTM A48 Class 30 cast iron housing.

c. Gears: Case hardened alloy steel forgings with precision ground gear teeth minimum AGMA quality 12.

d. Match torque-rating of driven equipment.

e. Minimum gear reducer service factor 1.2 minimum, based on motor horse power rating.

f. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

D. Valves

1. Backwash/Sludge Waste Valves

a. Each filter shall include actuated backwash and waste valves. The quantity of backwash and waste valves to be provided shall be per the drawings. Valves shall be either 316 stainless steel ball valves or cast iron butterfly valves.

b. Ball valves shall be 3 piece, grooved end with reinforced Teflon seats and seals. Ball valves shall be 1,5000 PSI WOG full port valves with 316 stainless steel body, ball and stem manufactured by Ta Chen International or Nibco.

c. Butterfly valves shall be short body, flanged type. Valve shall conform to AWWA C504, class 150B. Minimum working pressure across the valve shall be 150 psi. Flange Ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Butterfly valve materials shall be as follows:

Component	Material	Specification
Body	Cast iron or ductile iron	AWWA C504
Exposed body capscrews and bolts and nuts	Stainless steel	ASTM A276, Type 316
Discs	Cast iron, ductile iron, or Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 316
Seat material	EPDM	--

Where the rubber seat is applied to the disc, it shall be bonded to a stainless steel seat retaining ring which is clamped to the disc by Type 304 or 316 stainless steel screw fasteners or secured to a stainless steel seat by a combination of cap screws, a serrated disc retaining ring, and molded shoulders in the seat mating with machined registers in the disc. The rubber valve seat shall be secures to or retained in the valve body. Valves shall be Valworx Series 5644 or Bray Series 30.

d. Valve actuators shall be provided by the valve manufacturer and be provided as one valve/actuator unit. Actuators shall be 120V electric actuators, UL

listed, with NEMA 6 (IP 68) enclosures. Actuators shall be provided with limit switches to indicate full open and full closed positioning, manual override handwheel, motor heater/thermostat, and visual position indication.

e. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

E. Pressure Transducer

1. Provide one (1) submersible pressure transducer unit for each disk filter unit constructed of stainless steel for each filter to continuously monitor the level within the filter chamber and report liquid level. Transducer body shall be 316 stainless steel or Hastelloy. Transducer shall be IFM Effector PX series, KPSI Model 710, or Wika.

2. Transducer output shall be a 4-20 mA signal over a 0-5 psi range. Electrical connection shall be 2-wire, loop powered. Pressure transducer shall be provided with a mounting bracket and 316 stainless steel hardware.

F. High Level Float Switch

1. Provide two (2) float switches for each disk filter unit to indicate emerging overflow level and high level. The float switches shall be Anchor Scientific Model GSI 40NONC or approved equal.

2. The float shall be 120V and contain a non-mercury switch and chemical resistant polypropylene hermetically sealed casing.

G. Overflow System

1. Provide an overflow system on each EWRF filter with and overflow weir and overflow flange as shown in the drawings.

2. The Manufacturer shall provide an overflow system on each filter. The purpose of the overflow system is to allow unfiltered flow to be bypassed around or diverted from each filter that is malfunctioning or overloaded. The overflow system shall include an overflow weir, overflow trough, an overflow port, and an overflow flanged outlet. The overflow port is an opening to allow flow from the overflow trough to the effluent box where overflow will be routed around a malfunctioning or overloaded filter; if this feature is not used, it will be sealed drip-tight with a removable bolted gasketed plate. The overflow flanged outlet will allow flow from the overflow trough to a bypass pipe for diversion from a malfunctioning or overloaded filter; if this feature is not used, it will be sealed drop-tight with a removable bolted gasketed blind flange.

3. The overflow weir shall be level and shall be adjustable in the vertical direction. The overflow trough shall have a minimum capacity of 6 mgd per filter. A non-mercury float switch shall be provided to signal that the level in the filter is at or greater than the overflow weir elevation. The centerline of the overflow flanged outlet shall be a minimum of 9 inches below the elevation of the overflow weir, and shall be located as shown on the Drawings.

4. The elevation of the overflow weir is based on the initial backwash settings, which correspond to 10.5 inches of headloss for the “backwash initiate level”, and 12 inches of headloss for the “high level alarm”. The overflow weir will be adjustable and set at a minimum of 6 inches above the initial “high level alarm” water level.

H. For each NWRF filter, the MANUFACTURER shall provide a 304 stainless steel blind flange installed on the overflow flange, and provide a 304 stainless steel gasketed plate bolted in open position to allow overflow to bypass the filter from the overflow trough into the effluent box. Bolts, nuts, and washers shall be provided for the blind flanges and for the gasketed plates. Bolts shall be ASTM

A193 grade B8M class 1, with heavy hex nuts per ASTM A194 grade 8M class 1 coated to prevent galling; or provide bolts per ASTM A193 grade B8M class 2, with heavy hex nuts per ASTM A194 grade 8M class 1 uncoated. Washers shall be 316 stainless steel annealed per ASTM A240.

1. MANUFACTURER shall furnish all NWRF filters to satisfy the following design constraints:

Manufacturer Name	Minimum Overflow Weir Elevation (ft from Bottom of Filter)	Minimum Weir Length (ft)
Aqua-Aerobic Systems, Inc.	9.42	5.3
Alfa Laval	9.29	7.3
Five Star Filtration	10.09	8.0

I. For each EWRF filter, the MANUFACTURER shall provide a 304 stainless steel gasketed plate bolted in sealed position to direct flow in the overflow trough to the overflow flanged outlet instead of the effluent box. The EWRF filters will not be provided with a blind flange for the overflow flanged outlet. Bolts, nuts, and washers shall be provided for the gasketed plates. Bolts shall be ASTM A193 B8M class 1, with heavy hex nuts per ASTM A194 B8M class 1 coated to prevent galling; or provide bolts per ASTM A193 B8M class 2/ strain hardened, with heavy hex nuts per ASTM A194 B8M class 1 uncoated. Washers shall be 316 stainless steel annealed per ASTM A240.

J. Filter Control Panels

1. Disk filter control panels shall be provided by the disk filter manufacturer. Disk filter control panels shall be include all necessary logic, controls, and programming to operate the filter in manual mode. Integration of the disk filter control panels into the existing NWRF and EWRF control networks will be performed by the disk filter installation Contractor with coordination from the Disk Filter Manufacturer.

2. Provide one (1) UL listed, 480VAC control panel for complete automatic operation of each disk filter unit. Control panel enclosures shall be housed in a white polyester powder finish inside and out, NEMA 4X, Type 316 stainless steel.

3. Each disk filter control panel shall include the motor starter for both backwash/waste pumps as well as the backwash drive mechanism. Starters shall be combination thermal magnetic circuit breaker type full voltage non-reversing. Motor starters shall be NEMA rated for the horsepower of the motor.

4. Programmable logic controllers (PLCs) for filter control panels shall be Siemens S7-1500 and conform to the requirements of Division 13.

5. Control panels shall be built in a UL 508 shop and shall be UL labeled/listed.

6. Each filter control panel will be required to communicate with the existing plant SCADA system. The disk filter control panels shall be equipped with all hardware and software necessary to communicate with the SCADA system as described in the specifications. All programming within the filter control panels shall be the responsibility of the Disk Filter Manufacturer.

7. Each disk filter control panel shall be equipped with an Ethernet switch to communicate with the control panel PLC, the remaining disk filter control panels, and the plant SCADA system. Each disk filter control panel shall be equipped with a minimum of one (1) Ethernet port and two (2) fiber ports. The control panel PLC shall communicate with the control panel Ethernet switch via Ethernet. Each control panel shall communicate with the plant SCADA system via fiber. Ethernet switches shall be per Division 13.

8. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor.

9. Lightning/Surge suppression shall be provided for each disk filter control panel per Division 13.

10. Filter control panels shall be temperature controlled according to Section 13325.

11. All filter control panels shall be provided with an internal Uninterruptible Power Supply (UPS) system per Section 13310. All timers and setpoints shall be retained in the event of power fault.

12. Clearly mark all wires with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10.

13. Sunshields shall be provided on the sides and top of the panel enclosure as well as at each control panel operator interface and any field mounted displays. Sunshields shall be constructed of stainless steel shall be mounted over the operator interface or instrument display to provide protection and visibility of operator screens in outdoor applications. Sunshields shall be mounted where practical facing north to minimize sun exposure.

14. Filter control panel hardware and programming shall be factory tested prior to shipment.

15. An operator interface terminal (OIT) shall be provided on each disk filter control panel. OITs shall be NEMA 4X with color displays and provided with a touch screen for data entry. OITs shall meet the requirements of Section 13310 Part 2,A. A graphic of each filter with a status of all associated equipment shall be displayed on the OIT. Each OIT shall also provide the following control, indication, and monitoring functions:

    a. Hand/Off/Auto selector switch for the filter unit

    b. Start/Stop for each piece of motorized equipment

    c. Open/Close control for each actuated valve

    d. On/Off indication for each piece of motorized equipment and Open/Close indication for each actuated valve

    e. Alarm indications for all motorized equipment, valves, and filter high level

    f. Selector switch to place the filter out of service with In Service/Out of Service indication. Selection of In Service/Out of service shall send a signal to Open/Close the actuated valve on the filter influent piping.

    g. Backwash sequence initiation

    h. Filter backwash in progress

i. Elapsed time since last backwash

j. Filter level indication

k. Backwash interval/level initiation setpoint

l. Sludge waste interval and duration setpoint

16. The following indication and controls shall be provided on the face of the disk filter control panel:

a. Filter In Service/Out of Service selector switch. Selection of In Service/Out of Service shall send a signal to Open/Close the actuated valve on the filter influent piping.

b. Hand/Off/Auto selector switch for the filter unit

c. Start/Stop for each piece of motorized equipment

d. Open/Close control for each actuated valve

e. Backwash initiation pushbutton

f. Backwash in progress indication

g. Elapsed time since last backwash

h. Filter level indication

i. Backwash interval/level initiation setpoint

j. Sludge waste interval and duration setpoint

k. Elapsed time meter for each piece of equipment

l. On/Off indication for each piece of equipment

m. Alarm indicating lights for each piece of motorized equipment as well as filter high level.

17. A backwash cycle shall be initiated by one of the following conditions:

a. Filter high level

b. Operator adjustable time interval

c. Operator selected manual backwash initiation

18. A sludge waste cycle shall be initiated by one of the following conditions:

    a. Operator adjustable time interval

    b. Following an operator adjustable number of backwash cycles

    c. Operator selected manual backwash initiation

K. Spare Parts

1. Comply with the requirements specified in Section 01600.

2. Provide spare parts that are identical to and interchangeable with similar parts installed.

    a. Furnish the following spare parts for both the EWRF and NWRF site:

        (1) Two (2) shelf spare backwash pumps including pump and motor

        (2) A one (1) year supply of required lubricants.

        (3) One full set of spare belts, if applicable.

        (4) One (1) complete set of spare disk filter frame and cloth assemblies for the EWRF facility shall be provided to replace all disks in one filter unit. One (1) complete set of spare disk filter frame and cloth assemblies for the NWRF facility shall be provided to replace all disks in one filter unit.

        (5) One (1) complete set of spare backwash/waste valves and actuators shall be provided to replace all valves on one filter unit at the EWRF facility. One (1) complete set of spare backwash/waste valves and actuators shall be provided to replace all valves on one filter unit at the NWRF facility.

        (6) Center tube bearing where applicable

        (7) One (1) drive motor

        (8) One (1) set of all gaskets and seals

        (9) Control panel spare parts per Section 13325

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(10) Any other manufacturer recommended spare parts.

(11) One set of all special tools required

3. Spare parts shall be packaged in sealed, rotationally moulded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Disk Filter Manufacturer shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

4. Pertaining to general inventory of all containers, the Disk Filter Manufacturer shall provide a general ascending alpha-numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

5. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum; Process description and Process number, equipment description, equipment tag, Manufacturer's information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

6. The Disk Filter Manufacturer shall provide an electronic log in MS Excel of all containers which include the following at a minimum; container alpha-numerical designation, content description, site storage location, O&M Manual volume subsection reference.

7. A copy of all inventory and manufactures product information data sheets shall be provided within a file pocket attached within the container.

8. Containers shall be positioned on site as designated by the Owner's Representative

PART 3 - EXECUTION

A. Installation

1. Disk filters units shall be delivered to both the NWRF and EWRF sites and placed in a location determined by

the Resident Project Representative.

2. Filters shall be placed at each site and equipped for long term storage as recommended by the manufacturer.

3. Disk filters shall be installed under separate contract.

B. Shop Testing

1. Comply with the requirements specified in Section 01664 and as specified herein.

2. Provide motor shop testing in accordance with Section 16150.

3. Filter Assembly Testing

a. All shop tests will be nonwitnessed.

b. Control Panel Tests:

(1) Test all functions and alarms of each control panel. After acceptance and prior to shipping apply dielectric grease and install corrosion inhibitors as specified.

c. Filter Assembly Tests:

(1) Fully factory assemble each disk filter unit and operate filled with water for a minimum of 1 hour.

(2) Conduct testing using job motors control panels.

3. Repeat tests until specified results are obtained.

4. In event that specified tests indicate that equipment will not meet the specifications, AECOM has the right to require complete witnessed tests for all equipment at no additional cost.

5. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to Owner.

6. Provide a 30 day minimum notice prior to testing.

7. When witness performance testing is specified, provide roundtrip airfare, all transportation and lodging for witness testing for two (2) people. If air travel is more than 6 hours provide business class airfare.

C. Painting and Coating

1. All ferrous surfaces shall be shop coated with a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Epoxy coating shall be Scotchkote 134 or 206N, or Lilly Powder Coatings "Pipeclad 1500 Red.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

4. After installation and testing with no exceptions noted by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

D. Service Conditions

1. Provide filters for filtering clarified effluent from an activated sludge process with the following conditions:

2. EWRF Equipment Tag Numbers: 570-DF-1, 570-DF-2, 570-DF-3, 570-DF-4, and 570-DF-5.

3. NWRF Equipment Tag Numbers: 065-DF-1, 065-DF-2, 065-DF-3, 065-DF-4, 065-DF-5, & 065-DF-6.

4. Performance Data: See tables in this section.

Wastewater Flow	
Maximum Flow/Filter, mgd	6.0
Average Flow, mgd	3.0
Wastewater Composition	
Average TSS, mg/L Filter Influent	10.0
Average TSS, mg/L Filter Effluent	≤5.0
Maximum TSS, mg/L Filter Influent	20.0
Maximum TSS, mg/L Filter Effluent	5
BOD, mg/L Filter Influent	5.0
Phosphorous, mg/L Filter Influent	1.0

EWRF Filter Requirements	
Number of Filter Units	5
Number Operating	4
Type of Tank	304 SS
Peak Unit Capacity, mgd	6.0
Peak Hydraulic Loading, gpm/ft^2	6.50
Media Nominal Pore Size Rating, microns	10
Number of Discs/Unit	7-12
Minimum net filter surface (submerged, without frame work), ft^2 per disc	53.8
Minimum submerged filter area per unit, ft^2	576
Drive motor power, HP	1/3 – 2
Drive Motor Enclosure	TEFC
NWRF Filter Requirements	
Number of Filter Units	6
Number Operating	5
Type of Tank	304 SS
Peak Unit Capacity, mgd	6.0
Peak Hydraulic Loading, gpm/ft^2	6.50
Media Nominal Pore Size Rating, microns	10
Number of Discs/Unit	7-12
Minimum net filter surface (submerged, without frame work), ft^2 per disc	53.8
Minimum submerged filter area per unit, ft^2	576
Drive motor power, HP	1/3 – 2
Drive Motor Enclosure	TEFC
Filter Backwash/Waste Requirements (Aqua-Aerobic)	
Total Backwash Capacity, gpm	260
Number of Backwash Pumps/Filter	2
Backwash Pump Design Point	130 gpm @ 23 ft TDH
Back-wash pump power, HP	2

Back-wash Pump Motor Enclosure	TENV or TEFC
Number of Backwash Valves	6
Backwash valve size	2 inch
Number of Waste Valves	1
Waste valve size	2 inch
Filter Backwash Requirements (Alfa Laval)	
Total Backwash Capacity, gpm	400
Number of Backwash Pumps/Filter	2
Backwash Pump Design Point	200 gpm @ 30 ft TDH
Back-wash pump power, HP	5
Back-wash Pump Motor Enclosure	TENV
Number of Backwash Valves	8
Backwash valve size	4 inch
Number of Waste Valves	1
Waste valve size	3 inch
Filter Backwash Requirements (Five Star)	
Total Backwash Capacity, gpm	1,150
Number of Backwash Pumps/Filter	2
Backwash Pump Design Point	575 gpm @ 25 ft TDH
Back-wash pump power, HP	7.5
Back-wash Pump Motor Enclosure	TEFC
Number of Backwash Valves	2
Backwash valve size	6 inch
Number of Waste Valves	1
Waste valve size	3 inch

a. Provide the filters designed for continuous operation with varying flow rates and with filtration continuous during back-wash operation.

E. Field Testing

1. Following installation of the disk filters under

separate contract the disk filter manufacturer shall return to both the NWRF and EWRF sites and provide field testing as described below.

2. All testing shall be coordinated with the Owner and Engineer a minimum of fourteen (14) days in advance by submitting a C.A.R.

3. Comply with the requirements specified in Section 01664 and as specified herein.

4. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, and a completed and signed pretesting check list. See Division 1 for checklist.

5. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct a dry running test and a performance test for each unit in presence of the Engineer to determine its ability to meet the specified performance under specified conditions.

   a. Dry Testing:

      (1) Dry test each filter to demonstrate the correct alignment, smooth operation, proper and equal spacing of screen bars freedom from vibration, excessive noise and overheating of the moving parts and bearings.

      (2) All defects recorded during the above field tests and all defects and failures occurring within the first year of operation shall be corrected at no additional cost to the Owner.

   b. Performance Test:

      (1) During tests, observe and record influent and effluent flow rates, influent and effluent TSS and turbidity, hydraulic loading rate (gpm/sf), maximum solids loading rate (ppd/sf), TSS removal (ppd), backwash rate (gpm) and backwash duration.

      (2) Twenty four (24) samples of the above mentioned parameters shall be taken each day during performance testing. Samples shall be taken from mid-depth of the filter influent

and effluent boxes. Sampling and quality control practices shall be per 40 CFR part 136.

(3) Test Duration: Five (5) days total, two (2) days at peak capacity hydraulic loading rate and three (3) days at the average day flow of 3.0 MGD. Hydraulic loading rate (gpm/sf) shall be defined as the total effluent flow divided by the number of filters in service divided by the effective submerged filtration area of each filter.

(4) The disk filter system shall be deemed to pass the performance test when 100% of the collected samples meet the maximum effluent TSS requirement defined in Performance Data Table in Section 11399 Part 3 D.

(5) Each filter must demonstrate thirty (30) days of continuous, defect-free operation prior to final acceptance.

(6) Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

c. Repeat tests until specified results are obtained.

6. Make all adjustments necessary to place equipment in specified working order at time of above tests.

F. Contract Closeout

Provide in accordance with Section 01700.

G. Warranty

The equipment shall be warranted for three (3) years, non-prorated, commencing from date of delivery and acceptance of the filters or no later than January 1st 2017.

H. Additive Warranty

Reference Section 01025 for two (2) years in additional warranty duration added to warranty stated above. Additional warranty shall be provided to extend the non-prorated duration of the warranty listed above by two years. Additive

warranty shall be included in an additive bid item listed in Section 01025.

I. Certification

Provide a written certification from the equipment manufacturer that the equipment has been properly installed according to the plans, specifications and manufacturer's recommendations, and that the equipment is operating normally. Make all necessary corrections and adjustments at no additional cost to the Owner.

END OF SECTION

SECTION 13300 PROCESS INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

A. Scope of Work

1. The Disk Filter Manufacturer shall furnish all services and equipment defined herein and in other Specification Sections as listed below under Related Work.

2. The DISK FILTER MANUFACTURER shall provide all materials, equipment, labor, and services required to achieve a fully operational system. The DISK FILTER MANUFACTURER shall design and coordinate the instrument and control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these Specifications and with related existing equipment.

3. Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided by other suppliers under other Sections of these Specifications, shall be included whether they are shown on the instrument drawings or not.

4. Substitutions on functions or type of equipment specified will not be acceptable. In order to insure the interchangeability of parts, the maintenance of existing equipment, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the DISK FILTER MANUFACTURER to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required.

5. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detailed Drawings, Specifications, engineering data, instructions and recommendations of the equipment manufacturer as accepted by the Engineer.

6. To facilitate the Owner's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.

7. Equipment removed in the course of this work shall be the property of the Owner. Contractor shall coordinate with the Owner in the removal of all designated existing equipment.

8. The Orange County East and Northwest Regional Water Reclamation Facilities are operating facilities, and all work shall be coordinated with its operating personnel to minimize impact on its daily operation.

9. All equipment and installations shall satisfy applicable Federal, State, and local codes as well as UL certification requirements as a minimum.

10. Supplementing this Section, the Drawings and the related Specification sections provide additional details showing panel elevations, instrument device schedules, functional requirements of the system, and interaction with other equipment.

11. All materials, equipment, labor, and services necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner such that the monitoring and control functions are available when the equipment is ready to be placed into service.

B. Related Work

1. The DISK FILTER MANUFACTURER shall furnish all materials, labor and services specified in the following Specification Sections as required to ensure a single, coordinated system is supplied:

a. Section 13310 – Programmable Logic Controllers (PLC) and Digital Equipment

b. Section 11399 – Disk Filter and Appurtenances

c. Section 13325 – Control Panels And Panel Mounted Equipment

2. Divisions requiring coordination shall include, but not be limited to, the following:

a. Division 11 – Equipment

b. Division 13 Special Construction

c. Division 15 – Mechanical

d. Division 16 Electrical

C. Submittals

1. Submit Shop Drawings in accordance with Section 01300. These Shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Submittals shall be bound in separate three ring binders, with an index and sectional dividers, with all Drawings reduced to a maximum size of 11 in x 17 in for inclusion within the binder.

2. Project Plan Submittal

a. The Project Plan shall provide an overview of the proposed system including the approach to work, proposed system architecture diagrams (both Ethernet and Profibus), a preliminary bill of materials of major items to be provided, the proposed work schedule indicating milestones and meetings, project personnel and organization, overviews of testing procedures and training, and a

paragraph by paragraph review of the Specifications indicating any proposed deviations.

b. The schedule shall illustrate all major project milestones including the following:

i Schedule for all subsequent project submittals.
ii Tentative dates for all project design review meetings.
iii Schedule of manufacture and staging of all instrumentation and control system equipment.
iv Schedule for all tests.
v Schedule for shipment of all instrument and control system equipment and all peripheral devices.
vi Schedule for equipment startup.
vii Schedule for all training.

c. The project personnel section shall include the project manager, project engineers and all field technicians/staff anticipated to be used on this project. Provide up to date résumés for all personnel identified.

d. The Project Plan must be submitted and approved before any further submittals will be accepted.

3. Instrumentation Submittal

a. This submittal shall provide complete documentation of all field instruments, panel components, and other instrument and control equipment not specified to be submitted elsewhere.

i Provide data sheets for each component listing all model numbers, optional, and ancillary devices that are being provided. The data sheets shall be provided with an index and proper identification and cross referencing. They shall include but not be limited to the following information:

1) Plant Equipment Number and ISA tag number per the Loop Diagrams.

2) Product (item) name used herein and on the Contract Drawings.
3) Manufacturers complete model number.
4) Location of the device.
5) Input output characteristics.
6) Range, size, and graduations.
7) Physical size with dimensions, enclosure NEMA classification and mounting details.
8) Materials of construction of all components.
9) Instrument or control device sizing calculations where applicable.
10) Certified calibration data on all flow metering devices.

b. Provide equipment specification sheets which shall fully describe the device, the intended function, how it operates, and its physical, environmental and performance characteristics. Each data sheet shall have appropriate cross references to loop or equipment identification tags. As a minimum the specification sheets shall include the following:
1) Dimension, rigid clearances.
2) Mounting or installation details.
iii Connection.
iv Electrical power or air requirements.
v Materials of construction.
vi Environmental characteristics.
vii Performance characteristics.

c. Detailed drawings covering control panels, consoles and/or enclosures which shall include:
i Cabinet assembly and layout Drawings to scale. These shall include both front and rear layouts.
ii Fabrication and painting specifications.
iii Color selection samples for selection by the Engineer.
iv Panel wiring diagrams showing all power connections to equipment within and on the enclosure, combined panel power draw requirements (volts, amps), breaker sizes, fuse sizes, and grounding. This wiring diagram shall

be in ladder logic format and shall reference the appropriate Loop Drawing for continuations or details where required. Show all wire numbers and terminal block designations.

d. The submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the DISK FILTER MANUFACTURER to proceed with the detailed site preparation for all equipment.

e. This submittal shall include:
   i A list of and descriptive literature for tools, spares, expendables, and test equipment as specified in Instrumentation Specifications.
   ii A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the DISK FILTER MANUFACTURER.
   iii Unit and total costs for the additional spare items recommended for each subsystem.
   iv Storage instructions for all spare parts.

4. Digital System Hardware Submittal

a. This submittal shall provide complete documentation of the proposed control room and system equipment other than that included in the Instrumentation submittal: computers, communications equipment, peripherals, fiber optic cable, radio telemetry equipment, etc.

b. Provide a complete system block diagram(s) showing in schematic form, the interconnections between major hardware components such as: control centers, panels, power supplies, consoles, computer and peripheral devices, telemetry equipment, local digital processors and like equipment. The block diagram shall reflect the total integration of all digital devices in the system and shall reflect any HMI locations. All components shall be clearly identified with appropriate cross references to the

location of each. The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.

c. Provide a data sheet and manufacturer cut sheets for each hardware component listing all model numbers, optional, auxiliary and ancillary devices that are being provided. The data sheets shall be provided with an index and proper identification and cross referencing.

d. The Digital System Hardware submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, radio survey information, plug identifications, safety precautions or guards, and equipment layouts in order to enable the DISK FILTER MANUFACTURER to proceed with the detailed site preparation for all equipment.

e. The DISK FILTER MANUFACTURER shall provide fiber optic power budget for each cable run in excess of 500 feet. Cable budget shall include transmitter power, receiver sensitivity, connector losses, cable losses and a 3 dB aging margin. Fiber optic transmission line shall maintain a minimum of 3 dB safety margin.

f. This submittal shall include:
   1) A list of and descriptive literature for tools, spares, expendables, and test equipment as specified in Instrumentation Specifications.
   2) A separate list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the DISK FILTER MANUFACTURER.
   3) Unit and total costs for the additional spare items recommended for each subsystem.
   4) Storage instructions for all spare parts.

5. Testing Submittals

a. The test plan shall be submitted after all hardware submittals have been approved by the Engineer.

b. The test plan shall demonstrate that the DISK FILTER MANUFACTURER has designed and configured a system that meets the design specifications. The documents for the test plan shall be structured so that the Owner understands what the inputs are, what the predicted outputs should be and what the actual outputs are. The test plan should have sign off and date block for the DISK FILTER MANUFACTURER, the Engineer and the Owner, and where applicable, the APS.

c. The complete test plan should include as a minimum descriptions for the following:
   i System hardware and software summary.
   ii A schedule for the testing describing the specific tasks to be performed and the time allotted for each.

d. Test Procedures: Submit the procedures proposed to be followed during the test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests.
   i Preliminary test procedure submittals: Prior to the preparation of the detailed test procedures, submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and checklists. The same test forms may be used for unwitnessed and witnessed tests.
   ii Test Procedure Submittals: After the preliminary test procedure submittals have been reviewed by the Engineer and returned stamped either "approved" or "approved as noted, confirm" submit the proposed detailed test procedures. Testing may not be started until all Testing Submittals have been approved.

e. Test Documentation: Submit a copy of the signed off test procedures upon completion of each required test.

6. Training

   a. The training plan shall include:
      i Definitions of each course.
      ii Specific course attendance.
      iii Schedule of training courses including dates, duration, and locations of each class.
      iv Resumes of the instructors who will actually conduct the training.

7. Refer to Related Sections of the Specifications for other required submittals.

D. Reference Standards

1. American Society for Testing and Materials (ASTM).

   a. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

2. International Society of Automation (ISA)

   a. ISA-5.1 – Instrumentation Symbols and Identification
   b. ISA-5.2 Binary Logic Diagrams for Process Operations
   c. ISA-5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems
   d. ISA-5.4 Instrument Loop Diagrams
   e. ISA-5.5 – Graphic Symbols for Process Displays

3. American National Standards Institute (ANSI)

   a. ANSI X3.5 Flowchart Symbols and Their Usage in Information Processing

4. National Electrical Manufacturers Association (NEMA)

   a. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

E. Quality Assurance

1. The DISK FILTER MANUFACTURER shall perform all work necessary to select, furnish, install, connect, and place into operation all hardware specified within this Division.

2. Actual installation of the system need not be performed by the DISK FILTER MANUFACTURER's employees; however, the DISK FILTER MANUFACTURER shall be responsible for the onsite technical supervision of the installation.

3. The DISK FILTER MANUFACTURER shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

F. System Description

1. The responsibilities of the Disk Filter Manufacturer shall include, but not be limited to, the following:

   a. Furnish and install all field devices and instrumentation as shown on the Contract Drawings and called out in Sections 13300 and 13315.

   b. Furnish and install the new PLC panels, and other control panels as specified. Panels and panel components shall conform to the requirements of Sections 13300, 13310 and 13325.

   c. Applications software programming, including PLC ladder logic, Human-Machine Interface (HMI) graphics, networking, redundancy, database, reports, and local panel HMI screen and database programming, will be provided by the Disk Filter Manufacturer.

2. DISK FILTER MANUFACTURER shall refer to the Contract Drawings and the Specifications for complete

information concerning all equipment and services to be furnished under this contract.

3. Any disputes or conflicts over scopes of work shall be settled by the Engineer.

G. Delivery, Storage and Handling

1. Identification

a. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

b. A permanent plastic tag, black letters on white background, shall be firmly attached and permanently and indelibly marked with the instrument tag number, as given in the Drawings, to each piece of equipment supplied.

2. Storage

a. Equipment shall not be stored out of doors. Equipment shall be stored in dry permanent shelters including in line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be replaced by the DISK FILTER MANUFACTURER at his own cost and expense.

H. Project/Site Requirements

1. Environmental Requirements. Indoor, non-process areas require NEMA Type 12 painted enclosures. All other areas require NEMA Type 4X 316 stainless steel enclosures with a white exterior coating. Refer to Division 16 for area environmental hazardous classifications. Outdoor areas require sun shields.

2. Elevation. Unless otherwise noted equipment shall be designed to operate at a ground elevation of approximately 15 to 20 feet above mean sea level. Equipment mounted below grade shall be NEMA Type 4X.

3. Temperature. Indoor areas' equipment shall be suitable for 10 to 40 C degrees ambient. Outdoor areas' equipment shall be suitable for -30 to 50 C degrees ambient. Storage temperatures will range from 0 to 50 C degrees ambient. Additional cooling or heating shall be furnished if required by the equipment furnished.

4. Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 80 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.

5. Power Supply. 120 volts AC sources of electric supply will be unregulated industrial panel boards.

I. Tools, Spare Parts and Expendables

1. In addition to those defined in related Specification Sections, furnish the following, or approved equals.

2. Tools

a. Electro-Mechanical Tool Kit, JTK-88.

b. LAN/PC Tool Kit, Jensen JTK-5000.

c. Handheld multifunction calibrator, Fluke 725, with complete set of instrument modules, leads and clamps, belt holster, and spare batteries/battery charger.

d. Handheld calibrator for instruments and networks, with complete set of instrument modules, leads and clamps, belt holster, and spare batteries/battery charger.

3. Spares and Expendables

a. Spare parts shall be as defined in the related specification sections. All spare parts shall be new and unused.

b. All spare parts shall be individually packaged and labeled, and packed in a manner suitable for long term storage and adequately protected against corrosion, humidity and temperature.

c. Any required software shall be licensed to Orange County Utilities.

d. Provide one gallon of touch up paint, in one quart containers, for each type and color used for all cabinets, panels, consoles, etc.

J. Final System Documentation

1. Prior to final acceptance of the system and owner training, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished. The DISK FILTER MANUFACTURER shall submit the final documents after the review and acceptance of the Engineer as specified in Section 01300.

2. Provide at least the following documentation as a minimum:

a. A comprehensive index.

b. A complete "As Constructed" set of corrected and completed Shop Drawings.

c. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

d. Full specifications on each item.

e. System schematic drawings "As Constructed", illustrating all components, piping and electrical connections of the systems supplied under this Section.

f. Detailed service, maintenance and operation instructions for each item supplied.

g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic Drawings and instructions.

i. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

3. The final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

4. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

5. If the DISK FILTER MANUFACTURER transmits any documentation or other technical information which he considers proprietary, such information shall be so designated. Documentation or technical information which is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

6. The requirements for the final documentation are as follows:

   a. As built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the System resulting from the Factory and/or Field Acceptance Tests shall be incorporated in this documentation.

   b. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the System in good operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:

      i Operation Information: This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

      ii Preventative Maintenance Instructions: These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

      iii Corrective Maintenance Instructions: These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the

symptoms, probable cause, and instructions for remedying the malfunction.

iv Parts Information: This information shall include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between the Instrumentation System Supplier's part number and manufacturer's part numbers shall be provided.

7. Electronic O&M Information

a. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals on CD-R or DVD-R. Electronic documents shall be supplied in PDF format or as specified below.

b. Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Word and PDF format as applicable.

c. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.

d. Each PLC and PC shall be backed up onto CD-R or DVD-R after Final Completion and shall be turned over to the Owner. Provide all final as-built PLC and HMI project files in their respective native formats. Each file must contain all instruction and rung comments.

PART 2 - PRODUCTS

A. General Equipment Requirements

1. Instrumentation

a. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals which are established standards for the water and wastewater industries.

b. Digital or discrete (on/off) control signals shall be 120VAC, 60Hz. Analog measurement signals shall be 24VDC, 4-20 mA. No zero based signals will be allowed.

c. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

d. Wall- or surface-mounted instruments that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

e. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Electrical Drawings, to comply with the National Electrical Code.

f. All indicators and recorder read outs shall be linear in process units, unless otherwise noted.

g. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent.

h. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

i. All equipment, cabinets and devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

j. The field mounted digital system equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

k. All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC compliant.

2. Electrical

a. All equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplied required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

b. Materials and equipment used shall be U.L. listed wherever available.

c. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

d. Existing signal and control wiring may be wired through intermediate junction boxes/termination cabinets. Note that all new wiring shall not utilize junction boxes or termination cabinets, but shall be connected directly between PLC or other control system panels, and field devices, equipment or motor control panels.

B. Lightning/Surge Protection

1. General

a. Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure. All contact points to be copper with nickel plating. The transient response of units shall be less than 1 nanosecond.

b. The surge protector should meet UL 1449, NEMA LS-1, and IEEE C62.41 Standards, as applicable. This requirement can be met using UL itself or a Nationally Recognized Testing Lab (NRTL) testing to UL standards, in accordance with FTC rules.

c. The manufacturer shall be Current Technology/ Joslyn, Dehn, EDCO, or Surge Suppression Inc. (SSI).

2. Installation

a. The following standards shall be observed:

i All analog signal lines, that include an outdoor instrument and a control panel, shall be protected by surge suppressors at all termination points.

ii All 120V power to outdoor instruments shall be protected with a local surge suppressor mounted at the instrument, as indicated above. Main power to a panel should be on a circuit breaker.

iii Network cable (other than fiber optic) shall be protected at both ends if it runs beyond the walls of a structure.

C. Tubing and Fittings

1. All instrument air header takeoffs and branch connections less than 2-inch size shall be 316 stainless steel.

2. All instrument shut off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. Fittings shall be Swagelok 316 stainless steel or equal and valves shall be Whitney 316 stainless steel or equal.

3. All instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of O.D. scratches having the following dimensional characteristics as required to fit the specific installation:

a. 1/4 in to 1/2 in O.D. x 0.035 wall thickness.

b. 5/8 in to 1 in O.D. x 0.049 wall thickness.

c. 1 in O.D. x 0.065 wall thickness.

d. 1 1/4 in O.D. x 0.065 wall thickness.

e. 1 1/2 in O.D. x 0.083 wall thickness.

f. 2 in O.D. x 0.095 wall thickness.

4. All process connections to instruments shall be annealed 1/2 in O.D. stainless steel tubing, Type 316.

5. All tube track shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 - EXECUTION

A. General Installation

1. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as accepted by the Engineer during construction. Obtain in the field all information relevant to the placing of process control work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work.

2. The instrumentation loop diagrams indicate the intent of the interconnection between the individual instruments. Any exceptions should be noted. Two complete sets of As Constructed shop drawings shall be kept at the job site during all on site construction. Both sets shall be identically marked up to reflect any modifications made during field installation or start up. All markings shall be verified and initialed by the Engineer or his designated representative.

3. Following completion of installation and the operational readiness test, one set of the marked up

drawings shall be provided to the Engineer, the other retained by the DISK FILTER MANUFACTURER for incorporation of the mark ups into final as built documentation. Record drawings shall be as called out in Section 01340 of these specifications.

4. The instrumentation installation details on the Contract Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.

5. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the DISK FILTER MANUFACTURER shall bear full responsibility for such violations and assume all costs arising therefrom.

6. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the DISK FILTER MANUFACTURER shall bear full responsibility for such violations and assume all costs arising there from.

7. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

8. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut off valves.

9. Field instruments requiring power supplies shall be provided with local electrical shutoffs and fuses as required.

10. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

11. The DISK FILTER MANUFACTURER shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the DISK FILTER MANUFACTURER shall be required to ship his material in sections sized to permit passing through restricted areas in the building. The DISK FILTER MANUFACTURER shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).

12. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

13. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

B. Tests (General)

1. The DISK FILTER MANUFACTURER shall test all equipment, hardware and software, to be furnished under this Contract at DISK FILTER MANUFACTURER's own facility before transporting it to the project site.

2. As a minimum, the testing shall include the following:

a. Unwitnessed Factory Test (UFT).

b. Witnessed Factory Test (WFT).

c. Operational Readiness Tests (ORT).

d. Functional Demonstration Tests (FDT).

e. Performance Acceptance Test (PAT).

3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

4. All tests shall be conducted in accordance with prior Engineer reviewed procedures, forms, and check list. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

5. Copies of these sign off test procedures, forms, and check lists will constitute the required test documentation.

6. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.

7. The Disk Filter Manufacturer shall coordinate all testing with the Engineer, all affected Subcontractors, and the Owner.

8. The Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the previously accepted test procedures.

9. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

10. No equipment shall be shipped until the engineer has received all test results and the system is ready for shipment.

11. The DISK FILTER MANUFACTURER shall furnish the services of servicemen, all special calibration and test equipment and labor to perform the field tests.

C. Unwitnessed Factory Tests (UFT)

1. The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All control loops and programs shall be tested. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/ functions.

2. All panels and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, specifications, and Contract Drawings.

3. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.

4. All PLC and HMI software programming must be completed and debugged by the Disk Filter Manufacturer prior to the Unwitnessed Factory Test. UFT test results shall include full testing of software and programming.

D. Operational Readiness Test (ORT)

1. General: Prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, tested, and documented) that it is READY for operation.

2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation,

calibrated, and adjusted on a loop by loop and component by component basis to ensure that it is in conformance with related submittals and these Specifications.

a. The Loop/Component Inspections and Tests shall be implemented using Engineer forms and check lists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the followinginformationand checkoff items with spacesforsign offby the DISK FILTER MANUFACTURER:

   i Project Name.

   ii Loop Number.

   iii Tag Number for each component.

   iv Checkoffs/sign offs for each component.
      1) Tag/identification
      2) Installation
      3) Termination wiring
      4) Termination tubing
      5) Calibration/adjustment

   v Checkoffs/sign offs for the loop.
      1) Panel interface terminations
      2) I/O interface terminations
      3) I/O signal operation
      4) Inputs/outputs operational: received/sent, processed, adjusted
      5) Total loop operation

   vi Space for comments.

b. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign off by the DISK FILTER MANUFACTURER:

   i Project Name.

ii Loop Number.

iii Component Tag Number of I/O Module Number.

iv Component Code Number Analog System.

v Manufacturer (for Analog system element).

vi Model Number/Serial Number (for Analog system).

vii Summary of Functional Requirements. For example:

1) For Indicators and Recorders: Scale and chart ranges
2) For Transmitters/Converters: Scale and chart ranges
3) For Computing Elements: Function
4) For Controllers: Action (direct/reverse) control Modes (PID)
5) For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
6) For I/O Modules: Input or output

viii Calibrations. For example:

1) For Analog Devices: Required and actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
2) For Discrete Devices: Required and actual trip points and reset points.
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Required and actual inputs or outputs for 0, 10, 50, and 100 percent of span, rising and falling.

ix Space for comments.

x Space for sign off by the DISK FILTER MANUFACTURER.

c. The DISK FILTER MANUFACTURER shall maintain the Loop Status Reports and Components Calibration sheets at the job site and make them available to the Engineer/Owner at any time.

3. These inspections and tests do not require witnessing. However, the Engineer will review and initial all Loop Status Sheets and Component Calibration Sheets and spot check their entries periodically and upon completion of the Operational Readiness Tests. Any deficiencies found shall be corrected.

E. Functional Demonstration Test (FDT)

1. Prior to startup and the Functional Demonstration Test, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the operational readiness tests.

2. Once the facility has been started up and is operating, a witnessed Functional Demonstration Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop and site by site basis.

3. Loop specific and non-loop specific tests shall be the same as specified under Operational Readiness Test except that the entire installed system shall be tested and all functions demonstrated.

4. Updated versions of Shop Drawings shall be made available to the Engineer at the job site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available to the Engineer at the job site both before and during testing.

5. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.

F. Performance Acceptance Test (PAT)

1. After completion of the Operational Readiness and Functional Demonstration Tests, the DISK FILTER

MANUFACTURER shall be responsible, with respect to all components and services provided under this Section, for operation of the entire system for a period of 5 consecutive days, under conditions of full plant process operation, meeting all process requirements, without a single non field repairable malfunction.

2. During this test, plant operating, DISK FILTER MANUFACTURER personnel who have an intimate knowledge of the hardware and software of the system shall be present as required.

3. While this test is proceeding, the Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.

4. Any malfunction during the tests shall be analyzed and corrections made by the DISK FILTER MANUFACTURER and/or the Contractor as appropriate. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

5. Any malfunction during this test period, which cannot be corrected within 24 hours of occurrence by the DISK FILTER MANUFACTURER's personnel, or more than two similar failures of any duration, will be considered as a non-field repairable malfunction.

6. Upon completion of repairs by the DISK FILTER MANUFACTURER, the test shall be repeated as specified herein.

7. In the event of rejection of any part or function, the DISK FILTER MANUFACTURER shall perform repairs or replacement within 90 days.

8. The total availability of the system shall be greater than 99.0 percent during this test period. Availability shall be defined as "Avail. = (Total Time Down Time)/Total Time". Down times due to power outages or other factors outside the normal protection devices or back up power supplies provided, shall not contribute to the availability test times above.

9. Upon successful completion of the 5 day PAT and subsequent review and al of complete system final documentation, the system shall be considered complete and the warranty period shall commence. Warranty period shall be five (5) years per Section 01025.

G. Training

1. The cost of Owner training programs shall be included in the Contract price. Two (2) days of training shall be provided at a minimum.

2. All Technicians, Operators, Engineers, and Managers of the Water Treatment Facility will require training on the System. The Instrumentation System Supplier shall be responsible for providing detailed Operation and Maintenance (O&M) Manuals and training courses.

3. The O&M Manuals shall include specific details of the equipment supplied and details of operations specific to this Project. The training courses will deal with fundamentals of Programmable Logic Controller (PLC) and Digital Equipment hardware and software, telemetry systems, field devices, and maintenance.

4. All instructors must be intimately familiar with the operation and control of the Owner’s facility.

5. The training shall be structured as follows:

   a. The system training program shall be structured such that the operating personnel will understand the system's operation, and the functions available in the system.

   b. The level and amount of training will be based on the understanding of the individual staff members. Preventive and corrective maintenance of system devices and hardware shall be presented.

   c. A number of basic theory courses shall be provided to give the operators an appreciation of how the system can help them perform their jobs.

6. The DISK FILTER MANUFACTURER shall provide detailed manuals and shall include specific details of equipment supplied and operations specific to the project.

7. The DISK FILTER MANUFACTURER shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.

8. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

9. On Site Training for operator personnel shall deal with fundamentals of system hardware and software, field devices, instrumentation calibration and maintenance. Training shall cover all aspects of the instrumentation and controls system. Training is expected to cover a period of not less than three (3) eight-hour days.

END OF SECTION

SECTION 13310 PROGRAMMABLE LOGIC CONTROLLER (PLC) AND DIGITAL EQUIPMENT

PART 1 - GENERAL

A. Scope of Work

1. The General Provisions of Section 13300 apply to this Section.

2. All the Work in this Section shall be the product of the Disk Filter Manufacturer. Components and enclosures may be provided to the Disk Filter Manufacturer by sub-suppliers and/or manufacturers, but the packaging of these components and the production of the final product shall conform to this specification and shall be the sole responsibility of the Disk Filter Manufacturer.

3. The Disk Filter Manufacturer shall provide control panels with Programmable Logic Controllers and Digital Equipment which will be integrated into the larger EWRF and NWRF plant control network. PLC components included in the component list herein have been provided such that the control panels can communicate with the existing facilities. An Instrumentation System Supplier (ISS) will be retained under separate contract for integration of the disk filter control panels into the existing control systems. The Disk Filter Manufacturer shall coordinate with the ISS in order to fully integrate the disk filters.

B. Submittals

1. Refer to Section 13300.

C. Delivery, Storage and Handling

1. Refer to Section 13300.

D. Spare Parts

1. In addition to the spare parts listed in other instrumentation sections, provide the following:

2. Programmable Logic Controller (PLC) and associated equipment:

a. Provide one (1) spare plus one for every ten (10) of any given component supplied.

b. Provide one (1) spare CPU battery for each CPU supplied.

c. Provide a spare removable nonvolatile memory card for each new and modified PLC, pre-loaded with the as-built program for that PLC.

3. Networking equipment: one (1) spare plus one for every ten (10) of each type of Ethernet and Profibus communications device supplied.

4. Ethernet patch cables, CAT-6: One (1) per every five (5) furnished.

5. Storage media: a minimum of twenty-five (25) of each type of media used by the PCs, such as CD-Rs and DVD+Rs, with storage cases.

6. Printer: Two (2) of each type of ink/toner cartridge used, and a 500-page ream each of 20lb laser printer paper in Letter and 11″x17″ size.

7. Two (2) spare keypads shall be provided.

8. Any required software shall be licensed to Orange County Utilities.

PART 2 - PRODUCTS

A. Panel Mounted Industrial Workstations

1. Panel Mounted Industrial Workstations shall be mounted on control panels where indicated on the Drawings, and shall be set up to run the HMI software applications and other software.

2. Performance

a. CPU: Core2 Duo P8400 2.26 GHz or Atom N270 1.6 GHz.

b. RAM: 2GB minimum

c. Storage: SATA SSD, 80GB minimum

d. Ports (minimum): 1 serial (RS-232), 1 Ethernet 10/100/1000Mbit (RJ-45), 2 USB 2.0, 1 DVI.

e. Display: 19-inch TFT touchscreen color LCD, 1280x1024 resolution.

f. Operating System: Windows 7 Ultimate 32-bit.

3. Physical

a. Environment: NEMA 4; Class I Division 2.

b. Operating Temperature: 0-50˚C with 10-85% RH.

c. Power: 120vac, 130W max consumption.

4. Software. In addition to the operating system, the following software shall be installed on each unit:

a. HMI software as specified in this Section, as required for Thin Client operation.

b. Microsoft Internet Explorer

c. Virus scan and protection software, as specified in this Section

d. Adobe Acrobat Reader

e. WinZip Professional

5. Manufacturer: Proface (Xycom), Model 4800; or equal.

6. Panel mounted workstations that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of 316 stainless steel of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

B. Ethernet Switch

1. General: Provide managed Ethernet switch(es) for the control network as shown in the Drawings and specified herein.

2. Physical Features:

a. Fiber uplinks: 100/1000 FX ports, as required plus 25 percent

b. Copper ports: 10/100/1000 TX RJ45 ports, as required plus 25 percent

c. Operating temperature: 32 to 130 degrees F

d. Power: 120VAC, 60Hz

e. Enclosure: Metal case. Provide 19” rack form factor, or DIN-rail mounted for industrial environments, as required for the location.

3. Network Features:

a. Fault tolerant for use in a ring topology if shown on drawings

b. Full duplex on all ports

c. Auto negotiation and manual configurable speed and duplex

d. Wire speed switching fabric

e. IEEE 802.1w RSTP

f. IGMP snooping

g. IGMP filtering

h. Configuration password protected

i. Configuration backup capability required

j. SNMP V3

4. Manufacturers:

a. Per product list in the section.

C. Programmable Logic Controller (PLC)

1. Disk Filter Manufacturer shall furnish and install PLC equipment as required by the Drawings and the following Specification and in accordance with the attached data sheets, including all necessary auxiliary equipment, in order to provide a fully integrated and working system.

2. Components shall be chosen from the list in this Section and assembled such that the intended function is achieved. In general, each PLC shall be equipped with one (1) CPU, one (1) SINAUT module, and one (1) Power Supply per rack, input/output modules as needed, and any communication modules needed to interface with a redundant CPU, the existing plant network, or other network devices. Furnish all cables, connectors, and ancillary devices necessary

for the complete functioning of each PLC. Any components needed that are not listed shall be by Siemens or those recommended by Siemens, or its authorized representative in writing.

3. Provide a minimum of twenty-five percent (25%) active spare I/O points of each type, and twenty-five percent (25%) room for future I/O modules in each PLC. All new, existing, and future I/O points, as shown on the Drawings or discovered in field investigation, shall be included in the total count for the purpose of determining the quantity of spares required.

4. CPU usage shall be tested, and shall not exceed 50% of capacity under full load conditions. Disk Filter Manufacturer shall ensure that the CPU and RAM selected are adequate to the application needs.

5. Distribute series of I/O points across multiple modules and racks so as to eliminate a single point of failure. For example, if there are two identical pumps, terminate the I/O for each pump in a different card and a different rack with separate power supply where possible.

6. Components used should be selected from the following list:

Product	Description	Part Number
CPU	SIMATIC S7-1500, CPU 1516-3 PN/DP, CENTRAL PROCESSING UNIT WITH WORKING MEMORY 1 MB FOR PROGRAM AND 5 MB FOR DATA, 1. INTERFACE: PROFINET IRT WITH 2 PORT SWITCH, 2. INTERFACE: ETHERNET, 3. INTERFACE: PROFIBUS, 10 NS BIT- PERFORMANCE, SIMATIC MEMORY CARD NECESSARY	6ES7516-3AN01-0AB0
Micro Memory Card	12MB	6ES7954-8LE02-0AA0
SINAUT TIM 3V-IE Advanced	10/100 Mbit/s Ethernet	6NH7 800-3CA00

Product	Description	Part Number
Digital Input Card	SIMATIC S7-1500, DIGITAL INPUT MODULE DI16 X DC24V, 16 CHANNELS IN GROUPS OF 16; INPUT DELAY 0.05 ... 20MS; INPUT TYPE 3 (IEC 61131); DIAGNOSIS, PROCESSALARMS	6ES7521-1BH00-0AB0
Digital Output Card	SIMATIC S7-1500, DIGITAL OUTPUT MODULE DQ 8 X 230VAC/5A,RELAY; 8 CHANNELS IN GROUPS OF 1, 5A PER GROUP; DIAGNOSIS; SUBSTITUTE VALUE	6ES7522-5HF00-0AB0
Analog Input Module	SIMATIC S7-1500, ANALOG INPUT MODULE AI 8 X U/I HS, 16 BITS OF RESOLUTION, ACCURACY 0.3 %; 8 CHANNELS IN GROUPS OF 8; COMMON MODE VOLTAGE APPR. 10V; DIAGNOSIS, PROCESSALARMS; 8 CHANNELS IN 0.0625 MS INCL. INFEED ELEMENT, SHIELD CLAMP AND SHIELD TERMINAL	6ES7531-7NF10-0AB0
Analog Output Module	SIMATIC S7-1500, ANALOG OUTPUT MODULE AQ 8 X U/I HS 16 BITS OF RESOLUTION, ACCURACY 0.3 %, 8CHANNELS IN GROUPS OF 8, DIAGNOSIS, SUBSTITUTE VALUE 8 CHANNELS IN 0.125 MS INCL. INFEED ELEMENT, SHIELD CLAMP AND SHIELD TERMINAL	6ES7532-5HF00-0AB0
Thermocouple Module	SIMATIC S7-1500, ANALOG INPUT MODULE AI 8 X U/I/RTD/TC, 16 BITS OF RESOLUTION, ACCURACY 0.3 %; 8 CHANNELS IN GROUPS OF 8; 4 CHANNNELS FOR RTD MEASURING, COMMON MODE VOLTAGE APPR. 10 V; DIAGNOSIS, PROCESSALARMS INCL. INFEED ELEMENT, SHIELD CLAMP AND SHIELD TERMINAL	6ES7531-7KF00-0AB0

Product	Description	Part Number
Remote I/O Interface Module	SIMATIC ET 200MP. PROFINET IO-DEVICE INTERFACEMODULE IM 155-5 PN HF FOR ET 200MP ELEKTRONIKMODULES; UP TO 12 IO-MODULES WITHOUT ADDITIONAL PS; UP TO 30 IO-MODULES WITH ADDITIONONAL PS SHARED DEVICE; MRP; IRT >=0.25MS; ISOCHRONICITY FW-UPDATE; I&M0...3; FAST STARTUP S2 REDUNDANCY; SHARED DEV. WITH 4 CONTROLLER	6ES7155-5AA00-0AC0
SIMEAS P Profibus Power Meter	Measurements include: power, voltage, current and power factor; total power; average voltage and current; line frequency; percent unbalanced voltage and current. 120VAC, Profibus DP communications.	7KG7 800-8AB10-0BA0
Power Supply 5A	SIMATIC PM 1507 24 V/3 A STABILIZED POWER SUPPLY FOR SIMATIC S7-1500 INPUT: 120/230 V AC OUTPUT: 24 V/3 A DC	
Power Supply 10A	SIMATIC PM 1507 24 V/8 A STABILIZED POWER SUPPLY FOR SIMATIC S7-1500 INPUT: 120/230 V AC OUTPUT: 24 V/8 A DC	
Mounting Rail 19"	SIMATIC S7-1500, MOUNTING RAIL 482 MM (APPR. 19 INCH) INCL. GROUNDING ELEMENT, INTEGRATED DIN RAIL FOR MOUNTING OF SMALL COMPONENTS SUCH AS CLAMPS, FUSES OR RELAYS	6ES7590-1AE80-0AA0
Mounting Rail 530mm	SIMATIC S7-1500, MOUNTING RAIL 530 MM (APPR. 20.9 INCH); INCL. GROUNDING ELEMENT, INTEGRATED DIN RAIL FOR MOUNTING OF SMALL COMPONENTS SUCH AS CLAMPS, FUSES OR RELAYS	6ES7590-1AF30-0AA0

Product	Description	Part Number
Mounting Rail 830mm	SIMATIC S7-1500, MOUNTING RAIL 830 MM (APPR. 32,7 INCH); INCL. GROUNDING ELEMENT, INTEGRATED DIN RAIL FOR MOUNTING OF SMALL COMPONENTS SUCH AS CLAMPS, FUSES OR RELAYS	6ES7590-1AJ30-0AA0
Mounting Rail 2000mm	SIMATIC S7-1500, MOUNTING RAIL 2000 MM (APPR. 78.7 INCH); W/O GROUNDING ELEMENT, INTEGRATED DIN RAIL FOR MOUNTING OF SMALL COMPONENTS SUCH AS CLAMPS, FUSES OR RELAYS FOR SELF CONFIGURING, GROUNDING ELEMENT (6ES7590-5AA00-0AA0, 20 PIECES) MUST BE ORDERED SEPARTELY	6ES7590-1BC00-0AA0
Active DIN Rail	483 mm	6ES7 195-1GA00-0XA0
Active DIN Rail	530 mm	6ES7 195-1GF30-0XA0
Active DIN Rail	620 mm	6ES7 195-1GG30-0XA0
Active DIN Rail	2000 mm	6ES7 195-1GC00-0XA0
Active Bus Unit	PS/IM	6ES7 195-7HA00-0XA0
Active Bus Unit	2 x 40 mm	6ES7 195-7HB00-0XA0
Active Bus Unit	1 x 80 mm	6ES7 195-7HC00-0XA0
Active Bus Cover Plates	-	6ES7 195-1JA00-0XA0
Profibus Cable	Fast Connect Standard	6XV18300EH10

Product	Description	Part Number
Communication Module	COMMUNICATION PROCESSOR CP 1543-1 FOR CONNECTING SIMATIC S7-1500 TO INDUSTRIAL ETHERNET: TCP/IP, ISO, UDP, S7-COMMUNICATION, IP-BROADCAST/ MULTICAST, SECURITY (HARDWARE-IDENTIFICATION, IP/MAC ACCESS LIST, FIREWALL), DIAGNOSIS SNMPV1/V3, DHCP, FTP CLIENT/ SERVER, E-MAIL, IPV4/IPV6, DATA STORAGE ON SD CARD OF CPU, CLOCK SYNCHRONISATION VIA NTP, ACCESS TO WEBSERVER OF CPU; GIGABIT-SS 1XRJ45 (10/100/1000 MBIT)	6GK7543-1AX00-0XE0
Communication Module RS232	SIMATIC S7-1500, CM PTP RS232 HF COMMUNICATION MODUL FOR SERIAL CONNECTION RS232, FREEPORT, 3964(R), USS, MODBUS RTU MASTER, SLAVE, 115200 KBIT/S, 9-PIN SUB-D CONNECTOR	6ES7541-1AD00-0AB0
Communication Module RS485	SIMATIC S7-1500, CM PTP RS422/485 HF COMMUNICATION MODUL FOR SERIAL CONNECTION RS422, RS485, FREEPORT, 3964(R), USS, MODBUS RTU MASTER, SLAVE, 115200 KBIT/S, 15- PIN SUB-D FEMALE CONNECTOR	6ES7541-1AB00-0AB0
Communications Module - Industrial Ethernet	CP343-1 10/100 Mbit/s	6ES7 343-1EX10-0EX0
Communications Module – Profibus DP	IM 157	6ES7 157-0AA82-0XA0
Profibus DP/PA Coupler	IM 157 companion module	6ES7 157-0AC80-0XA0 & 6ES7 157-0AC81-0XA0
BM DP/PA Coupler Bus Module	Bus module	6ES7 195-7HF80-0XAO
PC Network Interface Card	CP1613 PCT Ethernet Card TCP/IP	6GK1 161-3AA00
PC Ethernet Interface Card	CP5611 for desktop PCs	6GK1 561-18A00

Product	Description	Part Number
PC Ethernet Interface Card	CP5511 for laptops (PCMCIA)	6GK1 551-18A00
PC Ethernet Interface Cable	Cable used to provide communications between the CP5611 or CP5511 PC cards to the MPI port on the PLC	6ES7 901-0BF00-AA0
Industrial Ethernet Switch	SCALANCE XM408-4C; MANAGED MODULAR IE SWITCH; 8 X 10/100/1000 MBIT/S RJ45; 4 X 100/1000 MBIT/S ST-/SC-PLUGGABLE AS COMBO PORTS; 8 PORTS USABLE IN TOTAL; EXPANDABLE UP TO 24 PORTS ELECTRICAL OR OPTICAL; LAYER 3 WITH KEY PLUG AVAILABLE MOUNTING DIN-/S7-PROFILE-RAIL PROFINET-IO DEVICE; REDUNDANCY FUNCTIONS; OFFICE FEATURES (RSTP, VLAN, IGMP,..); C-PLUG IN SCOPE OF SUPPLY	6GK5408-4GP00-2AM2 with 4 6GK5991-1AB00-8AA0
PC Network Interface Software	S7-1613 Win NT 4.0-V.2.0	6GK1 716-1CB20-3AA0
Panel-mounted HMI Touchscreen	10.4” color TFT, Touchscreen, Profibus DP/Ethernet/serial connections	Siemens Model MP277
Panel-mounted HMI Client Software	SIMATIC WinCC Flexible	
Panel-mounted HMI Programming Software	TIA Portal WinCC	
PLC Programming Software	SIMATIC Step 7 Professional	ISFL-00129-0100
PLC MMC USB prommer		6ES7 792-0AA00-0XA0

D. Profibus DP Media Converter

1. In each disk filter control panel provide a solid-state media converter in order to communicate to the EWRF and NWRF control networks. The device shall convert Profibus DP copper to 850nm fiber optic cable with ST converters (as specified in Section 13320), for point-to-point communication over fiber. The device shall also act as the terminating resistor for the Profibus DP bus where required. The media converter shall be 24VDC powered and rail mounted.

2. Manufacturer: Siemens OLM series.

E. Uninterruptible Power Supply (UPS) for Control Panels

1. Unless otherwise indicated on the Drawings, the power supplied to all microprocessor-based equipment within a PLC control panel shall be protected by an Uninterruptible Power Supply (UPS) mounted within the panel. The UPS shall prevent spikes, sags, surges, noise, and harmonics from adversely affecting digital equipment.

2. UPS input and output shall be galvanically isolated from one another. Input power shall be 120 VAC, 60 Hz. Output power may be 120VAC, 24VDC, or as needed to support connected equipment.

3. UPS shall contain internal backup batteries sufficient to allow all connected equipment to run continuously for no less than 15 minutes at full load. Provide load calculations which show these requirements to be met.

4. UPS shall include normally closed contact outputs for “On Battery” and “Low Battery/Fault”, which shall be picked up by the PLC for operator notification.

5. UPS units shall be UL508/1778 labeled and capable of being mounted within UL508 approved cabinets without derating.

6. UPS shall be Allen-Bradley 1609U, or approved equal.

7. Furnish and install a UPS maintenance bypass switch that will permit removal of the UPS for service while maintaining 120VAC power to all panel components. Provide a contact output indicating “UPS Bypassed” to the PLC for operator notification.

F. PLC Software

1. Vendor shall purchase the following software and provide application development. The software licenses shall be in the Owner’s name, and shall be turned over to the Owner

upon conclusion of the project.

a. Two (2) licenses of SIMATIC Step 7/V13 Professional Combo

b. Two (2) licenses of SIMATIC WinCC Flexible.

c. Two (2) licenses of TIA Portal WinCC Advanced V13.

G. Network Components

1. Network components for SCADA workstation equipment, if necessary, shall comply with the Appendix H-21.

PART 3 - EXECUTION

Refer to Section 13300.

END OF SECTION

SECTION 13325 CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1 - GENERAL

A. Scope of Work

Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.

B. Submittals

Refer to Section 13300.

C. Delivery, Storage and Handling

1. The panels shall be mounted on wood skids four inches high. Adequate crating will be provided for the panel being shipped where a transfer from one truck to another is planned.

2. Instruments shall be blocked and tied to prevent damage during shipment. Front-panel mounting instruments shall be removed and prepacked in their original containers for shipment.

3. Accessories, drawings, instruction bulletins, etc., shall be packed and shipped with the panel.

4. Refer to Section 13300.

D. Spare Parts

1. Provide the following spares and consumables:

a. Fuses: 20 percent of each size and type used, but no less than ten of each size and type.

b. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.

c. Relays: One (1) spare unit for every ten (10) of each type installed, minimum one.

d. Panel-Mounted Lights and Switches: One (1) spare mechanism for every ten (10) of each type installed, minimum one; plus 10 units or 20 percent of bulbs and colored lenses installed, whichever is more.

e. Corrosion Inhibiting Vapor Capsules: Provide 10 of each type and size used.

E. Warranty

Refer to Section 13300.

PART 2 - PRODUCTS

A. General

Refer to Section 13300.

B. Lightning/Surge Protection

Refer to Section 13300.

C. Control Panel - General Requirements

1. Furnish and install the panels per Specifications and Drawings.

2. The construction and wiring shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear, and sides of the panels.

3. Unless otherwise specified on applicable panel drawings, all panels shall be of the fully enclosed type designed for use with high-density instrumentation mounting.

4. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for each local panel provided under this Contract shall be keyed alike.

5. The instruments designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

6. Conductors running from the field to the panels shall be continuous without splices, except at junction boxes. The junction boxes shall have terminal blocks with 20 percent spare terminals. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance. Cables entering panels shall be multiconductor. Conduit and multiconductor cables entering panels shall be sealed to prevent the intrusion of gas and moisture.

7. Multiconductor cable shall be used between junction boxes and the panels.

8. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component. Components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and ISS's data.

9. The internal framework of each panel shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete.

10. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

11. All panels shall be supplied with suitable nameplates which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be approximately 1-in x 3-in constructed of white and black laminated, phenolic material having engraved Micarta letters approximately 1/8-in high, extending through the white face into the black layer. Nameplates shall be beveled and attached to panels with epoxy glue.

D. Control Panel - Materials and Construction

1. General

a. All panels located in indoor climate-controlled areas shall be of NEMA 12 construction and shall be labeled by Underwriters Laboratories. Freestanding panels shall be constructed of 12 gauge or thicker sheet steel, suitably braced internally for structural rigidity and strength. Wall or Unistrut mounted panels

shall be 14 gauge or better steel. All exposed welds, seams, or edges shall be ground smooth. Front panels or panels containing instruments shall be 10 gauge or thicker sheet steel, reinforced to prevent warping or distortion. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three point latches.

b. All panels located in outdoor areas, or in indoor areas that are not air conditioned, and where otherwise specified in the Contract Documents, shall be of NEMA 4X construction with white exterior coating and shall be labeled by Underwriters Laboratories. NEMA 4X panels, whether wall or Unistrut mounted panels or freestanding panels, shall be of all 316 Stainless Steel construction. Minimum thickness shall be 12 gauge for freestanding panels, 14 gauge for wall or Unistrut mounted panels. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three-point latches. Panels with door clamps instead of three-point latching will not be accepted. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument mounting.

c. Provide explosion-proof enclosures where required in hazardous areas.

d. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel details. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. All doors shall open a minimum of 90 degrees.

e. Refer to panel details and other Drawings for approximate panel size and equipment layout.

f. The panel shall be suitable for bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

g. Support Structures. Do not use expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions. Do not use power-actuated fasteners and devices. All hardware shall be 316 stainless steel including channels, rack accessories, etc.

2. Finish Requirements

a. All sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

b. Panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

c. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.

d. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.

e. Panel exterior color shall be white.

3. Manufacturer. All panels shall be by Hoffman or acceptable equal.

E. Control Panel - Temperature Control

1. The internal temperature of all panels shall be regulated so as not to exceed 122 degrees Fahrenheit. Under no circumstances shall the panel cooling equipment compromise the NEMA rating of the panel.

2. NEMA 4X rated panels that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments

mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

F. Control Panel - Corrosion Control

Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Instruments Model Zerust VC; Hoffman Engineering Model A-HCI; or equal. Corrosion inhibitors shall not be installed and activated until the panel is delivered to the site.

G. Control Panel - Internal Construction

1. Internal Electrical Wiring

a. Panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with the National Electrical Code. Wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring/connection diagrams. Wiring and connection diagrams shall comply with ISA-5.4 and shall be submitted by the manufacturer as part of the Shop Drawings for review by the Engineer.

b. Power and low voltage DC signal wiring shall be routed in separate wire ways. Crossing of the two system wires shall be at right angles.

c. Power wire shall be 12 AWG Type THHN/THWN stranded and shall be insulated for not less than 600 volts unless specified otherwise. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90°C.

d. Control and signal wire shall be 1 pair 16 AWG stranded. Analog signal wire shall be shielded. Conductors shall be of tinned copper construction.

e. Electronic Communications cable (such as RS-232) shall be low-capacitance, double-shield cables consisting of twisted pairs with 22 AWG stranded conductors and PVC jacketing.

f. Wire colors shall be:

Line Power	Black
Neutral	White
AC Control	Red
DC Control	Blue
DC common	Gray
Equipment/Chassis Ground	Green
Externally-Powered Interlocks	Yellow

g. Wiring shall terminate at a master terminal board, rigid type and numbered.

h. Terminal blocks shall be arranged in vertical rows and separated into groups (Power, AC control, DC signal, and alarm). Terminal strips shall be provided for the purpose of connecting all control and signal wiring. Terminal blocks shall be Phoenix style, IEC rated, Allen-Bradley or similar, with the appropriate voltage rating (600 volts minimum).

i. Each 4-20 mA analog signal loop shall be individually fused. Each group of discrete loops for a common piece of equipment shall be fused.

j. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by using stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

k. Wire connectors shall be the hook fork type with insulated barrel for crimp type compression connection to the wire.

l. Each wire shall be provided with a numbered heat shrink tubing identification marker, with the same number at both ends. Numbering shall be in accordance with the Control Panel Drawings and shall include the instrument Loop Number. Identification markers shall be pretyped. Handwritten markers or paper markers will not be permitted.

m. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-in of the side panel or adjacent terminal.

n. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component

identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.

o. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

p. Each panel shall have a magnetic reed switch pair mounted to the frame of each door that will indicate a common panel intrusion condition in the PLC within that panel, when any door is opened. Magnetic reed switches shall be heavy-duty, GE Magnetic Contacts model 2505A or approved equal.

q. Each panel shall have a specification grade duplex convenience receptacle mounted internally within a stamped steel device box with appropriate cover.

r. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

s. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

t. Each panel, where applicable, shall be provided with analog signal isolation (I/I) where analog signals are sent from one panel or console to another.

u. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical and electronic equipment. Surge suppressor grounding shall be accordance with the manufacturer's recommendations. Refer to Section 13300.

v. Each panel shall be provided with a fused power disconnect switch.

w. All wiring to hand switches and the like which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

x. Panels shall have an initial installed capacity of I/O (terminal blocks, fuses, surge suppressors, interposing relays as required) plus a minimum of

twenty-five percent (25%) active spare I/O points of each type, and twenty-five percent (25%) room for future I/O points. All new, existing, and future I/O points shown on the Drawings or discovered in field investigation shall be included in the total count for the purpose of determining spares.

2. Pneumatic Tubing

   a. Refer to Section 13300.

3. Print Storage Pockets

   a. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment.

H. Direct Current (DC) Power Supply

1. Provide a 24 VDC power supply in the control panel to power instrument loops, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

2. Control panels that are principally designed to house Profibus DP fiber optic modules shall include battery backup capability.

3. Components shall meet the following requirements:

   a. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

   b. Output voltage: 24 VDC.

   c. Output voltage adjustment: 5 percent.

   d. Line regulation: 0.05 percent for 10 volt line change.

   e. Load regulation: 0.15 percent no load to full load.

   f. Ripple: 3 mV RMS.

   g. Operating temperature: 32 to 140 degrees Fahrenheit.

   h. Batteries: sealed high-temperature type with charger.

4. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity. Battery shall be sized to support full load operation for 30 minutes upon loss of power.

5. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

6. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

7. Power supply shall be manufactured by Adtec, Sola, Power One, or acceptable equal.

I. Panel Components

1. Pilot Type Indicating Lights

a. Type: Heavy duty oil-tight type which utilizes a low voltage lamp.

b. Functional/Performance:
   i Units shall be provided with low voltage lamps suitable for the voltage supplied. Lights supplied with 120VAC power shall have integral reduced voltage transformers.
   ii Lamps shall be replaceable from the front of the unit.
   iii Units shall be push-to-test.

c. Physical:
   i Lens color shall be as indicated on the instrument device schedule. Lens shall be approximately 1-1/4-in diameter.
   ii Provide legend faceplates engraved to indicate the required function of each device.
   iii Units shall be rated NEMA 13 for indoor panels. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.

d. Manufacturers:
   i Microswitch
   ii Allen Bradley
   iii General Electric
   iv Square D

2. Rotary Hand Switches and Push Buttons

a. Type: Control devices shall be heavy duty, oil-tight type with stackable contact blocks.

b. Functional/Performance: Provide contact arrangement and switching action as required for the control system specified.

c. Physical:
   i For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide silver sliding contacts rated 5 amps at 125VDC, for electronic (millivolt/ milliamp) switching provide contacts rated 1 amp at 28VDC.
   ii Push buttons shall have flush type operators. Selector switches shall have knob or wing lever operators.
   iii Units shall be rated NEMA Type 13 for indoor service. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X 316 stainless steel.
   iv Provide legend plates denoting switch/push button position/function.

d. Options/Accessories Required:
   i Provide lock-out-push buttons, key-operators, etc., as indicated on the instrument device schedule.
   ii Provide make-before-break bridging contacts where required.

e. Manufacturers:
   i Microswitch
   ii Allen Bradley
   iii General Electric
   iv Square D

3. Industrial Relays and Time Delays

a. Type: Industrial heavy duty relays.

b. Functional/Performance:
   i Contact arrangement/function shall be as required to meet the specified control function specified.
   ii Contacts shall be rated 10 amps continuous at 600 volts.
   iii Relays shall be provided with convertible contact blocks.
   iv Pneumatic time delay relays shall be used on time delays less than 180 seconds and shall be adjustable.
   v Solid state time delay relays shall be used on time delays between 180 seconds and one hour.

c. Options/Accessories Required:
   i Provide all mounting rails, etc. that are required.
d. Manufacturers:

i Microswitch
ii Allen Bradley
iii General Electric
iv Square D

4. General Purpose Relays and Time Delays

a. Type: Units shall be of the general purpose plug-in type.

b. Functional/Performance:
i Coil voltage shall match supply voltage.
ii Contact arrangement/function shall be as required to meet the specified control function.
iii Mechanical life expectancy shall be in excess of 10,000,000 operations.
iv Duty cycle shall be rated for continuous operation.
v Units shall be provided with integral indicating light to indicate if relay is energized.
vi Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
vii Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

c. Physical:
i For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide contacts rated 5 amps at 28VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service.
ii Relays shall be provided with dust and moisture resistant covers.

d. Options/Accessories Required:
i Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
ii Provide mounting rails/holders as required.

e. Manufacturers:
i Eagle Signal Controls
ii Allen Bradley
iii Potter & Brumfield

5. Electronic Indicator

a. Type: Electronic; 3-in by 6-in NEMA 4X case.

b. Operation: To accept a standard analog input signal, and display the manually set flow on a vertical indicating scale.

c. Functional:
   i Input - 4-20 mADC.
   ii Accuracy plus or minus 0.5 percent of span for input/output.

d. Physical:
   i Case Size - Nominal 3-in by 6-in face.
   ii NEMA 4X enclosure, with slide tray.
   iii Mounting - Flush panel, suitable for high density mounting arrangements.
   iv Scales – Digital, 0 to 100 percent output.

e. Manufacturers:
   i ABB Instrumentation
   ii Moore Industries

6. Signal Relay Switches (Current Trips)

a. Type: Solid state electronic, dual setpoint.

b. Functional/Performance:
   i Input - 4-20 mA
   ii Output - Isolated contact output, double pole double throw, rated 5 Amps at 120 VAC.
   iii Accuracy - 0.1 percent.
   iv Protection - Provide RFI protection.
   v Deadband - Adjustable between 0.1 and 5.0 percent of span.
   vi Setpoint Adjustment - Provide graduated dial for each alarm set point from 0 to full scale. Alarms shall be adjustable to trip on rising or falling input signal.
   vii Repeatability - Trip point repeatability shall be at least 0.1 percent of span.

c. Physical:
   i Mounting - Suitable for mounting in an enclosure or high density instrument rack.

d. Options/Accessories Required:
   i Mounting rack or general-purpose enclosure as required.

e. Manufacturers:
   i Acromag
   ii Moore Industries
   iii Rochester Instrument Systems

PART 3 - EXECUTION

A. Installation

1. The panels shall be installed at locations as shown on the Drawings.

2. Panels shall be factory tested prior to shipment. Field installation shall consist only of setting the panel in place and making necessary electrical and conduit connections.

3. Refer to Section 13300.

B. Tests (General)

Refer to Section 13300.

END OF SECTION

SECTION 15240 DUCTILE-IRON PIPE

PART 1 - GENERAL

A. Description

This section describes materials, testing, and installation of ductile-iron pipe and fittings 64 inches and smaller.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Provide an affidavit of compliance with standards referenced in this specification, e.g., AWWA C151. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate that the minimum safety factor described in AWWA C153, Section 5.5 is met.

3. Provide the following information:

   a. Mortar lining thickness.

   b. Wall thickness.

   c. Material test data for this project.

   d. Show deflections at push-on and mechanical joints.

   e. Submit joint and fitting details and manufacturer’s data sheets.

4. Submit calculations and test data proving that the proposed restrained joint arrangement can transmit the required forces with a minimum safety factor of 1.5.

5. Submit certificate that cement for mortar lining complies with ASTM C150, designating type and AWWA C104.

6. Submit test report on physical properties of rubber compound used in the gaskets.

7. Submit drawing or manufacturer's data sheet showing flange facing, including design of facing serrations.

8. Submit weld procedure specification, procedure qualification record, and welder's qualifications prior to any welding to ductile-iron pipe.

9. Submit leak free results of factory air tests for all fittings with welded bosses or outlets.

PART 2 - MATERIALS

A. Pipe

Pipe shall be cast ductile (nodular) iron, conforming to AWWA C151.

B. Pipe Wall Thickness

1. Minimum wall thickness for pipe having push-on or mechanical joints, restrained joints, plain ends, or cast flange ends shall be Class 150, unless otherwise shown in the drawings.

2. Minimum wall thickness for pipe having threaded flanges shall be Special Class 53.

3. Minimum pipe wall thickness required for corporation stops and tapped outlets shall be in accordance with Table A.1 of AWWA C151 for three full threads for design pressures up to 250 psi and four full threads for design pressures over 250 to 350 psi.

C. Fittings

1. Fittings 48 inches and smaller shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Material shall be ductile iron. Flanges shall be flat faced.

2. Mechanical joint fittings conforming to AWWA C153 may be used in lieu of AWWA C110 fittings.

3. Material for fittings with welded-on bosses shall have a Charpy notch impact value of minimum 10 ft-lbs under the conditions defined in AWWA C151. Manufacturer shall submit leak free results of factory air tests for all such welded bosses or outlets.

4. Fittings in Air-1 service shall be unlined.

D. Flanges

1. Flanges shall be solid back, Class 125 per AWWA C115. Flanges on pipe shall be either cast or threaded. Material shall be ductile iron.

2. Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C115. Flanges shall be individually fitted and machine tightened in the shop, then machined flat and perpendicular to the pipe barrel. Flanges shall be backfaced parallel to the face of flange. Prior to assembly of the flange onto the pipe, apply a thread compound to the threads to provide a leak-free connection. There shall be zero leakage through the threads at a hydrostatic test pressure of 250 psi.

E. Pipe Lining-Cement Mortar

1. Ductile iron pipe associated with the disk filters shall be cement mortar lined. Line the pipe interior and fittings with cement-mortar per AWWA C104. Lining thickness shall be the double thickness listed in AWWA C104, Section 4.8. Lining material shall conform to ASTM C 150, Type V. This shall include the following pipes: Line the interior of the pipes as identified in the Flow Stream Identification chart in the drawings.

2. Line blind flanges per with a fusion bonded epoxy. Apply the manufacturer’s recommended number of coats to attain the specified minimum coating thickness. Products: Carboline Carboguard 891HS, Tnemec N140, Sherwin-Williams Tank Clad HS B62-W80/B60-V80, 16 mils total. Color of topcoat: white. Each coat shall be different color than the one preceding it.

3. Remove and reconstruct lining in areas where quality is defective per AWWA C104.

F. Gaskets for Flanges

Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

G. Bolts and Nuts for Flanges

1. Bolts and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors and above ground, shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

2. Bolts and nuts for buried or submerged Class 150 flanges and Class 150 flanges located outdoors above ground or in vaults and structures shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

3. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B7.

4. Fit shall be Classes 2A and 2B per ASME B1.1 when connecting to cast-iron valves having body bolt holes.

5. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

6. Provide washers for each nut. Washers shall be of the same material as the nuts.

H. Outlets and Nozzles

1. Provide outlets 2 inches and smaller by using a threaded welded-on boss.

2. For outlets larger than 2 inches use a tee with a flanged outlet.

I. Joints

1. Joints in aboveground or submerged piping or piping located in vaults and structures shall be flanged.

2. Joints in buried piping shall be of the restrained type per AWWA C111 except where flanged joints are required to connect to valves, meters, and other equipment.

3. All buried joints shall be restrained.

4. Restrained joint devices shall be accordance with the Orange County Utilities Standards and Construction

Specifications Manual List of Approved Products in Appendix A.

5. Restrained joints for piping 4 to 36 inches shall be American Cast Iron Pipe “Fast Grip Gaskets”, U.S. Pipe “Field Loc Gaskets” or equal. Joint restraint shall be certified to a rated pressure of 250 psi. Restrained joints for piping 42 ~~36~~ inches to 64 inches shall be American Cast Iron Pipe “Flex-Ring”, or “Lok-Ring”, U.S. Pipe “TR Flex” or “HP Lok”, or equal.

6. Where thrust restraint is called for in the drawings, provide pipe with restrained joints capable of transmitting 1.5 times the thrust, as calculated by the following equation:

$$T = 1.5 * (0.785 * P * D^2)$$

where:

P = Pressure class of pipe in psi.
D = Outside diameter of pipe in inches.
T = Thrust in pounds.

7. Existing unrestrained bell & spigot joints are to be restrained using Series 1100HD restraint devices by EBBA Iron, Inc. Restraint may also be provided by a thrust collar constructed in accordance with the Orange County Utilities Standards and Construction Specifications, Figure A105-1 & -2. Existing unrestrained fittings and appurtenances are to be restrained using Series 1100SD by EBBA Iron, Inc.

J. Mechanical Joint Restraint System Using Follower Ring and Wedges

The restraining mechanism shall consist of a follower gland having a seal gasket and individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The system manufacturer shall provide all the components (follower ring, wedges, and gaskets) for the restraining device. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be constructed of ductile iron conforming to ASTM A 536, Grade 60-42-10. The wedges shall be ductile iron, heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall

be such that it can be used with mechanical joint bells conforming to AWWA C111 and AWWA C153. The design shall use torque limiting twist-off nuts to provide actuation of the restraining wedges. The mechanical joint restraint shall be available in the size range of 3 through 48 inches. Minimum rated pressure shall be 350 psi for sizes 16 inches and smaller and 250 psi in sizes 18 inches and larger. Products: Megalug Series 1100 as manufactured by EBAA Iron, Inc., or equal.

K. Ductile-Iron Pipe Weldments

1. All welding to ductile-iron pipe, such as for bosses, joint restraint, and joint bond cables, shall be done at the place of manufacture of the pipe. Perform welding by skilled welders experienced in the method and materials to be used. The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedures specification, procedure qualification, and welder performance qualification test records.

2. Welds shall be of uniform composition, neat, smooth, full strength, and ductile. Completely grind out porosity and cracks, trapped welding flux, and other defects in the welds in such a manner that will permit proper and complete repair by welding.

3. Prior to the application of any coating or lining in the outlet area all weldments for branch outlets shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer’s written procedures.

PART 3 - EXECUTION

A. Delivery, Unloading, and Temporary Storage of Pipe at Site

1. Use unloading and installation procedures that avoid cracking of the lining.

2. Do not move pipe by inserting any devices or pieces of equipment into the pipe barrel. Field repair linings damaged by unloading or installation procedures.

B. Sanitation of Pipe Interior

1. During laying operations, do not place tools, clothing, or other materials in the pipe.

2. When pipe laying is not in progress, close the ends of the installed pipe by a child- and vermin-proof plug.

C. Installing Flanged Pipe and Fittings

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket,

reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

8. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried piping.

9. Prior to paint, trim back gasket and caulk joints.

D. Painting and Coating

1. Prior to finish coating, trim excess gaskets protruding from flanged connections and caulk the joint.

2. Coat pipe located above ground and in vaults and structures as shown in the Piping Schedule in the drawings. Apply prime coat in the shop before transporting pipe to the jobsite.

3. Apply intermediate coats in the field before installing the pipe, then touch up after installation.

4. All field cut pipe ends shall be coated, no bare metal shall be permitted.

5. Provide asphaltic coating on buried pipe per AWWA C151.

6. Coat submerged pipe with fusion-bonded epoxy.

E. Cleaning Pipe

Sweep pipe clean of all dirt and debris. If hardened mud exists in the pipe, remove with the use of pressurized water hoses.

F. Pipe Labeling

G. Labels for Exposed Piping

1. Labels for piping shall bear the full piping system name as shown in the Piping Schedule in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels and flow direction arrows shall be painted on using commercial paint stencils to spell out the pipe name.

2. Provide 1-inch thick molded fiberglass insulation with jacket for each plastic pipe label or marker to be

installed on uninsulated pipes subjected to fluid temperatures of 125°F or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

H. Labels for Valves

Provide each valve of size 3 inches and larger and all actuated valves regardless of size with an identification tag. Tag shall be 2-inch square or circular aluminum or 1/16-inch thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings. Tags for actuated valves shall show the power source of the actuator.

I. Labels for Valves

Provide each valve of size 3 inches and larger and all actuated valves regardless of size with an identification tag. Tag shall be 2-inch square or circular aluminum or 1/16-inch thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings. Tags for actuated valves shall show the power source of the actuator.

J. Buried Warning and Identification Tape

Provide detectable warning tape per Section 15075. Warning and identification shall read “CAUTION BURIED WATER PIPING BELOW” or similar wording.

END OF SECTION

SECTION 15276 STAINLESS STEEL PIPE

PART 1 - GENERAL

A. Description

This section includes materials and installation of stainless steel pipe and fittings 30 inches in diameter and smaller conforming to ASTM A312 or A778 and having a maximum design pressure of 150 psi.

B. Submittals

Submit shop drawings in accordance with Section and 01300.

PART 2 - MATERIALS

A. Pipe

1. Pipe smaller than 3 inches shall conform to ASTM A 312, Grade TP 304L. Pipe 3 inches and larger shall conform to ASTM A 312 or A778, Grade TP 304L.

2. Pipe sizes and wall thicknesses shall conform to ANSI B36.19 as follows:

Pipe Size	**Wall Thickness**
1 inch and smaller	Schedule 80S
1-1/4 inches through 3 inches	Schedule 40S
3-1/2 inches through 8 inches	Schedule 40S
Larger than 8 inches, through 30 inches	Schedule 40S

B. Fittings

1. Fittings 3 inches and smaller shall be threaded or socket welded, conforming to ANSI B16.11, 3,000-pound CWP. Material for threaded fittings shall conform to ASTM A 403, Class WP304 or ASTM A 182, Grade F304. Material for socket welded fittings shall conform to ASTM A 403, Class WP304L or ASTM A 182, Grade F304L.

2. Fittings for submerged pipe larger than 3 inches through 24 inches shall be butt-welded, conforming to ASTM A403, Class WP or ASTM A774, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

3. Fittings for aboveground or exposed pipe larger than 3 inches through 24 inches shall be butt-welded or flanged, conforming to ASTM A403, Class WP or ASTM A774, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

4. Fittings for pipe larger than 24 inches shall conform to ANSI B16.9, or shall be fabricated, per Section 15201. Material shall be the same as the pipe.

C. Quality Control

Include the "Hydrostatic Test" and "Flattening Test" requirements described in ASTM A 530.

D. Protective End Caps

Provide protective end caps on each piece of pipe or fabricated section, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each fitting, or ship and store fittings in sealed boxes or containers.

E. Unions

Unions shall be 3,000-pound WOG forged stainless steel, with dimensions conforming to MSS SP-83. Ends shall be threaded per ANSI B1.20.1 or socket-welding type. Material shall

conform to ASTM A 182, Grade F304 for threaded end unions and Grade F304L for socket welded type.

F. Joints

1. Joints for pipes 3 inches and smaller shall be threaded or socket welded, same material as specified for fittings, 3,000-pound WOG, conforming to ANSI B16.11.

2. Joints for submerged pipe larger than 3 inches shall be butt-welded.

3. Joints for aboveground or exposed pipe larger than 3 inches shall be flanged or butt-welded.

4. See Section 15201 for additional requirements.

G. Outlets and Nozzles

1. Outlets of size 3 inches and smaller in piping 4 inches and larger shall be of the Thredolet type, per MSS SP-97 and AWWA Manual M11 (1989 edition), Figure 13-23. Outlets shall be 3,000-pound WOG stainless steel per ASTM A 182, Grade F304L, or ASTM A 403, Grade WP304L. Threads shall comply with ANSI B1.20.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or equal.

2. See Section 15201 for additional requirements.

H. Thread Lubricant

Use Teflon thread lubricating compound or Teflon tape.

I. Flanges

1. Provide weld-neck flanges (conforming to ANSI B16.5) for piping 3 inches and smaller to connect to flanged valves, fittings, or equipment. Provide weld-neck or Van Stone flanges (per ASTM F2015) for piping larger than 3 inches. Flanges shall be Class 150 per ANSI B16.5. Flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment. Flanges shall be flat face.

2. Material for weld-neck flanges shall conform to ASTM A182, Grade F304L.

3. Material for Van Stone flanges shall be as follows:

Application	Material	Specification
Exposed	304 Stainless Steel	ASTM A 351, Grade CF8M
Submerged	304 Stainless steel	ASTM A 351, Grade CF8M

J. Bolts and Nuts for Flanges

1. Bolts and nuts for flanges shall be Type 304 stainless steel conforming to ASTM A 193, Grade B8 for bolts and ASTM A 194, Grade 8 for nuts.

2. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B8, Class 2.

3. Bolts for flange insulation kits shall conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H.

4. Provide washer for each nut. Washers shall be of the same material as the nuts.

K. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal.

L. Gaskets for Flanges

Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

M. Wye Strainers

Strainers 2 inches and smaller shall be stainless steel, wye pattern, with minimum pressure rating of 300-psi WOG. Material shall conform to ASTM A 351 or A 743, Grade CF8M. Screen shall be 20 mesh and same material as the strainer. Provide pet cock of the same material as the strainer body in the blowoff connection. Ends shall be threaded conforming to ANSI B1.20.1. Provide one spare screen for each strainer.

Strainers shall be Sarco Type 316, Muessco No. 861, or equal.

PART 3 - EXECUTION

A. Fabrication, Assembly, and Erection

1. Use an inert or shielding gas welding method. Do not use oxygen fuel welding. The interior of the pipe shall be purged with inert gas prior to the root pass.

2. Welded butt joints (both longitudinal and circumferential) shall comply with AWWA C220, Section 4. Do not allow heat tint to form in the heat affected zone (HAZ) or remove heat tint completely from the HAZ of the finished weld. The maximum depth of grinding or abrasive blasting to remove defects shall not exceed 10% of the wall thickness. Do not perform abrasive blasting with steel shot, grit, or sand.

3. No iron or steel surfaces shall come into contact with the stainless steel. This includes placing on steel tables, racks, pipe supports, etc. Do not use carbon steel wire brushes or grinders.

4. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS A5.9. Use electrodes as follows:

Pipe Material	**Welding Electrode Material**
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

B. Installing Threaded Piping

Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before installing fittings, couplings, unions, or joints.

C. Installing Flanged Piping

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting

up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer's specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

8. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried piping.

9. Prior to paint, trim back gasket and caulk joints.

D. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

E. Installing Unions

Provide unions on exposed piping 3 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).

2. 6 to 12 inches downstream of valves.

3. Every 40 feet in straight piping runs.

4. Where shown in the drawings.

F. Installing Aboveground or Exposed Piping

1. Provide pipe hangers and supports as detailed in the drawings.

2. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

G. Field Hydrostatic Testing

1. Do not allow test water to remain in the pipe for more than five days. Drain and dry the piping after completing the testing.

H. Painting and Coating

Do not coat stainless steel Van Stone flanges.

END OF SECTION

SECTION 16150 MOTORS

PART 1 GENERAL

A. Scope Of Work

All motors shall be furnished as called for in other Sections of these Specifications and shall be in conformance with the requirements of this section.

B. Qualifications

Routine tests shall be performed on representative motors, and shall include the information described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors". Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

C. Submittals

1. Submittal of motor data for acceptance shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors" and, in addition, the following for motors typical of the units furnished:

    a. Efficiency at ½, ¾ and full load.

    b. Power factor at ½, ¾ and full load.

    c. Motor outline, dimensions and weight.

    d. Descriptive bulletins, including full description of insulation system.

    e. Bearing design data.

    f. Special features (i.e., space heaters, temperature detectors, etc.).

    g. Power factor correction capacitor rating and type.

    h. Manufacturer’s warranty.

2. The motor manufacturer shall submit to the Engineer as provided in Section 01300, certified dimension prints showing nameplate data and outline dimensions within three

weeks of the date they receive the order.

D. Reference Standards

1. Institute of Electrical and Electronics Engineers (IEEE)

2. National Electrical Manufacturers Association (NEMA)

3. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

E. Warranty

1. All equipment supplied under this Section shall be warranted by the Disk Filter Manufacturer and the equipment manufacturers for a period of three (3) years.

2. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the machine(s) and the unit(s) restored to service at no additional cost to the Owner.

3. The manufacturer's warranty period shall run concurrently with the Disk Filter Manufacturer's warranty period. No exception to this provision shall be allowed.

F. Extended Warranty (Bid Additive Alternate)

1. If authorized by the Owner, Contractor and equipment manufacturer shall extend the initial warranty period listed in the previous paragraph for a period of two (2) years, bringing the total warranty coverage up to five (5) years.

2. The extended warranty shall include all terms and conditions required to be provided by the Owner to maintain the terms of the warranty.

PART 2 PRODUCTS

A. General

1. Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 volt, 3-phase, 60 Hertz, and motors below ½ horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.

2. All motors used with variable frequency drives shall be

rated for inverter duty and shall be in accordance with the latest NEMA MG1, Section IV, Part 31.

3. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards. Motors shall be of the type and quality described by this Section and other Divisions of the Specifications, and/or as shown on the Drawings, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

B. Ratings

1. All motors shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity and over the operational range. Unless otherwise noted, motors driving pumps, blowers, etc. shall not be overloaded at any head or discharge condition. The motor shall not be required to deliver more than its rated nameplate horsepower, at the 1.0 service factor, under any condition of mechanical or hydraulic loading (i.e. although a 1.15 service factor is required, it may not be used under any condition).

2. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Electrical Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

3. All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient unless noted otherwise.

4. Specific motor data such as Hp, rpm, etc., is specified under the detailed specification for the equipment with which the motor is supplied.

C. Nameplates

The motor manufacturer's nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

D. Condensation Heaters

Condensation heaters, where specified herein or under the detailed mechanical specifications shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate.

E. Winding Temperature Detectors

1. Winding temperature detectors, unless specified otherwise herein shall be a factory installed, embedded, bi-metallic switch type with leads terminating in the main conduit box. This device shall protect the motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts or ventilation failure. The switch shall have normally open contacts. Not less than three detectors shall be furnished with each motor.

2. All motors operating with variable frequency drives shall be equipped with winding temperature detectors.

F. Three Phase Induction Motors

1. Unless specifically noted in other Sections of these Specifications, all motors shall have minimum efficiencies as listed below:

Horsepower	NEMA Nominal Efficiency, %
1-2	84.0
3-5	88.5
7-1/2	89.5
10	90.2
15	91.0
20	92.0
25	92.2
30	92.4
40-50	94.0
60-100	94.5
Over 100	95.0

G. Construction

1. General:

   a. Motors for the disk filter units shall TEFC or TENV as identified in section 11399 Part 3 D. Totally enclosed motors shall be provided with an upgraded insulation by additional dips and bakes to increase moisture resistance and shall not be encapsulated. Motors for outdoor service shall have vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance.

   b. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

   c. All motors shall be of the premium efficiency and high power factor type. All motors shall be the corrosion resistant type conforming to motors designated as “Corro-Duty” by U.S. Motors or equal.

   d. Vertical motors shall be hollow or solid shaft as required by the equipment furnished under other Sections of these Specifications.

   e. Totally enclosed non-ventilated (TENV) motors shall include the same ratings and accessories as specified for TEFC motors.

   f. Explosion-proof motors shall be UL listed and FM approved for Class 1, Division 1 hazardous areas.

   g. Motors installed in Class 1, Division 2 areas shall be rated / listed for this hazardous area.

2. Low Voltage, Three Phase Motors:

   a. Motors shall be of the squirrel-cage induction type. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as called for on the Drawings and as specified in other Sections of these specifications. Motors shall be of the type and quality described by these Specifications, and/or as shown on the schedule on the Drawings, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

b. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 650 percent full load current), and low slip.

c. Unless otherwise specified, motors shall be totally enclosed fan-cooled construction with a 1.15 service factor at the Class B Temperature-Rise.

d. The output shaft shall be suitable for direct connection or belt drive as required.

e. Motors shall have a Class F non-hygroscopic insulation system but shall be limited to Class B Temperature-Rise, at 1.15 service factor.

f. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.

g. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads.

h. All machine surfaces shall be coated with rust inhibiter for easy disassembly.

i. Conduit box shall be split from top to bottom and shall be capable of being rotated to four 90 degree positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-inch diameter, shall be provided inside the conduit box for motor frame grounding. All motor conduit boxes shall be provided with the correct number of conduit openings sized as indicated on the drawings. Boxes shall be suitably sized for conductor bending and terminations.

j. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

k. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T

and larger. Enclosures shall have stainless steel screens. Motors shall be protected for corrosion, fungus and insects.

l. Low voltage, three phase motors shall be manufactured by Nidec-U.S. Motors, Reliance Electric or Baldor.

m. Fractional Horsepower:

1) Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be cast iron or heavy fabricated steel. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.

2) Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.

3) For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.

4) For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years normal operation without re-lubrication.

n. Integral Horsepower:

1) Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

2) Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.

3) The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.

4) Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.

5) Motors shall be equipped with vacuum-degassed anti-friction bearings made to American Bearing Manufacturers Association (ABMA) Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but

facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.

6) Bearings of high thrust motors will be locked for momentary upthrust of 30 percent downthrust. All bearings shall have a minimum B10 life rating of 5 years in accordance with ABMA life and thrust values.

7) Vertical motors will have non-reverse ratchets to prevent backspin. Non-reverse ratchets shall be suitable for duty with variable frequency drives.

3. Low Voltage, Single Phase Motors:

a. Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm indicated on the drawings or as required by the specifications. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open drip-proof, or totally enclosed fan cooled as indicated on the drawings or as required by the specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.

b. Totally enclosed fan cooled motors shall be designed for severe-duty.

c. Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protective plating.

d. Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 EXECUTION

A. Installation

1. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of liquid tight conduit unless otherwise indicated. For all motor connections of No. 4 AWG or

larger wire size, the Contractor shall install a grounding conductor in theconduit and terminate at main conduit box and at the motor control center or variable frequency drive with approved ground lugs and clamps.

2. Low Voltage: For wire sizes #8 AWG and larger, long barrel tin-plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

B. Tests and Checks

1. The following tests shall be performed on all motors after installation but before putting motors into service. All tests shall be performed in the presence of the Resident Project Representative.

a. The Contractor shall megger (1000 volts DC) each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one (1) minute of megger test run.

Degrees Winding Temperature		Voltage		
F	C	115 V.	230 V.	460V.
37	3.9	60	108	210
50	10	32	60	120
68	20	13	26	50
86	30	5.6	11	21
104	45	2.4	4.5	8.8
122	50	1	2	3.7
140	60	0.50	0.85	1.6

b. The Contractor shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with Manufacturer's instructions. The Contractor shall

check direction of rotation of all motors and reverse connections if necessary. The correction for wrong rotational direction shall be made at the motor.

c. All tests shall meet the requirements of, but not be limited to, IEEE 43, 85 and 112. Efficiency tests forEEE 112 shall include Method B.

d. The Contractor shall provide to the Engineer a typed list of all motors 1 HP and larger listing the no load motor current and voltage and the full load current and voltage. Any phase current imbalance greater than 10% shall be reported to the Engineer.

2. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association.

END OF SECTION