LEE COUNTY

BID SET
TECHNICAL SPECIFICATIONS FOR:

FORT MYERS BEACH WRF BELT PRESS REPLACEMENT

CIP: 9094

ISSUE DATE: August, 2023

LEE COUNTY UTILITIES
1500 MONROE STREET, THIRD FLOOR
FORT MYERS, FLORIDA 33901
Website: https://www.leegov.com

Hazen

Engineer's Project No. 41552-002

Fort Myers Beach WRF Belt Press Replacement

Technical Specifications
Issued for Bid

August 2023

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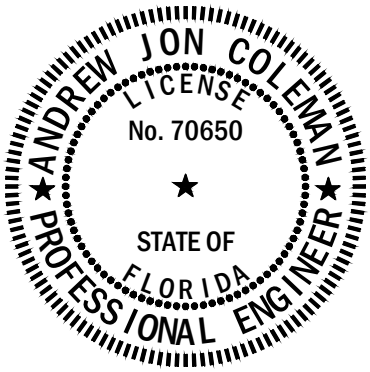
<tr>
<td>Andrew J. Coleman, PE
License No. 70650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Date: 2023.09.06 10:19:57-04'00'</td>
<td>The seal and signature to the left applies to the following Specifications Divisions and Sections:
• Division 01
• Division 02
• Division 09
• Division 31
• Division 32
• Division 33
• Division 40
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• Division 41
• Division 43
• Division 46</td>
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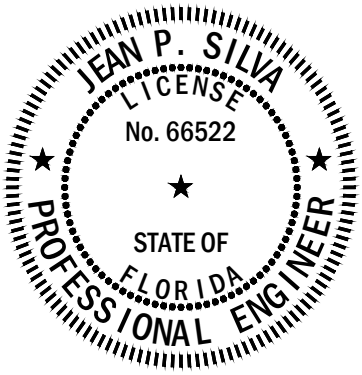
<tr>
<td>Jean P. Silva, PE
License No. 66522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Jean Paul Silva
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Date: 2023.09.07 17:36:35 -04'00'</td>
<td>The seal and signature to the left applies to the following Specifications Divisions and Sections:
• Division 03
• Division 05
• Division 07</td>
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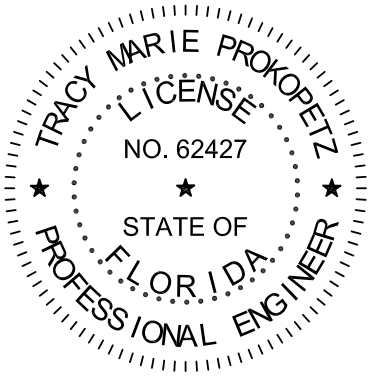
<tr>
<td>Tracy Marie Prokopetz, PE
License No. 62427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<td>This item has been digitally signed and sealed by Tracy Marie Prokopetz, PE, on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Digitally signed by Tracy M Prokopetz
Date: 2023.09.12 13:59:17 -04'00'</td>
<td>The seal and signature to the left applies to the following Specifications Divisions and Sections:
• Division 26</td>
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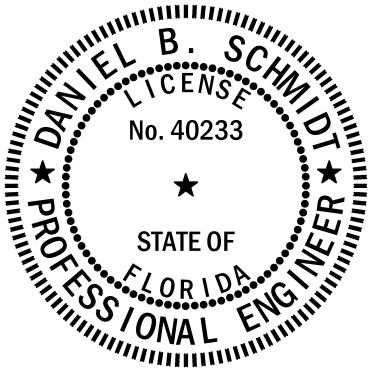
Daniel B. Schmidt License No. 40233  	This item has been digitally signed and sealed by Daniel B. Schmidt, PE, on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies. Daniel B. Schmidt 2023.09.08 11:01:43-04'00'	The seal and signature to the left applies to the following Specifications Divisions and Sections: • Division 40 ○ Sections 40 61 00

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Division 01

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SUMMARY OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Description of Work

B. Contractor's Use of Site

C. Work Sequence

D. Owner’s Occupancy

1.02 DESCRIPTION OF WORK

A. General: The Work to be done under this Contract is located at the Fort Myers Beach Water Reclamation Facility (17155 Pine Ridge Road, Fort Myers Beach, FL 33931). The Work consists of the following as shown and specified in the Contract Documents entitled Fort Myers Beach WRF Belt Press Replacement:

1. Two (2) new belt filter presses, including controls
2. Sludge feed piping modifications
3. Two (2) new polymer activation units, including controls
4. New polymer transfer pump and storage tank system
5. New overhead traveling bridge crane system, including controls
6. New belt filter press feed pumps, including controls
7. Structural improvements
8. Electrical improvements
9. Integration and PLC and SCADA programming

B. The Work includes:

1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.

2. Maintaining the Work area and site in a clean and acceptable manner.

3. Maintaining existing facilities in service at all times except where specifically provided for otherwise herein.

4. Protection of finished and unfinished Work.

5. Repair and restoration of Work damaged during construction.

6. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.

7. Furnishing, installing, and protecting all necessary guides, track rails, bearing plates, anchor and attachment bolts, and all other appurtenances needed for the installation of the devices included in the equipment specified. Make anchor bolts of appropriate size, strength and material for the purpose intended. Furnish substantial templates and shop drawings for installation.

C. Implied and Normally Required Work: It is the intent of these Specifications to provide the Owner with complete operable systems, subsystems and other items of Work. Any part or item of Work which is reasonably implied or normally required to make each installation satisfactorily and completely operable is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.

D. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

1.03 CONTRACTOR'S USE OF SITE

A. In addition to the requirements of the General Conditions, limit use of site and premises for work and storage to allow for the following:

1. Coordination of the Work under this Contract with the work of the other contractors where Work under this Contract encroaches on the Work of other contractors.

2. Owner occupancy and access to operate existing facilities.

3. Coordination of site use with Engineer.

4. Responsibility for protection and safekeeping of products under this Contract.

5. Providing additional off site storage at no additional cost to Owner as needed.

1.04 WORK SEQUENCE

A. Construct Work in stages to accommodate Owner's use of premises during construction period and in accordance with the limitations on the sequence of construction specified. Coordinate construction schedules and operations with Owner and Engineer.

B. Coordinate Work of all subcontractors.

1.05 OWNER OCCUPANCY

A. Owner will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with Owner's representative in all construction operations to minimize conflict, and to facilitate Owner usage.

B. Conduct operations so as to inconvenience the general public in the least.

1.06 PERMITS

A. Permits obtained by, or applied for by, the Owner are as follows:

1. FDEP Domestic Wastewater Minor Modification permit revision (FLA144215-029-DW1).

2. Lee County Department of Community Development LDO permit (LDO2022-00536).

B. The Contractor shall notify the Owner a minimum of 30 days prior to the expiration of a permit if said expiration occurs prior to completion of the Work.

C. Prior to any land clearing or tree removal, the Contractor shall construct a soil tracking device in accordance with current FDOT design standard.

D. Contractor shall be responsible for adhering to all permit conditions associated with the above permits and all additional permits required to perform the work. The Contractor is responsible for reviewing all conditions associated with the various permits and incorporating the conditions into the cost of the work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 STARTING WORK

A. Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

SECTION 01 22 13
MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Explanation and Definitions

B. Measurement

C. Payment

D. Schedule of Values

E. Application for Payment

F. Release of Lien

G. Payment Item Descriptions

1.02 EXPLANATION AND DEFINITIONS

A. The following explanation of the Measurement and Payment for the bid form items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the bid form or relieve the Contractor of the necessity of furnishing such as a part of the Contract.

1.03 MEASUREMENT

A. The quantities set forth in the bid form are approximate and are given to establish a uniform basis for the comparison of bids. The Owner reserves the right to increase or decrease the quantity of any class or portion of the work during the progress of construction in accord with the terms of the Contract.

1.04 PAYMENT

A. Payment shall be made for the items listed on the Bid Form on the basis of the work actually performed and completed, such work including but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, clean up, restoration of disturbed areas, and all other appurtenances to complete the construction and installation of the work as shown on the drawings and described in the specifications.

B. Estimated and mutually agreed upon percent complete values shall be used as a means of computing the amount for periodic payments for work performed. Determining value of additions or deletions during construction may rely upon applicable values as broken down by individual items listed in the approved Schedule of Values.

1.05 SCHEDULE OF VALUES

A. Approval of Schedule: Submit for approval a preliminary schedule of values, in duplicate, for all of the Work. Prepare preliminary schedule in accordance with the General Conditions. Submit preliminary schedule of values within 10 calendar days after the Effective Date of the Agreement. Submit final schedule of values in accordance with the General Conditions.

B. Format: Utilize the submitted Bid Schedule for the list of individual pay items finalizing actual amounts to be used for payment if different than that initially submitted with the bid. Identify each line item with number and title of the major specification items. Identify site mobilization, bonds and insurance. Include with each line item, a direct proportional amount of Contractor's overhead and profit. Within the Schedule of Values, break down the individual bid schedule items into more specific items included in that bid schedule item (concrete, individual equipment, electrical components, instrumentation, piping sections, startup, training, O&M Manuals, etc). Intent is to break down the work by areas that can more easily allow estimation of the percent complete for each item. Attempt to break down the individual items listed in values of $50,000 or less wherever possible.

C. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

D. Revisions: With each Application for Payment, revise schedule to list approved Change Orders.

1.06 APPLICATION FOR PAYMENT

A. Required Copies: Submit three copies of each application on EJCDC Form No. 620 (latest version) or approved equal.

B. Execute certification by signature of authorized officer.

C. Use data from approved Schedule of Values.

D. Stored Materials: When payment for materials stored is permitted, submit a separate schedule for Materials Stored showing line item, description, previous value received, value incorporated into the Work and present value.

E. Change Orders: List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original item of work.

1. Final Payment: Prepare Application for Final Payment as required in the General Conditions.

2. Submit an updated construction schedule for each Application for Payment.

1.07 RELEASE OF LIEN

A. For any item included in a pay application that is to a third party, either a subcontractor or material supplier, a release of lien for those amounts shall be submitted with the next pay application before further payment can be considered.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 BASE BID PAYMENT ITEM DESCRIPTIONS

A. Payment shall be made on the basis of work actually performed completing each item in the Bid, such work including, but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, cleanup, and all other appurtenances to complete the construction and installation of the work to the configuration and extent as shown on the drawings and described in the specifications. Payment for each item includes compensation for cleanup and restorations. Cleanup and surface restorations (including pavement replacement) will be considered as ten percent (10%) of each pay item and complete payment will not be made until cleanup, restorations and as-builts are completed.

1. Item 1 - Mobilization and Demobilization: Included in this item are all general conditions and requirements, including but not limited to mobilization activities, scheduling, temporary facilities, design/layout, procuring, installing and testing temporary piping, valves, equipment, electrical, and controls for the temporary dewatering system, applying for and obtaining permits required to perform the work, indemnification, general conditions, demobilization, close out, and all other activities necessary to complete the contract work general requirements (pay applications, meetings, submittals, audio-video recordings, photographs, site protections, quality control testing services, field offices, and final close out items). Payment shall be made at the contract lump sum price for this bid item in accordance with the schedule listed below. This price shall be full compensation for furnishing all materials, for all labor, equipment, tools, and incidentals necessary to complete this item. Partial payment shall be made in accordance with the following:

Percent of Original Contract Amount Earned	Allowable Maximum Percent of Lump Sum Price for this Item
5	25
25	50
50	75
75	90
100	100

2. Item 2 - Civil Site Improvements: Payment for furnishing and installing sanitary sewer and site improvements will be made at the contract lump sum price. This item includes all labor, materials, equipment, supplies, and appurtenances necessary for furnishing, installing, testing, and placing in operation sewer drain piping and manholes, access road improvements and paving, and all other civil/site improvements as required for this project, including but not limited to, survey and staking, earthwork, erosion control, piping and precast structures, dewatering systems, site restoration, and final site cleanup and restoration of all areas disturbed by construction activities. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

3. Item 3 - Demolition: Payment for demolition will be made at the contract lump sum price. This item includes, but is not limited to, the lead and asbestos survey in areas of demolition work and corresponding lead and asbestos abatement, demolition and removal or relocation of the existing belt filter presses, existing polymer activation units, existing stairs and landing, existing monorail crane, existing belt filter press feed pumps, piping, concrete, asphalt, control panels, and associated equipment as indicated on the Drawings. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

4. Item 4 - Dewatering Improvements: Payment for furnishing and installing equipment and accessories in the dewatering building will be made at the contract lump sum price. This item includes all labor, materials, and equipment necessary for furnishing, installing, testing, and placing in operation the belt filter press equipment and appurtenances, washwater pumps, polymer activation systems, conveyor slide gates and electric actuators, traveling bridge crane and structural support system, stairs, supports, and landing, concrete improvements, trench grating system, conveyor slide gate actuator supports, polymer transfer pump and storage tank system, equipment pads and supports piers, coating systems, piping, valves, supports, and appurtenances as specified in the Contract Documents. This item shall include the O&M Manuals and Training for this equipment. This item shall also include all other Work not specifically identified as being payable under other payment item

descriptions. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

5. Item 5 - Belt Filter Press Feed Pump Improvements: Payment for furnishing and installing the belt filter press feed pumps will be made at the contract lump sum price. This item includes all labor, materials, and equipment necessary for furnishing, installing, testing, and placing in operation the belt filter press feed pumps, equipment pads, coating systems, suction and discharge piping, fittings, valves, supports, and appurtenances as specified in the Contract Documents. This item shall include the O&M Manuals and Training for this equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

6. Item 6 - Electrical Improvements: Payment for furnishing and installing the electrical modifications will be made at the contract lump sum price. This item includes all work shown on the electrical drawings and specified in Division 26. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

7. Item 7 - Instrumentation and Control Improvements: Payment for furnishing and installing the instrumentation systems will be made at the contract lump sum price. This item includes all Systems Integrator Work associated with furnishing instruments, control panels and PLC/HMI/SCADA programming, fiber optic cable and communications, plant network modifications, and plant SCADA modifications specified under Division 40. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

8. Item 8 – Concrete Repair Plan: Payment for concrete condition assessment and repair plan development will be made at the contract lump sum price. This item includes all labor, materials, and equipment necessary for completing visual inspection, non-destructive concrete sounding, and concrete repair plan development, in accordance with Section 03 01 30, Part 1.06 and these Contract Documents. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

9. Item 9 – Shallow Concrete Spall Repair: This Item includes all labor, materials, tools, and equipment necessary and required to remove deteriorated concrete from areas of damage (unsound concrete less than or equal to 1.5” deep with no exposure of underlying reinforcement), sawcut repair areas square, and provide and install new concrete repair mortar as specified and detailed on the Contract Drawings.

   Measurement: The quantity to be paid for under this Item is the actual area measured in square feet, of deteriorated concrete area repaired to the specified depth, as shown on the Contract Drawings, or as ordered and directed by the Engineer.

Payment: The unit price bid for this Item shall be full compensation as shown and specified. Payment for the work under this Item shall be made at the actual number of square feet repaired, as shown, specified, and directed and shall be full payment for the work under this Item.

10. Item 10 – Deep Concrete Spall Repair: This Item includes all labor, materials, tools, and equipment necessary and required to remove spalled concrete from areas of damage (unsound concrete greater than 1.5" deep with exposure of steel reinforcement), remove and splice in new reinforcement bars, sawcut repair areas square, and provide and install new concrete repair mortar as specified and detailed on the Contract Drawings.

    Measurement: The quantity to be paid for under this Item is the actual area measured in square feet, of spalled concrete area repaired to the specified depth, as shown on the Contract Drawings, or as ordered and directed by the Engineer.

    Payment: The unit price bid for this Item shall be full compensation as shown and specified. Payment for the work under this Item shall be made at the actual number of square feet repaired, as shown, specified, and directed and shall be full payment for the work under this Item.

11. Item 11 – Crack Repair: For providing all labor, materials, tools, and equipment necessary and required to repair dry horizontal or vertical concrete surface cracks (less than ¼" wide), as specified and shown on the Contract Drawings. Cracks wider than ¼" shall be treated as spalls and included under Items 9 or 10.

    Measurement: Quantities paid for under this item shall be the actual linear footage of crack repair as determined by the Engineer.

    Payment: No payment under this item shall be made for crack repair not ordered by the Engineer. Payment under this item shall be made at the unit price bid per linear foot as measured by the Engineer, which shall be full payment for Work under this Item. For establishing basis for payment, no separate classification shall be made for horizontal versus vertical crack repair or for dry versus actively leaking crack repairs. For bidding purposes, it shall be assumed that all cracks to be repaired will be dry.

END OF SECTION

SECTION 01 26 00

CHANGE ORDER AND FIELD DIRECTIVE CHANGE PROCEDURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Definitions

B. Change Orders

C. Field Directive Change

1.02 DEFINITIONS

A. Change Order: Refer to the Change Order definition in Article 2 of the General Conditions.

B. Field Directive Change: Field Directive Change is a written directive to the Contractor issued on or after the effective date of the agreement; signed by the Owner, recommended by the Engineer ordering an addition, deletion, or revision in the Work. A Field Directive Change will subsequently be followed by the issuance of a Change Order.

C. Overhead: Overhead is defined as the cost of administration, field office and home office costs, general superintendence, office engineering and estimating costs, other required insurance, materials used in temporary structures (not including form work), additional premiums on the performance bond of the Contractor, the use of small tools, scheduling costs, and all other costs incidental to the performance of the change or the cost of doing business.

1.03 CHANGE ORDERS

A. Initiation of Proposals:

B. From time to time, the Owner or the Engineer may issue a Request for a Change Order Proposal. The Request will contain a description of the intended change with supplementary or revised Drawings and Specifications as applicable, and the projected time for accomplishing the change.

C. The Contractor may propose a change in the Work by submittal of a Change Order Request to the Engineer describing the proposed change with a statement of the reason for the change and the effect on the Contract time and price, along with supporting documentation.

1. Execution of Change Order Proposal:

   a. When a Proposal is requested for changed work, submit proposal within 15 days following receipt of the Request from Owner or Engineer. State the increase or decrease, if any, in Contract Completion time and Contract Price.

   b. Explain proposal in sufficient detail to permit review by Owner.

   c. For Omitted Work the decrease in the Contract Price will be determined by the Engineer and will include appropriate amounts for profit and overhead.

   d. The Owner and Engineer will review the Proposal and may request additional information and documentation. Provide these items upon request.

   e. If the Owner decides to proceed with the change, the Owner will issue a Change Order for signature first by the Contractor and then by the Owner.

   f. The Contractor will promptly complete the approved change in the Work on receipt of the executed Change Order.

      1) Failure to sign the Change Order does not relieve the Contractor from performing the Work if the Change Order is signed by the Owner.

      2) Compute the cost of both additive and deductive changes in the Work in accordance with Article 11 of the General Conditions and as follows:

         a) Include, the costs of labor, crew foreman and general foreman performing or directly supervising the changed Work on the site. Include travel and subsistence, but only to the extent incurred.

         b) To the labor cost add all net premium for Workman's Compensation, taxes pursuant to the Federal Social Security Act, and payments required under State and Federal unemployment laws.

         c) Add necessary extra materials, delivered at the site.

         d) Include Subcontractor's costs, including a maximum of 10 percent overhead and 10 percent profit for the first $20,000; 7-1/2 percent overhead and 7-1/2 percent profit on the next

$30,000; and 5 percent overhead and 5 percent profit on balance over $50,000.

e) For all subcontract work add 5 percent overhead and 5 percent profit to the subcontractor's costs. For work performed by the Contractor's own forces add a maximum of 10 percent overhead and 10 percent profit for the first $20,000; 7-1/2 percent overhead and 7-1/2 percent profit on the next $30,000; and 5 percent overhead and 5 percent profit on balance over $50,000.

1.04 FIELD DIRECTIVE CHANGE

A. Initiation by Owner: Owner may issue a Field Directive Change with a Notice to Proceed without a prior Request for a Change Order Proposal or the Contractor's signature.

B. Payment Determination: The Owner will designate the method of determining the amount of compensation or credit, if any, based on one of the methods contained in Article 11 of the General Conditions.

C. Timing: Proceed with the change in the Work immediately upon receipt of the Field Directive Change.

D. Addition to Contract: The Field Directive Change will be incorporated into the Contract Documents via a Change Order at a later date.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 31 13
PROJECT COORDINATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Work Progress

B. Private Land

C. Work Locations

D. Open Excavations

E. Test Pits

F. Maintenance of Plant Operation

G. Shutdown and Tie-in Coordination

H. Suggested Sequence of Construction

I. Out-of-service Duration Limits

1.02 WORK PROGRESS

A. Furnish personnel and equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will allow the completion of the work within the time stipulated in the Bid of these Specifications. If at any time such personnel appears to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character or increase the personnel and equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress.

1.03 PRIVATE LAND

A. Do not enter or occupy private land outside of easements, except by permission of Owner. Construction operations shall be conducted in accordance with Section 01 57 00.

1.04 WORK LOCATIONS

A. Structures and pipelines shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as maybe found desirable to avoid interference noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

1.05 OPEN EXCAVATIONS

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

1.06 TEST PITS

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

1.07 MAINTENANCE OF PLANT OPERATION

A. The existing plant must be maintained in continuous operation during the entire construction period of the Contract as hereinafter specified. The intent of this Section is to outline the minimum requirements necessary to provide continuous treatment and meeting of all facility permit requirements throughout the construction period.

B. Operational Access: Owner’s personnel shall have access to equipment and areas that remain in operation.

C. Work under the Contract shall be scheduled and conducted by the Contractor so as not to impede any treatment process, reduce the quality of the plant effluent, interfere with the plant’s ability to meet permit requirements, or cause odor or other nuisances to the plant operations and maintenance staff. In performing the work shown and specified, the Contractor shall plan and schedule the work to meet the plant operating requirements in accordance with the constraints and construction requirements as outlined in this Section. No discharge of raw or treated wastewater shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of raw or treated wastewater resulting from the Contractor's work.

D. The Contractor shall be responsible for coordinating the general construction and the schedules of all subcontractors and for ensuring that permanent or temporary power and controls are available for all existing, proposed, and temporary facilities that are required at any given time.

E. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the Owner and provided that all requirements of these Specifications are fulfilled. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section are in consecutive calendar days.

F. Provide for the flow of sewers, drains, courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer well in advance of the interruption of any flow.

G. Do not shut off or disconnect existing operating systems, unless accepted by Engineer in writing. Operation of existing equipment will be by Owner unless otherwise specified or indicated. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.

H. General Constraints:

1. The Contractor shall schedule the work so that the plant is maintained in continuous operation. All treatment processes shall be maintained in continuous operation during the construction period except during approved process interruptions. All short-term system or partial system shutdowns and/or diversions shall be approved by the engineer with concurrence from Owner's operations staff. Long-term process shutdowns and diversions shall conform to the requirements hereinafter specified and shall be minimized by the Contractor as much as possible. If in the judgment of the Owner a requested shutdown is not required for the Contractor to perform the work, the Contractor shall utilize approved alternative methods to accomplish the work. All shutdowns shall be coordinated with the Owner and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period, with no temporary services in place, shall commence at a time approved by the Owner, and the Contractor shall proceed with the work continuously, (24 hours/day, 7 days/week) start to finish, until the work is completed and normal plant operation is restored. If the Contractor completes all required work before the specified shutdown period has ended, the Owner may immediately place the existing system back into service once accepted.

2. Short-term shutdowns in ability to operate equipment will be allowed for tie-ins to existing piping or for disconnection and/or reconnection of equipment power feeds. All such shutdowns shall be scheduled at times approved by the Owner and shall be for durations as agreed to with the Owner, but no more than four (4) hours. The

schedule and duration of short-term shutdowns shall be at the discretion of the Owner.

3. The Contractor shall schedule shutdowns in advance and shall present all desired shutdowns in the 30 and 60-day schedules at the progress meetings. Shutdowns shall be fully coordinated with the plant superintendent at least 72 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the shutdowns.

4. Any temporary work, access ramps, equipment, pathways, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable plant operation shall be furnished by the Contractor at the direction of the Engineer at no additional cost to the Owner.

5. The Owner shall have the authority to order work postponed, stopped, or prohibited that would, in their opinion, unreasonably result in interrupting the necessary functions of the plant operations.

6. If the Contractor impairs performance or operation of the plant as a result of not complying with specified provisions for maintaining plant operations, then the Contractor shall immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the Owner. Such work shall progress continuously to completion on a 24-hours per day, seven work days per week basis at the Contractor’s expense.

7. Plumbing Facilities: Sanitary facilities in the existing structures shall be operational at all times and shall be for plant operating personnel exclusively. Temporary sanitary facilities for the Contractor’s use shall be supplied by the Contractor and shall be either connected to waste collection facilities approved by the Owner or periodically pumped out by the Contractor at appropriate intervals.

8. Building Air Conditioning and Ventilating: Building air conditioning and ventilating for the existing plant structures shall be in service for the entire construction period. For air conditioning and ventilation systems being replaced under this contract, the existing system shall remain in service until the replacement system is ready to be installed and temporary air conditioning and ventilation shall be provided as required to adequately cool and vent facilities under construction and/or while systems are being replaced.

9. Power, Light and Communications Systems (General): Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas of the facility. Individual units may be disconnected as required for replacement, but service shall be available at all times including periods when plant

elements are out of service. The Contractor and electrical subcontractor shall coordinate shutdowns required to minimize the total number of shutdowns needed to complete construction. Owner's phone service to the plant shall be maintained in continuous operation during construction. Temporary excavations, blocking of normal access routes, and areas of active construction shall be well marked and cordoned off for safety of plant personnel and well lit at night using temporary lighting. CONTRACTOR shall pay all necessary costs related to continuously maintain the plant's power, lighting, and communications systems which may be impacted by the Work either as needed to complete the Work or for repairs resulting from accidental interruption.

10. Draining Process Pipes and Conduits (General): The contents of all pipes and conduits to be removed, replaced or relocated (or dewatered for a specific purpose) shall be transferred to a suitable facility in a manner approved by the Owner through hoses or piping, or by using pumps if hydraulic conditions so require them. The Contractor shall provide the pumps, piping and hoses at no additional cost to the Owner. No uncontrolled spillage of a pipe or conduit shall be permitted. Any spillage, other than potable water, shall be immediately washed down and flushed into an appropriate collection area. Contractor shall be responsible for making required notifications to applicable regulatory agency and pay all fees associated with such spills caused by construction activities.

11. Potable Water System: Potable water service shall be maintained in continuous service at all times during construction except for short term interruptions required for tie-ins. Shutdown of the potable water system shall be fully planned and coordinated with the Owner and shall be limited to not more than two (2) hours. Existing fire hydrants on potable water lines within the plant site shall be operational at all times, unless otherwise approved by the Owner.

12. Non-potable Water System: The existing non-potable water (reuse water) service shall be maintained in continuous operation during construction except for short term tie-ins of new or temporary facilities to existing facilities, until the new or re-routed non-potable water lines are brought into service. Temporary non-potable service for seal water systems shall be provided by the Contractor as necessary to insure continuous, uninterrupted service of these critical systems.

13. Sump Pumps and Sumps: All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.

14. Stormwater Ponds and Drainage: All existing drainage inlets, swales, and drainage culverts shall remain in service throughout the construction period such that no flooding of the existing facilities or grounds occurs.

1.08 SHUTDOWN AND TIE-IN COORDINATION

A. Coordination:

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

2. Notify other contractors in advance of Work requiring coordination with Owner's operations, to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.

3. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

B. Pre-Shutdown Meetings: Contractor shall schedule and conduct meeting with Owner and Engineer prior to scheduling shutdown.

C. Sequencing:

1. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, with Engineer's acceptance. Stages specified in this Section are sequential in performance of the Work.

D. Scheduling:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.

3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform

to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

5. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

6. Temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems may be required. Coordinate requirements for such shutdowns with Engineer and Owner.

E. Submittals

1. Action/Informational Submittals:

a. Shutdown Planning Submittal:

1) For each shutdown, submit an inventory of labor and materials required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.

2) Furnish submittal to Engineer at least thirty (30) days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning submittal.

b. Shutdown Notification: After acceptance of shutdown planning submittal and prior to starting the shutdown, provide written notification to Owner and Engineer of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each shutdown.

1.09 SUGGESTED SEQUENCE OF CONSTRUCTION

A. Work under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of the existing treatment facilities. Process control modifications shall not be made without first obtaining written permission from the Engineer. Areas of the work may require the Contractor to dewater wastewater lines. The Contractor shall be responsible for the proper containment and disposal of wastewater drained from pipelines during construction. The Contractor shall contain such wastewater (in accordance with all applicable codes) and shall dispose of such to an on-site wastewater basin as directed by the Owner.

B. The sequence of construction shall be such as to minimize interferences and disruptions to the wastewater reclamation facility, roads, homeowners, other utilities, and to the normal operation of other agencies having jurisdiction over the project.

C. At no time shall the Contractor undertake to close off any pipelines, or open valves, or take any other action that would affect the operation of the existing system, except as specifically required by the Contract Documents, after authorization is granted by the Owner or Engineer and after proper notification.

D. At no time shall the Contractor interrupt traffic, close streets or redirect traffic without previous authorization from the agencies having jurisdiction over the project.

E. The Owner may require the Contractor to finish certain portions of work that is in progress before work is started on any additional portion. The Owner may also require the Contractor to wait for completion of work being performed by other contractors.

F. Perform the Work in the specified sequence or as otherwise approved by Engineer. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, and with Engineer's acceptance. The sequence of construction is a precedence requirement and does not attempt to schedule the Contractor's work. It is intended only to indicate which activities must precede other activities in order to minimize interferences and disruptions. The construction sequence described herein includes recommended phasing of the work. If an alternate phasing is proposed by the Contractor, the Contractor shall gain full approval of the Engineer before proceeding.

G. Stage 1:

1. Mobilize and prepare the Site to receive the Work.

2. Complete demolition in the belt filter press feed pump area.

3. Supply and install new belt filter press feed pump equipment.

4. Replace west belt filter press feed pump suction header valve (V1)

   a. Coordinate with Owner to pump Tank No. 3 down to EL. 9.50 feet. If wasting operations need to be temporarily discontinued, the duration shall be limited to a single event with a maximum duration of 2 hours.

   b. No WAS flow into Tank No. 3 during valve replacement. Tank No. 1 to remain in operational service.

c. Close valve V3.

d. Replace valve V1.

5. Replace east belt filter press feed pump suction header valve (V2).

a. Coordinate with Owner to pump down Tank No. 1 by several feet to provide a tank head space that will serve as a buffer since WAS will be continuously directed to Tank No. 1 including during the period in which it is hydraulically isolated from the belt filter press feed pump station. If wasting operations need to be temporarily discontinued, the duration shall be limited to a single event with a maximum duration of 2 hours.

b. Close valves V3, V4, and V5.

c. Replace valve V2.

H. Stage 2:

1. Owner to mobilize Owner-owned mobile dewatering unit. Contractor shall install, wire, and connect.

2. Complete demolition in the dewatering area, polymer room, and sludge loading area.

3. Complete structural spot repairs.

4. Supply and install proposed belt filter press equipment, polymer equipment, traveling bridge crane, stairs and platform, conveyor drop chute slide gates, piping, valves, and appurtenances.

5. Wire and connect new equipment.

6. Complete instrumentation and controls improvements.

7. Supply and install sanitary sewer improvements.

8. Start up and test equipment.

9. Load test and certify new crane.

10. Demobilize temporary dewatering system.

I. Stage 3:

1. Complete surface restoration and cleaning activities.

2. Substantial Completion.

3. Final walkthrough and punch list.

4. Final Completion.

1.10 OUT OF SERVICE DURATION LIMITS

A. The belt filter press out of service duration shall be limited to 120 consecutive calendar days. This period shall commence once the Owner-supplied temporary dewatering system is operational and upon initiation of demolition Work within the dewatering area. At the end of this period the Owner shall be able to decommission the temporary dewatering system and return to normal dewatering operations using the new polymer activation units, crane, and belt filter presses; including controls.

B. The belt filter press feed pump suction header valve replacements shall be sequenced such that the out or service duration for each valve replacement is limited to 2 hours.

PART 2 – PRODUCTS

2.01 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed work shall be carefully protected from damage in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his own expense.

B. All structures shall be protected in a manner approved by the Engineer. Should any of the floors or other parts of the structures become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor at his own expense and to the satisfaction of the Engineer. Special attention is directed to substructure bracing requirements, described in Section 31 40 00. If, in the final inspection of the work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. The Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the contract.

C. Take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the Owner.

PART 3 – EXECUTION

3.01 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. Sequence and schedule shall work in a manner to preclude delays and conflicts between the work of various trades and contractors. Each trade shall stay informed as to the work of other trades on the project and shall execute their work in a manner that will not interfere with the work of other trades.

3.02 DIAGRAMMATIC NATURE OF DRAWINGS

A. Where layout is diagrammatic, such as pipelines, conduits, ductwork, etc., it shall be followed as closely as other work will permit. Changes from diagrams shall be made as required to conform to the construction requirements.

B. Before running lines, carefully verify locations, depths and sizes and confirm that lines can be run as contemplated without interfering with other construction. Any deviation shall be referred to the Engineer for approval before lines are run. Minor changes in location of the equipment, fixtures, piping, etc., from those shown on the Drawings, shall be made without extra charge if so directed by the Engineer before installation.

C. Determine the locations and sizes of equipment, fixtures, conduit, ducts, openings, etc., in order that there will be no interference in the installation of the work or delay in the progress of other work. In the event that interferences develop, the Engineer's decision regarding relocation of work will be final.

D. Any changes made necessary through failure to make proper arrangements to avoid interference shall not be considered as extras. Cooperate with those performing other work in preparation of interference drawings, to the extent that the location of piping, ductwork, etc., with respect to the installations of other trades shall be mutually agreed upon by those performing the work.

3.03 PROVISIONS FOR LATER INSTALLATION

A. Where any work cannot be installed as the construction is progressing, provide for boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work during later phases of construction. Arrange for chases, holes, and other openings in the masonry, concrete or other work and provide for subsequent closure after placing equipment. Arrangement for and closure of openings shall be subject to the approval of the Engineer and all costs therefor shall be included in the contract price for the work.

3.04 COORDINATION

A. The Contractor shall be fully responsible for the coordination of his work and the work of his employees, subcontractors, and suppliers with the Owner, Engineer, and regulatory agencies; and assure compliance with schedules.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Preconstruction Conference

B. Progress Meetings

C. Submittals

1.02 PRECONSTRUCTION CONFERENCE

A. General: Prior to commencement of the Work, in accordance with the General Conditions, the Owner will conduct a preconstruction conference to be held at a predetermined time and place.

B. Delineation of Responsibilities: The purpose of the conference is to designate responsible personnel, to establish a working relationship among the parties and to identify the responsibilities of the Owner, plant personnel and the Contractor. Matters requiring coordination will be discussed and procedures for handling such matters, established. The agenda will include:

1. Submittal procedures
2. Partial Payment procedures
3. Maintenance of Records
4. Schedules, sequences, and maintenance of facility operations
5. Safety and First Aid responsibilities
6. Change Orders and Field Directive Changes
7. Use of site
8. Housekeeping
9. Equipment delivery

C. Attendees: The preconstruction conference is to be attended by the representatives of the Contractor, the Owner, and plant personnel that will be associated with the project.

Representatives of regulatory agencies, subcontractors, and principal suppliers may also attend when appropriate.

D. Chair and Minutes: The preconstruction conference will be chaired by the Owner who will also arrange for the keeping and distribution of minutes to all attendees.

1.03 PROGRESS MEETINGS

A. Meeting Frequency and Format: Progress meetings shall be held on a monthly basis, at a minimum, during the performance of the Work. Meetings shall review the Work, discuss changes in schedules, maintain coordination and resolve potential problems. Invite Owner, Engineer, and major subcontractors. Suppliers may be invited as appropriate. Minutes of the meeting will be maintained by Contractor and reviewed by Engineer prior to distribution by the Contractor. Distribute reviewed minutes to attendees within 7 calendar days after each meeting.

1. Agenda, minimum:

a. Review, comment, and amendment (if required) of minutes of previous progress meeting.

b. Review of progress since the previous progress meeting.

c. Planned progress through next 30 – 60 days.

d. Review of Progress Schedule

1) Contract Times, including Milestones (if any)

2) Critical path.

3) Schedules for fabrication and delivery of materials and equipment.

4) Corrective measures, if required.

e. Submittals:

1) Review of status of critical submittals.

2) Review revisions to schedule of submittals.

f. Contract Modifications:

1) Requests for interpretation

2) Clarification notices

3) Field Orders

4) Proposal requests

5) Change Proposals

6) Work Change Directives

7) Change Orders

8) Claims

g. Applications for progress payments.

h. Problems, conflicts, and observations.

i. Quality standards, testing, and inspections.

j. Coordination between parties.

k. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.

l. Safety.

m. Permits.

n. Record documents status.

o. Punch list status, as applicable.

p. Other business.

1.04 SUBMITTALS

A. Pre-Construction Meeting Submittals: Prior to the conference, submit the following preliminary schedules in accordance with the General Conditions.

1. Progress schedule.

2. Schedule of submittals.

3. Schedule of values.

4. Contractor's safety and first aid procedures.

5. Confined space entry plan.

6. List of emergency contact information.

B. Progress Meeting Submittals:

1. List of Work accomplished since the previous progress meeting.

2. Up-to-date Progress Schedule.

3. Up-to-date Schedule of Submittals.

4. Detailed “look-ahead” schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the Owner, Project, and Site.

5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

C. Emergency Contact Information

1. Contractor shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 16
PROGRESS SCHEDULE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Form of Schedules

B. Content of Schedules: Submit for approval, a preliminary progress schedule in accordance with the General Conditions.

C. Schedule Revisions

D. Submittal Requirements

1.02 FORM OF SCHEDULES

A. Prepare schedules in form of a horizontal bar chart.

1. Provide separate horizontal bar for each trade or operation.

2. Utilize a horizontal time scale and identify first work day of each week.

3. Utilize scale and spacings to allow space for notations and future revisions.

B. Utilize a listing format which chronologically indicates the order of start of each item of work.

C. Identify each listing by major specification section numbers.

D. The Contractor's progress schedule shall be computer generated and resource loaded. Each construction progress schedule and associated report shall include the following tabulations: a list of activities in numerical order, a list of activity precedence, schedules sequenced by Early Start Date, Total Float, and Late Start Date. Each schedule and report shall include the following minimum items.

1. Activity Numbers

2. Estimated Duration

3. Activity Description

4. Early Start Date (Calendar Dated)

5. Early Finish Date (Calendar Dated)

6. Latest Allowable Start Date (Calendar Dated)

7. Latest Allowable Finish Date (Calendar Dated)

8. Status (whether critical)

9. Estimated Cost of the Activity

10. Total Float and Free Float

E. In addition, each construction progress schedule, network analysis and report shall be prefaced with the following summary data:

1. Contract Name and Number

2. Contractor's Name

3. Contract Duration and Float

4. Contract Schedule

5. The Effective or Starting Date of The Schedule (the date indicated in the Notice-to-Proceed)

1.03 CONTENT OF SCHEDULES

A. Completion Dates: Show the beginning and ending contract dates stated in documents. Schedules showing completion prior to the contract completion date will be accepted but in no event will they be considered basis for a claim for delay against the Owner by the Contractor for the period between the early completion date and the completion date provided in the Contract Documents.

B. Show complete sequence of construction by activity.

C. Show dates for beginning and completion of each major element of construction and installation dates for major items of equipment. Elements shall include, but not be limited to, the following:

1. Shop drawing receipt from supplier/manufacturer submitted to Engineer, review and return to supplier/manufacturer

2. Material and equipment order, manufacturer, delivery, installation, and checkouts

3. Performance tests and supervisory services activity

4. Construction of various facilities

5. Demolition

6. Excavation, sheeting, shoring, dewatering

7. Concrete placement sequence

8. Structural steel erection

9. Wall and roof construction

10. Piping and equipment installation

11. Electrical work activity

12. Heating, ventilating, and air conditioning work activity

13. Plumbing work activity

14. Sewer installation

15. Connection to existing sewers

16. Water main installation

17. Miscellaneous concrete placement

18. Subcontractor's items of work

19. Backfilling, grading, seeding, sodding, landscaping, fence construction, and paving

20. Final cleanup

21. Allowance for inclement weather

22. Coordination with concurrent Work on site

D. Show projected percentage of completion for each item as of first day of each month.

1.04 SCHEDULE REVISIONS

A. As a minimum, revise construction schedule every 30 calendar days to reflect changes in progress of Work for duration of Contract.

B. Indicate progress of each activity at date of submittal.

C. Show changes occurring since previous submittal of schedule.

1. Major change in scope

2. Activities modified since previous submittal

3. Revised projections of progress and completion

4. Other identifiable changes

D. Provide a written report as needed to define:

1. Problem areas, anticipated delays, and impact on schedule

2. Corrective action recommended and its effect

3. Effect of changes on schedules of other contractors

E. If the Contractor desires to make changes in its method of operating which affect the construction progress schedule and related items, the Contractor shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer accepts these changes, in writing, the Contractor shall revise and submit, without additional cost to the Owner, all of the affected portions of the construction progress schedule, and associated reports. The construction progress schedule and related items shall be adjusted by the Contractor only after prior acceptance, in writing by the Engineer. Adjustments may consist of changing portions of the activity sequence, activity durations, division of activities, or other adjustments as may be required. The addition of extraneous, nonworking activities and activities which add restraints to the construction progress schedule shall not be accepted.

F. Except where earlier completions are specified, schedule dates which show completion of all Work prior to the contract completion date shall, in no event, be the basis for claim for delay against the Owner by the Contractor.

G. Construction progress schedules and related items which contain activities showing negative float or which extend beyond the contract completion date will not be accepted by the Engineer.

H. Whenever it becomes apparent from the current construction progress schedule and associated reports that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the Engineer, the Contractor shall take some or all of the following actions at no additional cost to the Owner. They shall submit to the Engineer for approval, a written statement of the steps they intend to take to remove or arrest the delay to the critical path in the current construction progress schedule, including a computer-generated schedule revision to reflect proposed actions.

1. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.

2. Increase the number of working hours per shift, shifts per day, working days per week, the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate the backlog of work.

3. Reschedule activities to achieve maximum practical concurrency of accomplishment of activities, and comply with the revised schedule.

I. If so requested by the Engineer, the Contractor should fail to submit a written statement of the steps they intend to take or should fail to take such steps as reviewed and accepted in writing by the Engineer, the Engineer may direct the Contractor to increase the level of effort in manpower (trades), equipment and work schedule (overtime, weekend and holiday work, etc.)

to be employed by the Contractor in order to remove or arrest the delay to the critical path in the current construction progress schedule, and the Contractor shall promptly provide such level of effort at no additional cost to the Owner.

J. If the completion of any activity, whether or not critical, falls more than 100 percent behind its previously scheduled and accepted duration, the Contractor shall submit for approval a schedule adjustment showing each such activity divided into two activities reflecting completed versus uncompleted work.

K. Shop drawings which are not approved on the first submittal or within the time scheduled, and equipment which does not pass the specified tests and certifications shall be immediately rescheduled.

L. The contract time will be adjusted only in accordance with the General Conditions and other portions of the Contract Documents as may be applicable. If the Engineer finds that the Contractor is entitled to any extension of the contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the current construction progress schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule and related items. Actual delays in activities which, according to the construction progress schedule, do not affect any contract completion date will not be the basis for a change therein.

M. From time to time it may be necessary for the contract schedule of completion time to be adjusted by the Engineer in accordance with the General Conditions and other portions of the Contract Documents as may be applicable. Under such conditions, the Engineer will direct the Contractor to reschedule the Work or contract completion time to reflect the changed conditions, and the Contractor shall revise the construction progress schedule and related items accordingly, at no additional cost to the Owner.

N. Float belongs to the Project and may be used by Owner, Engineer, or Contractor to accommodate modifications, regardless of origination, in the Work or to mitigate the effect of events that may delay performance or completion of the Work. Changes or delays that influence scheduled Work Activities with Float and that do not extend the critical path will not be justification for an extension in Contract Times.

O. The Owner controls the float time and, therefore, without obligation to extend either the overall completion date or any intermediate completion dates, the Owner may initiate changes that absorb float time only. Owner initiated changes that affect the critical path on the network diagram shall be the sole grounds for extending the completion dates. Contractor initiated changes that encroach on the float time may be accomplished only with the Engineer's concurrence. Such changes, however, shall give way to Owner initiated changes competing for the same float time.

P. To the extent that the construction project schedule, or associated report or any revision thereof shows anything not jointly agreed upon or fails to shown anything jointly agreed upon, it shall not be deemed to have been accepted by the Engineer. Failure to include on a schedule any element of Work required for the performance of this Contract shall not excuse the Contractor from completing all Work required within any applicable completion date, not withstanding the review of the schedule by the Engineer.

Q. Review and acceptance of the construction progress schedule, and related reports, by the Engineer is advisory only and shall not relieve the Contractor of the responsibility for accomplishing the Work within the contract completion date. Omissions and errors in the construction progress schedule, and related reports shall not excuse performance less than that required by the Contract and in no way make the Engineer an insurer of the Contractor's success or liable for time or cost overruns flowing from any shortcomings in the construction progress schedule, and related reports.

1.05 SUBMITTAL REQUIREMENTS

A. Schedule: Submit final progress schedule in accordance with the General Conditions.

B. For preliminary and final submittal of construction progress schedule and subsequent revisions thereof furnish three copies to Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTALS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Description of Requirements

B. Submittal Procedures

C. Specific Submittal Requirements

D. Action on Submittals

E. Submittal Identification System

F. Resubmittal Review

1.02 DESCRIPTION OF REQUIREMENTS

A. This section specifies procedural requirements for shop Drawings, product data, samples, and other miscellaneous Work-related submittals.

B. Procedures concerning items such as listing of manufacturers, suppliers, subcontractors, construction progress schedule, schedule of Shop Drawing submissions, bonds, payment applications, insurance certificates, and schedule of values are specified elsewhere.

C. A general summary of the format and types of submittals required is as follows:

Format of Submittal	Type of Submittal
digital and hard copy	Construction Schedule
digital and hard copy	Schedule of Payment Items
digital	Shop Drawings
digital and hard copy	Warranties
digital or hard copy	Certificates
actual samples	Product Samples

digital	Preliminary O&M Manuals
digital and hard copy	Final O&M Manuals
digital	Photographs

D. At the preconstruction conference, submit a detailed list of items for which shop drawings, construction drawings, and samples will be submitted. Included in this list shall be the names of all proposed Suppliers furnishing specified items. Review of this list by the Engineer shall not relieve Contractor from submitting complete drawings and data and providing materials, equipment, etc., fully in accordance with the Contract Documents.

E. All submittals shall be submitted in digital, electronic, pdf format, other than samples. When hard copies are required, as noted above, submit the number of copies as noted herein. For all digital submittals, the Contractor shall submit one electronic copy to the Engineer via email or approved file share site. The Engineer will return one electronic file of each submittal with engineer's stamp and response comments via email or approved file share site with notification to the Contractor and Owner via e-mail. The Contractor shall be responsible to distribute the submittal response as needed to subcontractors impacted by each individual submittal. In the case of samples, an electronic submittal transmittal shall still be made with a description of the sample submitted with all samples delivered to an address approved by the Owner.

F. All graphical and textual-type submittals and documentation including operation and maintenance manuals shall be rendered and submitted in PDF format via email in the latest version of Microsoft Word or Adobe Acrobat Reader format or equivalent browser-based format. Graphical images shall be JPEG or equivalent browser-based formats.

G. Work-Related Submittals:

1. Substitution or "Or Equal" Items:

    a. Includes material or equipment Contractor requests Engineer to accept, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of particular supplier.

2. Shop Drawings:

    a. Includes technical data and drawings specially prepared for this Project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form.

b. Standard information prepared without specific reference to the Project is not considered a Shop Drawing.

3. Product Data:

a. Includes standard printed information on manufactured products, and systems that has not been specially prepared for this Project, including manufacturer's product specifications and installation instructions, catalog cuts, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.

4. Samples:

a. Includes both fabricated and manufactured physical examples of materials, products, and units of work, partial cuts of manufactured or fabricated work, swatches showing color, texture, and pattern, and units of work to be used for independent inspection and testing.

b. Mock-ups are special forms of samples which are too large or otherwise inconvenient for handling in manner specified for transmittal of sample submittals.

5. Working Drawings:

a. When used in the Contract Documents, the term “working drawings” shall be considered to mean the Contractor’s plans for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities control systems, forming and falsework for underpinning; temporary by-pass pumping and for such other work as may be required for construction but does not become an integral part of the project.

b. Copies of working drawings shall be submitted to the Engineer at least fourteen (14) calendar days (unless otherwise specified by the Engineer) in advance of the required work.

c. Working drawings shall be signed by a registered Professional Engineer currently licensed to practice in the State of Florida and shall convey, or be accompanied by, calculation or other sufficient information to completely explain the structure, machine, or system described and its intended manner of use.

H. Miscellaneous Submittals:

1. Work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance

agreements, Operating and Maintenance Manuals, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, and similar information, devices, and materials applicable to the Work.

1.03 SUBMITTAL PROCEDURES

A. Scheduling:

1. Submit for approval, a preliminary schedule of shop drawings and samples submittals, in duplicate, and in accordance with the General Conditions.

2. Prepare and transmit each submittal to Engineer sufficiently in advance of scheduled performance of related work and other applicable activities.

B. Coordination:

1. Coordinate preparation and processing of submittals with performance of work. Coordinate each submittal with other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.

2. Coordinate submission of different units of interrelated work so that one submittal will not be delayed by Engineer's need to review a related submittal. Engineer may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

C. Submittal Preparation:

1. Stamp and sign each submittal certifying to review of submittal, verification of products, field measurement, field construction criteria, coordination of information within submittal with requirements of the Work and the Contract Documents, coordination with all trades, and verification that product will fit in space provided.

2. Transmittal Form: In the transmittal form forwarding each specific submittal to the Engineer include the following information as a minimum.

a. Date of submittal and dates of previous submittals containing the same material.

b. Project title and number.

c. Submittal and transmittal number.

d. Contract identification.

e. Names of:

1) Contractor

2) Supplier

3) Manufacturer

f. Identification of equipment and material with equipment identification numbers, model numbers, and Specification section number.

g. Variations from Contract Documents and any limitations which may impact the Work.

h. Drawing sheet and detail number as appropriate.

D. Resubmittal Preparation:

1. Comply with the requirements described in Submittal Preparation. In addition:

a. Identify on transmittal form that submittal is a resubmission.

b. Make any corrections or changes in submittals required by Engineer's notations on returned submittal.

1) Respond to Engineer's notations:

a) On the transmittal or on a separate page attached to Contractor's resubmission transmittal, answer or acknowledge in writing all notations or questions indicated by Engineer on Engineer's transmittal form returning review submission to Contractor.

b) Identify each response by question or notation number established by Engineer.

c) If Contractor does not respond to each notation or question, resubmission will be returned without action by Engineer until Contractor provides a written response to all Engineer's notations or questions.

2) Contractor initiated revisions or variations:

a) On transmittal form identify variations or revisions from previously reviewed submittal, other than those called for by Engineer.

b) Engineer's responsibility for variations or revisions is established in the General Conditions.

1.04 SPECIFIC SUBMITTAL REQUIREMENTS

A. Specific submittals required for individual elements of work are specified in the individual Specification sections. Except as otherwise indicated in Specification sections, comply with requirements specified herein for each indicated type of submittal.

B. Requests for Substitution or "Or Equal"

1. Collect data for items to be submitted for review as substitution into one submittal for each item of material or equipment in accordance with the General Conditions.

2. Submit with other scheduled submittals for the material or equipment allowing time for Engineer to evaluate the additional information required to be submitted.

3. If Contractor requests to substitute for material or equipment specified but not identified in Specifications as requiring submittals, schedule substitution submittal request in Submittal schedule and submit as scheduled.

C. Shop Drawings:

1. Check all drawings, data and samples before submitting to the Engineer for review. Each and every copy of the drawings and data shall bear Contractor's stamp showing that they have been so checked. Shop drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. All shop drawings shall be submitted through the Contractor, including those from any subcontractors.

2. Submit newly prepared information, with graphic information at accurate scale. Indicate name of manufacturer or supplier (firm name). Show dimensions and clearly note which are based on field measurement; identify materials and products which are included in the Work; identify revisions. Indicate compliance with standards and notation of coordination requirements with other work. Highlight, encircle or otherwise indicate variations from Contract Documents or previous submittals.

3. Include on each drawing or page:

a. Submittal date and revision dates.

b. Project name, division number and descriptions.

c. Detailed specifications section number and page number.

d. Identification of equipment, product or material.

e. Name of Contractor and Subcontractor.

f. Name of Supplier and Manufacturer.

g. Relation to adjacent structure or material.

h. Field dimensions clearly identified.

i. Standards or Industry Specification references.

j. Identification of deviations from the Contract Documents.

k. Contractor's stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.

l. Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.

4. Provide 8-inch by 3-inch blank space for Contractor and Engineer stamps.

5. Submittals:

a. Submit 1 PDF.

6. Distribution:

a. Do not proceed with installation of materials, products or systems until copy of applicable product data showing only approved information is in possession of installer.

b. Maintain one set of product data (for each submittal) at Project site.

c. Mark 5 additional copies with the date of approval and forward to the Engineer for use in field and for Owner's records.

D. Product Data:

1. Preparation:

a. Collect required data into single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on Project or are not included in submittal, mark copies to clearly show such information is not applicable.

b. Where product data must be specially prepared for required products, materials or systems, because standard printed data are not suitable for use, submit data as a Shop Drawing and not as product data.

2. Submittals:

a. Submittal is for information and record, and to determine that products, materials, and systems comply with Contract Documents. Submittal is final when returned by Engineer marked "Furnish as Submitted" or "Furnish as Corrected".

b. Submit 3 copies.

3. Distribution:

a. Do not proceed with installation of materials, products or systems until copy of applicable product data showing only approval information is in possession of installer.

b. Maintain one set of product data (for each submittal) at Project site, available for reference by Engineer and others.

c. Make 3 additional copies with the date of approval and forward to the Engineer for use in field and for Owner records.

E. Samples:

1. Preparation:

a. Where possible, provide samples that are physically identical with proposed materials or products to be incorporated into the Work. Where variations in color, pattern or texture are inherent in material or product represented by sample, submit multiple units (not less than 3 units) showing approximate limits of variations.

b. Provide full set of optional samples where Engineer's selection required. Prepare samples to match Engineer's selection where so indicated.

c. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards.

d. Submit samples for Engineer's visual review of general generic kind, color, pattern, texture, and for final check of coordination of these characteristics with other related elements of work.

2. Submittals:

a. At Contractor's option, and depending upon nature of anticipated response from Engineer, initial submittal of samples may be either preliminary or final submittal.

b. A preliminary submittal, consisting of a single set of samples, is required where specifications indicate Engineer's selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with Engineer's "Action" marking.

c. Final Submittals: Submit 3 sets of samples in final submittal, 1 set will be returned.

3. Distribution:

a. Maintain returned final set of samples at Project site, in suitable condition and available for quality control comparisons throughout course of performing work.

b. Returned samples intended or permitted to be incorporated in the Work are indicated in Specification sections, and shall be in undamaged condition at time of use.

F. Mock-Ups:

1. Mock-ups and similar samples specified in Specification sections are recognized as special type of samples. Comply with samples submittal requirements to greatest extent possible. Process transmittal forms to provide record of activity.

G. Miscellaneous Submittals:

1. Inspection and Test Reports:

a. Classify each inspection and test report as being either "Shop Drawings" or "product data", depending on whether report is specially prepared for Project or standard publication of workmanship control testing at point of production. Process inspection and test reports accordingly.

2. Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds:

a. Refer to Specification sections for specific requirements. Submittal is final when returned by Engineer marked "Approved" or "Approved as Noted".

b. In addition to copies desired for Contractor's use, furnish 2 executed copies. Provide 2 additional copies where required for maintenance data.

3. Survey Data:

    a. Refer to Specification sections for specific requirements on property surveys, building or structure condition surveys, field measurements, quantitative records of actual Work, damage surveys, photographs, and similar data required by Specification sections. Copies will not be returned.

        1) Survey Copies: Furnish 2 copies.

        2) Provide 10 copies of final property survey (if any).

        3) Condition Surveys: Furnish 2 copies.

4. Certifications:

    a. Refer to Specification sections for specific requirement on submittal of certifications. Submit 7 copies. Certifications are submitted for review of conformance with specified requirements and information. Submittal is final when returned by Engineer marked "Approved".

5. Closeout Submittals:

    a. Refer to Specification Section 01 77 00 for specific requirements on submittal of closeout information, materials, tools, and similar items.

        1) Record Documents: Section 01 77 00.

        2) Materials and Tools: Spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

        3) Operating and maintenance data.

H. Operation and Maintenance Manuals:

1. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.

I. General Distribution:

1. Unless required elsewhere, provide distribution of submittals to subcontractors, suppliers, governing authorities, and others as necessary for proper performance of work.

1.05 ACTION ON SUBMITTALS

A. Engineer's Action:

1. General:

    a. Except for submittals for record and similar purposes, where action and return on submittals are required or requested, Engineer will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, Engineer will also advise Contractor without delay.

    b. Engineer will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

B. Action Stamp:

    1. Furnish as Submitted (FAS):

        a. Final Unrestricted Release: Where submittals are marked "Furnish as Submitted", Work covered by submittal may proceed provided that it complies with the Contract Documents. Acceptance of Work will depend upon that compliance.

    2. Furnish as Corrected (FAC):

        a. When submittals are marked "Furnish as Corrected", Work covered by submittal may proceed provided that it complies with both Engineer's notations and corrections and with the Contract Documents. Acceptance of Work will depend on that compliance. Re-submittal is not required, except where Engineer's notations require it.

    3. Revise and Resubmit (R&R):

        a. When submittals are marked "Revise and Resubmit", do not proceed with Work covered by submittal. Do not permit Work covered by submittal to be used at Project site or elsewhere where Work is in progress.

        b. Revise submittal or prepare new submittal in accordance with Engineer's notations and corrections and Part 1.03.D. of this section. A complete resubmittal shall be prepared. Submission of partial resubmittals is not acceptable. Resubmit submittal without delay. Repeat if necessary to obtain different action marking.

    4. Receipt Acknowledged (RA):

        a. Information included in submittal conforms to the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to this submittal, and the Work covered by the submittal may

proceed, and products with submittals with this disposition may be shipped or operated, as applicable.

b. Information included in submittal is for Project record purposes and does not require Engineer's review or approval.

5. Rejected (R):

a. Information included in submittal does not conform to the applicable requirements of the Contract Documents and is unacceptable. Contractor shall submit products and materials as specified in the Contract Documents or provide required information for substitution as specified in the Contract Documents for consideration by Engineer.

1.06 SUBMITTAL IDENTIFICATION SYSTEM

A. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.

1. Submittal Number: Shall be separate and unique number correlating to each individual submittal required. Assign submittal numbers as follows:

a. First part of submittal number shall be the applicable Specification Section number, followed by a hyphen.

b. Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal furnished under the associated Specifications Section.

c. Typical submittal number for the third submittal furnished for Section 40 05 19, Ductile Iron Pipe, would be "40 05 19-003".

2. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:

a. "A" = Initial (first) submittal.

b. "B" = Second submittal (e.g., first re-submittal).

c. "C" = Third submittal (e.g., second re-submittal).

3. Examples:

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third submittal provided under Section 40 05 19, Ductile Iron Pipe	40 05 19-003-	A
Second review cycle (first re-submittal) of third submittal provided under Section 40 05 19, Ductile Iron Pipe	40 05 19-003-	B

1.07 RE-SUBMITTAL REVIEW

A. Cost of Subsequent Reviews: Shop Drawings and Operation and Maintenance Manuals submitted for each item will be reviewed no more than twice. 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 including all direct and indirect costs and fees. Reimburse the Owner for all such fees invoiced to the Owner by the Engineer.

B. Time Extension: Any need for more than one resubmission, or any other delay in Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 42 00

REFERENCE STANDARDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Abbreviations and Symbols

Reference Standards

B. Definitions

Owner-approved Materials List

C. Owner's Standards

Owner's Design Manual

1.02 RELATED SECTIONS

A. Information provided in this section is used where applicable in individual Specification Sections, Divisions 02 through 46.

1.03 REFERENCE ABBREVIATIONS

A. Reference to a technical society, trade association or standards setting organization, may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	Association of Home Appliance Manufacturers

AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders' Hardware Manufacturers Association
BIA	Brick Institute of American
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRD	U.S. Corps of Engineers Specifications
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation Fed. Spec. Federal Specifications
FGMA	Flat Glass Marketing Association

FM	Factory Mutual
HMI	Hoist Manufacturing Institute
HPMA	See HPVA
HPVA	Hardwood Plywood Veneer Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NBS	National Bureau of Standards, See NIST
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NFPA	National Fluid Power Association
NIST	National Institute of Standards and Technology
NLMA	National Lumber Manufacturers Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPI	Society of the Plastics Industry

SSPC	Steel Structures Painting Council
STI	Steel Tank Institute
TCA	Tile Council of American
TIMA	Thermal Insulation Manufacturers' Association
UL	Underwriters' Laboratories, Inc.
USBR	U. S. Bureau of Reclamation
USBS	U. S. Bureau of Standards, See NIST

1.04 REFERENCE STANDARDS

A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes.

B. References herein to "Building Code" shall mean the Florida Building Code (FBC). The latest edition of the code as approved and used by the local agency as of the date of the opening of bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

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

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

E. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

F. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. Latest Edition: Construe references to furnishing materials or testing, which conform to the standards of a particular technical society, organization, or body, to mean the latest standard, code, or specification of that body, adopted and published as of the date of bidding this Contract. Standards referred to herein are made a part of these Specifications to the extent which is indicated or intended.

H. Precedence: The duties and responsibilities of the Owner, Contractor, or Engineer, or any of their consultants, agents or employees are set forth in the Contract

Documents and are not changed or altered by any provision of any referenced standard specifications, manuals or code, whether such standard manual or code is or is not specifically incorporated by reference in the Contract Documents. Any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority, to undertake responsibility contrary to the powers of the Engineer as set forth in the Contract Documents cannot be assigned to the Engineer or any of the Engineer's consultants, agents or employees.

1.05 DEFINITIONS

A. In these Contract Documents the words furnish, install, and provide are defined as follows:

1. Furnish (Materials): to supply and deliver to the project ready for installation and in operable condition.

Install (services or labor): to place in final position, complete, anchored, connected in operable condition.

2. Provide: to furnish and install complete. Includes the supply of specified services. When neither furnish, install or provide is stated, provided is implied.

B. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

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

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

1.06 OWNER-APPROVED MATERIALS LIST

A. The Contractor shall refer to and comply with the most recent Approved Materials List, as of the date of the advertisement for these Contract Documents.

1.07 OWNER'S STANDARD DETAILS

A. The Contractor shall refer to the Owner's most recent version of their Standard Details, as of the date of the advertisement for these contract documents.

1.08 OWNER'S DESIGN MANUAL

A. The Contractor shall refer to the most recent Owner Design Manual, as of the date of the advertisement for these contract documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 13
ABBREVIATIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Abbreviations

B. Standards for Abbreviations

1.02 RELATED SECTIONS

A. Abbreviations provided in this section are used where applicable in individual Specification Sections, Divisions 02 through 46.

1.03 ABBREVIATIONS

A. Abbreviations which may be used for units of measure are as follows:

alternating current.....AC

American wire gauge .....AWG

ampere(s) ..... amp

ampere-hour(s) ..... AH

annual..... ann

Ampere Interrupting Capacity…….AIC

atmosphere(s) ..... atm

average ..... avg

biochemical oxygen demand ..... BOD

Board Foot..... FBM

brake horsepower ..... bhp

Brinell Hardness ..... BH

British thermal unit(s).....Btu

calorie (s).....cal

carbonaceous biochemical oxygen demand ..... CBOD

Celsius (centigrade)..... C

Center to Center ..... C to C

centimeter(s)..... cm

chemical oxygen demand ..... COD

coefficient, valve flow..... C_v

cubic ..... cu

cubic centimeter(s)..... cc

cubic feet per day..... cfd

cubic feet per hour ..... cfh

cubic feet per minute..... cfm

cubic feet per minute, standard conditions…….. scfm

cubic feet per second ..... cfs
cubic foot (feet) ..... cu ft
cubic inch(es) ..... cu in
cubic yard(s) ..... cu yd
decibels..... dB
decibels (A scale)..... dBa
degree(s).....deg
dewpoint temperature .....dpt
diameter ..... dia
direct current ..... dc
dissolved oxygen..... DO
dissolved solids .....DS
dry-bulb temperature.....dbt

efficiency.....eff
elevation..... el
entering water temperature.....ewt
entering air temperature ..... eat
equivalent direct radiation ..... edr

face area ..... fa
face to face..... f to f
Fahrenheit ..... F
feet per day..... fpd
feet per hour ..... fph
feet per minute..... fpm
feet per second ..... fps
foot (feet) ..... ft
foot-candle..... fc
foot-pound ..... ft-lb
foot-pounds per minute..... ft-lb/min
foot-pounds per second .....ft-lb/sec
formazin turbidity unit(s) ..... FTU
frequency..... freq

gallon(s)..... gal
gallons per day ..... gpd
gallons per day per cubic foot.....gpd/cu ft
gallons per day per square foot.....gpd/sq ft
gallons per hour ..... gph
gallons per minute ..... gpm
gallons per second ..... gps
gas chromatography and
mass spectrometry ..... GC-MS
gauge ..... ga
grain(s) ..... gr
gram(s) ..... g
grams per cubic centimeter .....gm/cc

Heat Transfer Coefficient.....U
height..... hgt
Hertz..... Hz
horsepower..... hp
horsepower-hour .....hp-hr
hour(s) ..... hr
humidity, relative..... rh
hydrogen ion concentration .....pH

inch(es)..... in

inches per second .....ips
inside diameter .....ID

Jackson turbidity unit(s) ..... JTU

kelvin..... K
kiloamperes..... kA
kilogram(s) ..... kg
kilometer(s) ..... km
kilovar (kilovolt-amperes reactive) ... kvar
kilovolt(s)..... kV
kilovolt-ampere(s)..... kVA
kilowatt(s).....kW
kilowatt-hour(s) .....kWh

linear foot (feet)..... lin ft
liter(s) L

megavolt-ampere(s) ..... MVA
meter(s).....m
micrograms per liter ..... ug/L
miles per hour .....mph
milliampere(s) ..... mA
milligram(s) ..... mg
milligrams per liter ..... mg/L
milliliter(s)..... mL
millimeter(s) ..... mm
million gallons ..... MG
million gallons per day..... mgd

millisecond(s) ..... ms
millivolt(s) ..... mV
minute(s) ..... min

mixed liquor suspended solid..... MLSS

nephelometric turbidity unit ..... NTU
net positive suction head.....NPSH
noise criteria..... nc
noise reduction coefficient..... NRC
number.....no

ounce(s) ..... oz
outside air .....oa
outside diameter ..... OD

parts per billion..... ppb
parts per million..... ppm
percent ..... pct
phase (electrical) ..... ph
pound(s) ..... lb
pounds per cubic foot ..... pcf
pounds per cubic foot per hour ..... pcf/hr
pounds per day..... lbs/day
pounds per day per cubic foot .....lbs/day/cu ft
pounds per day per square foot.. lbs/day/sq ft
pounds per square foot..... psf
pounds per square foot per hour ..... psf/hr

Jackson turbidity unit(s) ..... JTU

kelvin..... K
kiloamperes..... kA
kilogram(s) ..... kg
kilometer(s) ..... km
kilovar (kilovolt-amperesreactive) .... kvar
kilovolt(s)..... kV
kilovolt-ampere(s)..... kVA
kilowatt(s).....kW
kilowatt-hour(s) .....kWh

linear foot (feet)..... lin ft
liter(s) L

megavolt-ampere(s) ..... MVA
meter(s).....m
micrograms per liter ..... ug/L
miles per hour .....mph
milliampere(s) ..... mA
milligram(s) ..... mg
milligrams per liter ..... mg/L
milliliter(s)..... mL
millimeter(s) ..... mm
million gallons ..... MG
million gallons per day..... mgd
millisecond(s) ..... ms
millivolt(s) ..... mV
minute(s) ..... min

mixed liquor suspended solids..... MLSS

nephelometric turbidityunit ..... NTU
net positive suction head.....NPSH
noise criteria..... nc
noise reduction coefficient..... NRC
number.....no

ounce(s) ..... oz
outside air .....oa
outside diameter ..... OD

parts per billion..... ppb
parts per million..... ppm
percent ..... pct
phase (electrical) .... ph
pound(s) ..... lb
pounds per cubic foot ..... pcf
pounds per cubic foot per hour ….. pcf/hr
pounds per day..... lbs/day
pounds per day per
cubic foot ……lbs/day/cu ft
pounds per day per
square foot..... lbs/day/sq ft
pounds per square foot..... psf
pounds per square foot
per hour ..... psf/hr
pounds per square inch ..... psi

pounds per square inch absolute.....psia

pounds per square inch gauge .....psig

power factor.....PF

pressure drop or difference..... dp

pressure, dynamic (velocity) ..... vp

pressure, vapor..... vap pr

quart(s) ..... qt

Rankine ..... R

relative humidity..... rh

resistance ..... res

return air ..... ra

revolution(s)..... rev

revolutions per minute ..... rpm

revolutions per second..... rps

root mean squared..... rms

safety factor ..... sf

second(s)..... sec

shading coefficient..... SC

sludge density index ..... SDI

Sound Transmission Coefficient.....STC

specific gravity ..... sp gr

specific volume ..... Sp Vol

sp ht at constant pressure ..... Cp

square ..... sq

square centimeter(s).....sq cm

square foot (feet)..... sq ft

square inch (es) ..... sq in

square meter(s)..... sq m

square yard(s) ..... sq yd

standard ..... std

static pressure.....st pr

supply air..... . . sa

suspended solids ..... SS

temperature..... temp

temperature difference ..... TD

temperature entering..... TE

temperature leaving ..... TL

thousand Btu per hour..... Mbh

thousand circular mils ..... kcmil

thousand cubic feet..... Mcf

threshold limit value ..... TLV

tons of refrigeration ..... tons

Torque..... TRQ

total dissolved solids ..... TDS

total dynamic head ..... TDH

total kjeldahl nitrogen ..... TKN

total oxygen demand..... TOD

total pressure ..... TP

total solids ..... TS

total suspended solids..... TSS

total volatile solids ..... TVS

vacuum ..... vac

viscosity ..... visc

volatile organic compounds .....VOC

volatile solids.....VS

volatile suspended solids.....VSS

volt(s) V

volts-ampere(s) ..... VA

volume ..... vol

watt(s) ..... W

watthour(s) ..... Wh

watt-hour demand .....WHD

watt-hour demand meter ..... WHDM

week(s) .....wk

weight ..... wt

wet-bulb ..... WB

wet bulb temperature ..... WBT

yard(s)..... yd

year(s).....yr

B. STANDARD FOR ABBREVIATIONS

1. Use A S M E Y1.1-1989, "Abbreviations for use on Drawings and in Text" for abbreviations for units of measure not included in Paragraph 1.3.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 43 00
QUALITY CONTROL

PART 1 – PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals

B. Inspection Services

C. Inspection of Materials

D. Quality Control

E. Costs of Inspection

F. Acceptance Tests

G. Failure to Comply with Contract

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittals: Specific Submittal Requirements

1.03 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 01.

B. Certificate Submittals: Furnish the Engineer authoritative evidence in the form of Certificates of Manufacture that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

1.04 INSPECTION SERVICES

A. Owner's Access: At all times during the progress of the Work and until the date of final completion, afford the Owner and Engineer every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the Contractor of any obligations to perform proper and satisfactory work as specified. Replace work rejected due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, with satisfactory work at no additional cost to the Owner. Replace as directed,

finished or unfinished work found not to be in strict accordance with the Contract, even though such work may have been previously approved and payment made therefore.

B. Rejection: The Owner and the Owner's Authorized Representatives have the right to reject materials and workmanship which are defective or require correction. Promptly remove rejected work and materials from the site.

C. Inferior Work Discoveries: Failure or neglect on the part of the Owner or the Owner's Authorized Representatives to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the Owner or the Owner's Authorized Representatives at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.

D. Removal for Examination: Should it be considered necessary or advisable by the Owner or the Owner's Authorized Representatives, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, promptly furnish all necessary facilities, labor, and material, to make such an examination. If such Work is found to be defective in any respect, defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.

E. Operation Responsibility: Assume full responsibility for the proper operation of equipment during tests and instruction periods. Make no claim for damage which may occur to equipment prior to the time when the Owner accepts the Work.

F. Rejection Prior to Warranty Expiration: If at anytime prior to the expiration of any applicable warranties or guarantees, equipment is rejected by the Owner, repay to the Owner all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices, and upon the receipt of the sum of money, Owner will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. Do not remove the equipment from the premises of the Owner until the Owner obtains from other sources, equipment to take the place of that rejected. The Owner hereby agrees to obtain other equipment within a reasonable time and the Contractor agrees that the Owner may use the equipment furnished by the Contractor without rental or other charge until the other new equipment is obtained.

1.05 INSPECTION OF MATERIALS

A. Premanufacture Notification: Give notice in writing to the Engineer sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice to include a request for inspection, the date of commencement, and

B. the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, Engineer will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify Contractor that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. Comply with these provisions before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

C. Testing Standards: Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized, applicable test codes except as may otherwise be stated herein.

1.06 QUALITY CONTROL

A. Testing

1. Field and Laboratory

a. Provide personnel to assist the Engineer in performing the following periodic observation and associated services.

1) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.

2) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by Engineer.

3) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.

b. When specified in Divisions 0 2 through 46 of the Contract Documents, provide an independent laboratory testing facility to perform required testing. Qualify the laboratory as having performed previous satisfactory work. Prior to use, submit to the Engineer for approval.

c. Cooperate with the Engineer and laboratory testing representatives. Provide at least 24 hours notice prior to when specified testing is required. Provide labor and materials, and necessary facilities at the site as required by the Engineer and the testing laboratory.

d. Provide an independent testing agency, a member of the National Electrical Testing Association, to perform inspections and tests specified in Division 26 of these Specifications.

2. Equipment: Coordinate and demonstrate test procedures as specified in the Contract Documents or as otherwise required during the formal tests.

3. Pipeline and Other Testing: Conform to test procedures and requirements specified in the appropriate Specification Section.

B. Reports

1. Certified Test Reports: Where transcripts or certified test reports are required by the Contract Documents, meet the following requirements:

a. Before delivery of materials or equipment submit and obtain approval of the Engineer for all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents. Perform all testing in an approved independent laboratory or the manufacturer's laboratory. Submit for approval reports of shop equipment tests within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.

2. Certificate of Compliance: At the option of the Engineer, or where not otherwise specified, submit for approval a notarized Certificate of Compliance. The Certificates may be in the form of a letter stating the following:

a. Manufacturer has performed all required tests

b. Materials to be supplied meet all test requirements

c. Tests were performed not more than one year prior to submittal of the certificate

d. Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified

e. Identification of the materials

1.07 COSTS OF INSPECTION

A. Owner's Obligation: Initial inspection and testing of materials furnished under this Contract will be performed by the C o n t r a c t o r . If subsequent testing is necessary due to failure of the initial tests or because of rejection for non-compliance, the Contractor shall perform these tests at no cost to the Owner.

B. Contractor's Obligation: Include in the Contract Price, the cost of all shop and field tests of equipment and other tests specifically called for in the Contract Documents.

C. Reimbursements to Owner:

1. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Owner for compliance. Reimburse the Owner for expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.

2. Reimburse Owner for the costs of any jobsite inspection between the hours of 7:00 p.m. and 6:00 a.m.

3. Reimburse Owner for all costs associated with Witness Tests which exceed 5 Calendar Days per kind of equipment.

1.08 ACCEPTANCE TESTS

A. Preliminary Field Tests: As soon as conditions permit, furnish all labor and materials and services to perform preliminary field tests of all equipment provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.

B. Final Field Tests: Upon completion of the Work and prior to final payment, subject all equipment, piping and appliances installed under this Contract to specified acceptance tests to demonstrate compliance with the Contract Documents.

1. Furnish all labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests.

2. Conduct field tests in the presence of the Engineer. Perform the field tests to demonstrate that under all conditions of operation each equipment item:

a. Has not been damaged by transportation or installation

b. Has been properly installed

c. Has been properly lubricated

d. Has no electrical or mechanical defects

e. Is in proper alignment

f. Has been properly connected

g. Is free of overheating of any parts

h. Is free of all objectionable vibration

i. Is free of overloading of any parts

j. Operates as intended

C. Failure of Tests: If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the Owner, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the Contractor to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

1.09 FAILURE TO COMPLY WITH CONTRACT

A. Unacceptable Materials: If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, do not deliver said material or equipment, or if delivered remove it promptly from the site or from the Work and replace it with acceptable material without additional cost to the Owner. Fulfill all obligations under the terms and conditions of the Contract even though the Owner or the Owner's Authorized Representatives fail to ascertain noncompliance or notify the Contractor of noncompliance.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 57 00
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. General Requirements

B. Temporary Utilities

C. Temporary Construction

D. Barricades and Enclosures

E. Fences

F. Security

G. Temporary Controls

H. Traffic Regulation

I. Contractor's Field Offices and Sheds

J. Engineer's Field Office

1.02 GENERAL REQUIREMENTS

A. Plant and Facilities: Furnish, install, maintain and remove all false work, scaffolding, ladders, hoistways, braces, pumping plants, shields, trestles, roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the work, and which are not herein described or specified in detail. The Contractor shall accept responsibility for the safety and efficiency of such works and for any damage that may result from their failure or from their improper construction, maintenance or operation.

B. First Aid: Maintain a readily accessible, completely equipped first aid kit at each location where work is in progress.

C. Safety Responsibility: Accept sole responsibility for safety and security at the site. Indemnify and hold harmless the Owner and the Owner's Authorized Representatives, including the Engineer, for any safety violation, or noncompliance with governing bodies and their regulations, and for accidents, deaths, injuries, or damage at the site during occupancy or partial occupancy of the site by Contractor's forces while performing any part of the Work.

D. Hazard Communication: Furnish two copies of the Contractor's Hazard Communication Program required under OSHA regulations before beginning on site activities. Furnish two copies of amendments to Hazard Communications Program as they are prepared.

1.03 TEMPORARY UTILITIES

A. General: It shall be Contractor's responsibility to provide temporary utilities that are adequate for the performance of the Work under this Contract within the time specified.

1. All temporary utilities shall be kept in satisfactory operating condition, capable of safely and efficiently performing the required function, and are subject to inspection and approval by Owner at any time for the duration of the Contract. All Work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

2. The Contractor shall coordinate and install all temporary services in accordance with the requirements of the utility companies having jurisdiction and as required by applicable codes and regulations.

3. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges, maintenance, relocation and removal shall be borne by the Contractor at no additional cost to the Owner.

B. Water: Provide all necessary and required water for Contractor's use during construction without additional cost. If necessary, provide and lay water lines to the place of use; secure all necessary permits; pay for all taps to water mains and hydrants and for all water used at the established rates.

1. For continuous potable water use, potable water may be obtained through connection to an existing potable water line, with the Owner's approval. However, the Contractor shall install a temporary water meter obtained from the Owner. Contractor shall pay all connection fees, service fees, taxes, and consumption costs. Consumption costs shall be based on monthly readings of the water meter. Charges shall be paid directly to Owner on the water account established by the Contractor.

2. Water Connections: Contractor shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission of Owner. For each such connection made, Contractor shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter as obtained from the Owner to set up a new water supply account.

C. Light and Power: Provide, without additional cost to the Owner, all necessary power required for Contractor's operations and to perform the Work within these Contract Documents. Contractor shall provide and maintain temporary lighting and power facilities required for the

proper construction and inspection of the Work. If, in the Engineer's opinion, these facilities are inadequate, do not proceed with any portion of the Work affected thereby. Maintain temporary lighting and power until the Work is accepted.

1. Source: Power shall be obtained through temporary power meter(s) from the local power company and CONTRACTOR shall pay all connection fees, service fees, taxes, and consumption costs based on monthly meter readings by the power company.

2. Construction Lighting: All WORK conducted at night or under conditions of insufficient day light shall be suitably lighted to ensure proper WORK and to afford adequate facilities for inspection and safe working conditions.

3. Approval of Electrical Connection: All temporary connections for electricity shall be subject to approval by Owner and the power company representative and shall be removed in like manner at Contractor's expense prior to final acceptance of the WORK.

4. Separation of Circuits: Unless otherwise permitted by the ENGINEER, separate lighting circuits from power circuits.

5. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Standards for Construction.

D. Heat: Provide temporary heat, whenever required, for work being performed during cold weather to prevent freezing of concrete, water pipes, and other damage to the Work or existing facilities.

E. Sanitary Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Use of Owner facilities for general construction personnel is not allowed. Portable toilets which do not have hand washing facilities located within the unit shall have an operable hand sanitizer dispenser containing sanitation liquid affixed to the inside of the unit or immediately adjacent to the unit. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Regulations for Construction. Each contractor shall rigorously prohibit the committing of nuisances within, on, or about the work. CONTRACTOR shall pay all associated installation, removal, and periodic cleanout fees for portable units installed.

F. Connections to Existing Utilities:

1. Unless otherwise specified or indicated, make all necessary connections to existing facilities including structures, drain lines, and utilities such as water,

sewer, gas, telephone, and electricity. In each case, obtain permission from the Owner or the owning utility prior to undertaking connections. Protect facilities against deleterious substances and damage.

2. Thoroughly plan in advance all connections to existing facilities. Have on hand at the time of undertaking the connections, all material, labor and required equipment. Proceed continuously to complete connections in minimum time. Arrange for the operation of valves or other appurtenances on existing utilities, under the direct supervision of the owning utility.

1.04 TEMPORARY CONSTRUCTION

A. Bridges: Design and place suitable temporary bridges where necessary for the maintenance of vehicular and pedestrian traffic. Assume responsibility for the sufficiency and safety of all such temporary work or bridges and for any damage which may result from their failure or their improper construction, maintenance, or operation. Indemnify and save harmless the Owner and the Owner's representatives from all claims, suits or actions, and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.05 BARRICADES AND ENCLOSURES

A. Protection of Workmen and Public: Effect and maintain at all times during the prosecution of the Work, barriers and lights necessary for the protection of Workmen and the Public. Provide suitable barricades, lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the Work causes obstructions to normal traffic, excavation sites, or constitutes in any way a hazard to the public.

B. Barricades and Lights:

1. Protect all streets, roads, highways, excavations and other public thoroughfares which are closed to traffic; use effective barricades which display acceptable warning signs. Locate barricades at the nearest public highway or street on each side of the blocked section.

2. Statutory Requirements: Install and maintain all barricades, signs, lights, and other protective devices within highway rights-of-way in strict conformity with applicable statutory requirements by the authority having jurisdiction.

1.06 FENCES

A. Existing Fences: Obtain written permission from the Owner prior to relocating or dismantling fences which interfere with construction operations. Reach agreements with the fence owner as to the period the fence may be left relocated or dismantled. Install

adequate gates where fencing must be maintained. Keep gates closed and locked at all times when not in use.

B. Restoration: Restore all fences to their original or better condition and to their original location on completion of the Work.

1.07 SECURITY

A. Preservation of Property:

1. Preserve from damage, all property along the line of the Work, in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Preserve from damage, public utilities, trees, lawn areas, building monuments, fences, pipe and underground structures, and public streets. Note: Normal wear and tear of streets resulting from legitimate use by the Contractor are not considered as damage. Whenever damages occur to such property, immediately restore to its original condition. Costs for such repairs are incidental to the Contract.

2. In case of failure on the part of the Contractor to restore property or make good on damage or injury, the Owner may, upon 24 hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the Contractor under this Contract. If removal, repair or replacement of public or private property is made necessary by alteration of grade or alignment authorized by the Owner and not contemplated by the Contract Documents, the Contractor will be compensated, in accordance with the General Conditions, provided that such property has not been damaged through fault of the Contractor or the Contractor's employees.

B. Public Utility Installations and Structures:

1. Public utility installations and structures include all poles, tracks, pipes, wires, conduits, vaults, manholes, and other appurtenances and facilities, whether owned or controlled by public bodies or privately-owned individuals, firms or corporations, used to serve the public with transportation, gas, electricity, telephone, storm and sanitary sewers, water, or other public or private utility services. Facilities appurtenant to public or private property which may be affected by the Work are deemed included hereunder.

2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. Existing public utility installations and structures are indicated on the Drawings only to the extent such information was made available to, or found by, the Engineer in preparing the

Drawings. These data are not guaranteed for completeness or accuracy, and the Contractor is responsible for making necessary investigations to become fully informed as to the character, condition, and extent of all public utility installations and structures that may be encountered and that may affect the construction operations.

3. Contact utility locating service sufficiently in advance of the start of construction to avoid damage to the utilities and delays to the completion date.

4. Remove, replace, relocate, repair, rebuild, and secure any public utility installations and structures damaged as a direct or indirect result of the Work under this Contract. Costs for such work are incidental to the Contract. Be responsible and liable for any consequential damages done to or suffered by any public utility installations or structures. Assume and accept responsibility for any injury, damage, or loss which may result from or be consequent to interference with, or interruption or discontinuance of, any public utility service.

5. Repair or replace any water, electric, sewer, gas, irrigation, or other service connection damaged during the Work with no addition to the Contract price.

6. At all times in performance of the Work, employ proven methods and exercise reasonable care and skill to avoid unnecessary delay, injury, damage, or destruction to public utility installations and structures. Avoid unnecessary interference with, or interruption of, public utility services. Cooperate fully with the owners thereof to that end.

7. Give written notice to the owners of all public utility installations and structures affected by proposed construction operations, sufficiently in advance of breaking ground in any area or on any unit of the Work, to obtain their permission before disrupting the lines and to allow them to take measures necessary to protect their interests. Advise the Chiefs of Police, Fire and Rescue Services of any excavation in public streets or the temporary shut-off of any water main. Provide at least 24 hours notice to all affected property owners whenever service connections are taken out of service.

C. Miscellaneous Structures: Assume and accept responsibility for all injuries or damage to culverts, building foundations and walls, retaining walls, or other structures of any kind met with during the prosecution of the Work. Assume and accept liability for damages to public or private property resulting therefrom. Adequately protect against freezing all pipes carrying liquid.

D. Protection of Trees and Lawn Areas:

1. Protect with boxes, trees and shrubs, except those ordered to be removed. Do not place excavated material so as to cause injury to such trees or shrubs. Replace trees or shrubs destroyed by accident or negligence of the Contractor or Contractor's employees with new stock of similar size and age, at the proper season, at no additional cost to the Owner.

2. Leave lawn areas in as good condition as before the start of the Work. Restore areas where sod has been removed by seeding or sodding.

1.08 TEMPORARY CONTROLS

A. During Construction:

1. Keep the site of the Work and adjacent premises free from construction materials, debris, and rubbish. Remove this material from any portion of the site if such material, debris, or rubbish constitutes a nuisance or is objectionable.

2. Remove from the site all surplus materials and temporary structures when they are no longer needed.

3. Neatly stack construction materials such as concrete forms and scaffolding when not in use. Promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

4. Properly store volatile wastes in covered metal containers and remove from the site daily.

5. Do not bury or burn on the site or dispose of into storm drains, sanitary sewers, streams, or waterways, any waste material. Remove all wastes from the site and dispose of in a manner complying with applicable ordinances and laws.

B. Smoke Prevention:

1. Strictly observe all air pollution control regulations.

2. Open fires will be allowed only if permitted under current ordinances.

C. Noises:

1. Maintain acceptable noise levels in the vicinity of the Work. Limit noise production to acceptable levels by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.

2. Supply written notification to the Owner sufficiently in advance of the start of any work which violates this provision. Proceed only when all applicable authorizations and variances have been obtained in writing.

D. Hours of Operation:

1. Refer to the supplemental conditions section for hours of operation.

2. Do not carry out nonemergency work, including equipment moves, on Sundays without prior written authorization by the Owner. No work shall be performed on holidays or weekends unless otherwise specified or approved.

E. Dust Control:

1. Take measures to prevent unnecessary dust. Keep earth surfaces exposed to dusting moist with water or a chemical dust suppressant. Cover materials in piles or while in transit to prevent blowing or spreading dust.

2. Adequately protect buildings or operating facilities which may be affected adversely by dust. Protect machinery, motors, instrument panels, or similar equipment by suitable dust screens. Include proper ventilation with dust screens.

F. Temporary Drainage Provisions:

1. Provide for the drainage of stormwater and any water applied or discharged on the site in performance of the Work. Provide adequate drainage facilities to prevent damage to the Work, the site, and adjacent property.

2. Supplement existing drainage channels and conduits as necessary to carry all increased runoff from construction operations. Construct dikes as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the Owner's facilities and the Work, and to direct water to drainage channels or conduits. Provide ponding as necessary to prevent downstream flooding.

3. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

G. Pollution: Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. Do not permit sanitary wastes to enter any drain or watercourse other than sanitary sewers. Do not permit sediment, debris, or other substances to enter sanitary sewers. Take reasonable measures to prevent such materials from entering any drain or watercourse.

1.09 TRAFFIC REGULATION

A. Parking: Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Contract, to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.

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

1.10 CONTRACTOR'S FIELD OFFICES AND SHEDS

A. Contractor's Office: Erect, furnish, and maintain a field office with a telephone. Have an authorized agent present at this office at all times while the Work is in progress. Keep readily accessible copies of the Contract Documents, required record documents, and the latest approved shop drawings at this field office.

B. Material Sheds and Temporary Structures: Provide material sheds and other temporary structures of sturdy construction and neat appearance.

C. Location: Coordinate location of field offices, material sheds and temporary structures with Engineer and Owner.

1.11 ENGINEER'S FIELD OFFICE

A. None required.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:

1. Locate temporary systems for proper function and service.

2. Temporary systems shall not interfere with or provide hazards or nuisances to the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

    a. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

    b. Modify and extend temporary systems as required by progress of the Work.

3.02 MAINTENANCE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:

    1. Enforce compliance with Laws and Regulations.

    2. Enforce safe practices.

    3. Prevent abuse of services.

    4. Prevent nuisances and hazards caused by temporary systems and their use.

    5. Prevent damage to finishes.

    6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

D. Contractor shall replace broken and burned out lamps, blown fuses, and damaged wiring and appurtenances as required to maintain adequate and safe operating conditions.

E. Contractor shall permit subcontractors and others at a mutually agreed arrangement to use temporary electrical system that meet the following requirements:

    1. Equipment are suitable for 120 V, single phase, 60 Hz operation.

    2. Operating input does not exceed 1,500 volt-amperes.

    3. Single piece of equipment connected to one outlet.

    4. Contractor shall restrict use of equipment as required to prevent overloading circuits.

3.03 CLOSEOUT ACTIVITIES

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

B. Contractor is responsible for and shall return to original condition those portions of permanent electric system used in completing the Work.

C. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.

D. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

END OF SECTION

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SECTION 01 61 00
MATERIAL AND EQUIPMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Description

B. Substitutions

C. Manufacturer's Written Instructions

D. Transportation and Handling

E. Storage, Protection and Maintenance

F. Manufacturer's Field Quality Control Services

G. Startup

H. Post Startup Services

I. Special Tools and Lubricating Equipment

J. Lubrication

1.02 DESCRIPTION

A. Proposed Manufacturers List: Within 15 calendar days of the date of the Notice to Proceed, submit to the Engineer a list of the names of proposed manufacturers, materialmen, suppliers and subcontractors, obtain approval of this list by Owner prior to submission of any working drawings. Upon request submit evidence to Engineer that each proposed manufacturer has manufactured a similar product to the one specified and that it has previously been used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

B. Furnish and install Material and Equipment which meets the following:

1. Conforms to applicable specifications and standards.

2. Complies with size, make, type, and quality specified or as specifically approved, in writing, by Engineer.

3. Will fit into the space provided with sufficient room for operation and maintenance access and for properly connecting piping, ducts and services, as applicable. Make the clear spaces that will be available for operation and maintenance access and connections equal to or greater than those shown and meeting all the manufacturers' requirements. Make all provisions for installing equipment furnished at no increase in Contract Price.

4. Manufactured and fabricated in accordance with the following:

    a. Design, fabricate, and assemble in accordance with best engineering and shop practices.

    b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

    c. Provide two or more items of same kind identical, by same manufacturer.

    d. Provide materials and equipment suitable for service conditions.

    e. Adhere to equipment capabilities, sizes, and dimensions shown or specified unless variations are specifically approved, in writing, in accordance with the Contract Documents.

    f. Adapt equipment to best economy in power consumption and maintenance. Proportion parts and components for stresses that may occur during continuous or intermittent operation, and for any additional stresses that may occur during fabrication or installation.

    g. Working parts are readily accessible for inspection and repair, easily duplicated and replaced.

5. Use material or equipment only for the purpose for which it is designed or specified.

1.03 SUBSTITUTIONS

A. Substitutions:

1. Contractor's requests for changes in equipment and materials from those required by the Contract Documents are considered requests for substitutions and are subject to Contractor's representations and review provisions of the Contract Documents when one of following conditions are satisfied:

    a. Where request is directly related to an "or equal" clause or other language of same effect in Specifications.

b. Where required equipment or material cannot be provided within Contract Time, but not as result of Contractor's failure to pursue Work promptly or to coordinate various activities properly.

c. Where required equipment or material cannot be provided in manner compatible with other materials of Work, or cannot be properly coordinated therewith.

2. Contractor's Options:

a. Where more than one choice is available as options for Contractor's selection of equipment or material, select option compatible with other equipment and materials already selected (which may have been from among options for other equipment and materials).

b. Where compliance with specified standard, code or regulation is required, select from among products which comply with requirements of those standards, codes, and regulations.

c. "Or Equal": For equipment or materials specified by naming one or more equipment manufacturer and "or equal", submit request for substitution for any equipment or manufacturer not specifically named.

B. Conditions Which are Not Substitution:

1. Requirements for substitutions do not apply to Contractor options on materials and equipment provided for in the Specifications.

2. Revisions to Contract Documents, where requested by Owner or Engineer, are "changes" not "substitutions".

3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute basis for a Change Order, except as provided for in Contract Documents.

C. “Or Equal” Items: Whenever a particular brand or make of material, equipment, or other item is specified, or is indicated on the Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications. Any other brand or make which, in the opinion of the Engineer, is equivalent to that specified or indicated may be offered as a substitute subject to the following provisions:

1. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature, and performance data together with samples of the materials,

where feasible, to enable the Engineer to determine if the proposed substitution is equal.

2. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.

3. A list of installations where the proposed substitution is equal.

4. Where the acceptance of a substitution requires revision or redesign of any part of the Work, all such revision and redesign, and all new Drawings and details required therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to review of the Engineer.

5. In all cases the Engineer shall be the sole judge as to whether a proposed substitution is to be accepted. The Contractor shall abide by the Engineer's decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item, or substitute, as specified. No substitute items shall be used in the Work without written acceptance of the Engineer.

6. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents.

7. The Owner may require, at the Contractor’s expense, a special performance guarantee or other surety with respect to any substitute.

1.04 MANUFACTURER'S WRITTEN INSTRUCTIONS

A. Instruction Distribution: When the Contract Documents require that installation, storage, maintenance and handling of equipment and materials comply with manufacturer's written instructions, obtain and distribute printed copies of such instructions to parties involved in installation, including six copies to Engineer.

1. Maintain one set of complete instructions at jobsite during storage and installation, and until completion of work.

B. Manufacturer's Requirements: Store, maintain, handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's written instructions and in conformity with Specifications.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions.

2. Do not proceed with work without written instructions.

C. Performance Procedures: Perform work in accordance with manufacturer's written instructions. Do not omit preparatory steps or installation procedures, unless specifically modified or exempted by Contract Documents.

1.05 TRANSPORTATION, DELIVERY AND HANDLING

A. Coordination with Schedule: Arrange deliveries of materials and equipment in accordance with Construction Progress Schedules to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the Contractor shall provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss. Arrange deliveries of materials and equipment. Coordinate to avoid conflict with work and conditions at site.

B. Immediately upon delivery, inspect shipments to determine compliance with requirements of Contract Documents and approved submittals and that material and equipment are protected and undamaged.

C. Handling: Provide equipment and personnel to handle material and equipment by methods recommended by manufacturer to prevent soiling or damage to materials and equipment or packaging.

D. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

E. The Contractor shall transport, deliver, and handle products in accordance with supplier's written recommendations and by means and methods that will prevent damage, deterioration, and loss including theft

1.06 STORAGE, PROTECTION, AND MAINTENANCE

A. On-site storage areas and buildings:

1. Conform storage buildings to requirements of Section 01 57 00.

2. Coordinate location of storage areas with Engineer and Owner.

3. Arrange on site storage areas for proper protection and segregation of stored materials and equipment with proper drainage. Provide for safe travel around storage areas and safe access to stored materials and equipment.

4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

5. Store materials such as pipe, reinforcing and structural steel, and equipment on pallets, blocks or racks, off ground.

6. PVC Pipe may be damaged by prolonged exposure to direct sunlight and the Contractor shall take necessary precautions during storage and installation to avoid this damage. Pipe shall be stored under cover and installed with sufficient backfill to shield it from the sun.

7. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment which are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

B. Interior Storage:

1. Store materials and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible.

2. Store materials and equipment, subject to damage by elements, in weathertight enclosures.

3. Maintain temperature and humidity within ranges required by manufacturer's instructions.

C. Accessible Storage: Arrange storage in a manner to provide easy access for inspection and inventory. Make periodic inspections of stored materials or equipment to assure that materials or equipment are maintained under specified conditions and free from damage or deterioration.

1. Perform maintenance on stored materials of equipment in accordance with manufacturer's instructions, in presence of Owner or Engineer.

2. Submit a report of completed maintenance to Engineer with each Application for Payment.

3. Failure to perform maintenance, to notify Engineer of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

D. Owner's Responsibility: Owner assumes no responsibility for materials or equipment stored in buildings or on-site. Contractor assumes full responsibility for damage due to storage of materials or equipment.

E. Contractor's Responsibility: Contractor assumes full responsibility for protection of completed construction. Repair and restore damage to completed Work equal to its original condition.

F. Special Equipment: Use only rubber-tired wheelbarrows, buggies, trucks, or dollies to wheel loads over finished floors, regardless if the floor has been protected or not. This applies to finished floors and to exposed concrete floors as well as those covered with composition tile or other applied surfacing.

G. Surface Damage: Where structural concrete is also the finished surface, take care to avoid marking or damaging surface.

1.07 MANUFACTURER'S FIELD QUALITY CONTROL SERVICES

A. General:

1. Provide manufacturer's field services in accordance with this subsection for those tasks specified in other sections.

2. Provide training as specified in Section 01 79 00.

3. Include and pay all costs for suppliers' and manufacturers' services, including, but not limited to, those specified.

B. Installation Instruction: Provide instruction by competent and experienced technical representatives of equipment manufacturers or system suppliers as necessary to resolve assembly or installation procedures which are attributable to, or associated with, the equipment furnished.

C. Installation Inspection, Adjustments and Startup Participation:

1. Provide competent and experienced technical representatives of equipment manufacturers or system suppliers to inspect the completed installation as follows.

a. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions which may cause damage.

b. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

c. Verify that wiring and support components for equipment are complete.

d. Verify that equipment or system is installed in accordance with the manufacturer's recommendations, approved shop drawings and the Contract Documents.

e. Verify that nothing in the installation voids any warranty.

2. Provide manufacturer's representatives to perform initial equipment and system adjustment and calibration conforming to the manufacturer's recommendations and instructions, approved shop drawings and the Contract Documents.

3. Obtain Engineer's approval before start-up of equipment. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.

4. Furnish Engineer with three copies of the following. When training is specified, furnish the copies at least 24 hours prior to training.

    a. "Certificate of Installation, Inspection and Start-up Services" by manufacturers' representatives for each piece of equipment and each system specified, certifying:

        1) That equipment is installed in accordance with the manufacturers' recommendations, approved shop drawings and the Contract Documents.

        2) That nothing in the installation voids any warranty.

        3) That equipment has been operated in the presence of the manufacturer's representative.

        4) That equipment, as installed, is ready to be operated by others.

    b. Detailed report by manufacturers' representatives, for review by Engineer of the installation, inspection and start-up services performed, including:

        1) Description of calibration and adjustments if made; if not in Operation and Maintenance Manuals, attach copy.

        2) Description of any parts replaced and why replaced.

        3) Type, brand name, and quantity of lubrication used, if any.

        4) General condition of equipment.

        5) Description of problems encountered, and corrective action taken.

        6) Any special instructions left with Contractor or Engineer.

D. Field Test Participation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to participate in field testing of the equipment specified in Section 01 43 00.

E. Trouble-Free Operation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to place the equipment in trouble-free operation after completion of start-up and field tests.

1.08 START UP

A. The Contractor shall provide operating personnel for the duration of the startup. The Contractor shall also provide all water, power, chemicals and other consumables required. Additionally, the Contractor shall provide the effective coordination of all parties necessary for the successful startup, including suppliers, subcontractors, the Engineer, and the Owner.

B. It is not the intent of the Engineer to instruct the Contractor in the startup of the facilities; however, the Engineer will be available prior to and during startup to provide technical support to the Contractor.

C. The Contractor shall be required to startup the equipment, under direction of the Engineer, and operate it for a continuous one-day (24 hours) period at design conditions, except where more stringent requirements are included in the individual equipment specifications. The Contractor shall be available at all times during this period to provide necessary maintenance support services as may be deemed necessary by the Engineer.

D. Not less than two months prior to startup, the Contractor shall submit to the Engineer for review, a detailed schedule of operations which will be necessary to effect a successful initial operation and sustained period of operation for the duration of the required startup period.

E. The startup shall not be commenced until all required leakage tests, disinfection, and equipment tests, as applicable, have been completed to the satisfaction of the Engineer.

F. All defects in materials or workmanship which appear during this startup period shall be immediately corrected by the Contractor. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the Engineer, be justifiable cause for extending the startup test duration.

G. During the startup, the Contractor shall provide the services of authorized representatives of the suppliers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

H. During the startup, the Contractor shall keep records of the operations, in accordance with the instructions of the Engineer.

1.09 POST START-UP SERVICES

A. General: Provide Post Start-up Services in accordance with this subsection for equipment specified in other sections.

B. Site Visit: Provide the services of an authorized service representative for each equipment manufacturer or system supplier to make a final site visit after the equipment or

system has been in operation for at least 6 months, but no longer than 11 months. Furnish assistance to Owner's operating personnel in making adjustments and calibrations required to determine that the equipment and system is operating in conformance with design, manufacturer's, and specification requirements. Instruct the personnel in a review of proper operation and maintenance procedures.

C. Certificate: Furnish "Certificate of Post Start-up Services" cosigned by Engineer and the manufacturer's representative, certifying that this service has been performed. Use form provided in this section, and furnish Owner with three copies.

1.10 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

A. General: Furnish, per manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics.)

B. Time of Delivery: Deliver special tools and lubricating equipment to Owner when unit is placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.

C. Quality: Provide tools and lubricating equipment of a quality meeting equipment manufacturer's requirements.

1.11 LUBRICATION

A. General: Where lubrication is required for proper operation of equipment, incorporate in the equipment the necessary and proper provisions in accordance with manufacturer's requirements. Where possible, make lubrication automated and positive.

B. Oil Reservoirs: Where oil is used, supply reservoir of sufficient capacity to lubricate unit for a 24-hour period.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. General Requirements

B. Scheduling of Shutdown

1.02 RELATED SECTIONS

A. Section 32 10 01 – Pavement Repair and Restoration

1.03 GENERAL REQUIREMENTS

A. Contractor shall be responsible for all cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:

1. Make its several parts fit together properly.

2. Uncover portions of the work to provide for installation of ill-timed work.

3. Remove and replace defective work.

4. Remove and replace work not conforming to requirements of Contract Documents.

5. Remove samples of installed work as specified for testing.

6. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

B. Coordination: Perform all cutting, fitting or patching of the Work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.

C. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new Work in the existing construction.

D. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without the Engineer's concurrence.

1.04 SUBMITTALS

A. Submit a written request to the Engineer well in advance of executing any cutting or alteration which affects:

1. Work of the Owner or any separate contractor.

2. Structural value or integrity of any element of the project or work.

3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.

4. Efficiency, operational life, maintenance or safety of operational elements.

5. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of the work.

2. Description of affected work.

3. The necessity for cutting, alteration or excavation.

4. Effect on work of Owner or any separate contract, or on structural or weatherproof integrity of work.

5. Description of proposed work:

a. Scope of cutting, patching, alteration, or excavation.

b. Trades who will execute the work.

c. Products proposed to be used.

d. Extent of refinishing to be done.

6. Alternatives to cutting and patching.

7. Cost proposal, when applicable.

8. Written permission of any separate contractor whose work will be affected.

1.05 SCHEDULING OF SHUTDOWN

A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the Owner's normal operation is minimal. Overtime, night, and weekend work without additional compensation from the Owner, may be required to make these connections, especially if the connections are made at times other than those specified.

B. Request for Shutdowns: Submit a written request for each shutdown to the Owner and the Engineer sufficiently in advance of any required shutdown.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Comply with specifications and standards for each specific product involved.

PART 3 – EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of projects, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of the work.

C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with work until the Engineer has provided further instructions.

3.02 PREPARATION

A. Provide adequate temporary support as necessary to assure structural value or integrity or affected portion of work.

B. Provide devices and methods to protect other portions of project from damage.

C. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work, and maintain excavations free from water.

D. Material Removal: Cut and remove all materials to the extent shown or as required to complete the Work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials which are not salvageable from the site.

3.03 PERFORMANCE

A. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.

C. Employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

E. Restore work which has been cut or removed; install new products to provide completed work in accord with requirements of contract documents.

F. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

1. For continuous surfaces, refinish to nearest intersection.

2. For an assembly, refinish entire unit.

3.04 PAVEMENT RESTORATION

A. Restore all pavement or roadway surfaces in accordance with Section 32 10 01 – Pavement Repair and Restoration.

B. The restoration of existing street paving, including underdrains, if any are encountered, where damaged, shall be restored by the Contractor and shall be replaced or rebuilt using the same type of construction as was in the original. The Contractor shall be responsible for restoring all such work, including subgrade, base courses, curb and gutter or other appurtenances where present. The Contractor shall obtain and pay for at his own expense such local or other governmental permits as may be necessary for the opening of streets and shall satisfy himself as to any requirements other than those herein set forth which may affect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.

C. This section does not describe the construction of new road surfaces or the complete resurfacing of existing pavements.

D. In all cases, the Contractor will be required to maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract for a period of 12 months after the acceptance of the Contract, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.

E. The Contractor shall do all the final resurfacing or repaving of streets or roads, over the excavations that he has made and he shall be responsible for relaying paving surfaces of roads that have failed or been damaged, at any time before the termination of the maintenance period on account of work done by him and he shall resurface or repave over any tunnel jacking, or boring excavation that shall settle or break the surface, shall be repaved to the satisfaction of the Owner and at the Contractor's sole expense. Backfilling of trenches and the preparation of subgrades shall conform to the requirements of excavation and backfilling of pipeline trenches.

F. Where pipeline construction crosses paved streets, the Contractor may elect, at no additional cost to the Owner, to place the pipe by the jacking or boring or tunneling method in lieu of cutting and patching of the paved surfaces.

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SECTION 01 74 00
CLEANING

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. General Requirements

B. Disposal Requirements

1.02 GENERAL REQUIREMENTS

A. Execute cleaning during progress of the work and at completion of the work.

1.03 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DURING CONSTRUCTION

A. Execute daily cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations.

B. Provide onsite containers for the collection of waste materials, debris and rubbish. All waste materials including containers, food debris and other miscellaneous materials must be disposed of daily in onsite containers.

C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 FINAL CLEANING

A. Requirements: At the completion of work and immediately prior to final inspection, clean the entire project as follows:

1. Thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the Engineer.

2. Direct all subcontractors to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.

3. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.

4. Should the Contractor not remove rubbish or debris or not clean the buildings and site as specified above, the Owner reserves the right to have the cleaning done at the expense of the Contractor.

B. Employ experienced workers, or professional cleaners, for final cleaning.

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

D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

G. Replace air-handling filters if units were operated during construction.

H. Clean ducts, blowers, and coils, if air-handling units were operated without filters during construction.

I. Vacuum clean all interior spaces, including inside cabinets.

J. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

K. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

L. Clean interior of all panel cabinets, pull boxes, and other equipment enclosures.

M. Wash and wipe clean all lighting fixtures, lamps, and other electrical equipment which may have become soiled during installation.

N. Perform touch-up painting.

O. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

P. Remove erection plant, tools, temporary structures and other materials.

Q. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

3.03 FINAL INSPECTION

A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the Owner and Engineer.

END OF SECTION

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SECTION 01 77 00
CONTRACT CLOSE OUT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Warranties and Bonds

B. Special Tools

C. Record Drawings

1.02 WARRANTIES AND BONDS

A. Prior to final payment deliver to the Owner the original and one copy of all bonds, warranties, guarantees and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one-year correction period. Show Owner as beneficiary of these documents.

1.03 SPECIAL TOOLS

A. Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.

B. For each type of equipment provided under this Contract, furnish a complete set of all special tools including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Furnish only tools of high grade, smooth forged alloy tool steel. Manufacture grease guns of the lever type.

C. Furnish and erect one or more neat and substantial steel wall cases or cabinets with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

1.04 RECORD DRAWINGS

A. General Requirements:

1. At the start of the Project, label each record document to be submitted as, “PROJECT RECORD” using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.

2. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.

3. Do not permanently conceal the Work until required information has been recorded.

4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from Engineer-accepted record documents.

5. Marking of Entries:

    a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.

    b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.

    c. Date all entries on record documents.

    d. Call attention to changes by drawing a “cloud” around the change(s) indicated.

    e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

6. All as-built conditions must be noted as follows:

    a. Buried valves, fittings, plugs and caps, taps for disinfection and testing, and air release valve assemblies. Locate by survey using state plane coordinate system for horizontal location and by elevation to top of fitting or valve.

    b. Invert elevation of all gravity stubouts for future connections, including terminal point.

    c. Limits, dimensions, and depth of concrete encasing, encasing pipe and sheeting.

    d. Horizontal and vertical locations of other public and private utilities when they are encountered during construction.

    e. Indicate size, type, depth, location, and limits of any pipe that is abandoned as part of the work or any existing pipe that is crossed by new piping as part of the work. Include type of abandonment (i.e. end plug, mortar filled, etc.) for abandoned pipe.

    f. Certified survey of the location of all new structures in relation to the property boundaries and other existing structures. Indicate location of all underground pipe and duct bank at point of connection to structures. Locate from corner or centerline of structure.

g. Storm Drains, Inlets, and Structures: Location for all catchbasins, manholes, and other structures. Elevations of grates, throats, weirs, and orifices. Invert elevations for all pipes and structures. Pipe size, type, material, slope, and distance between structures.

h. Roadway: Elevations of all roadway vertical control points and terminations of curb returns.

B. Recording Changes to Drawings:

1. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.

2. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.

3. Record actual construction including:

a. Depths of various elements of foundation relative to Project datum.

b. High and low pipeline points, service taps, restrained joints, and fire hydrants.

c. Pipe diameter and material, including services.

d. Beginning and end points where pipe joints are significantly deviated to avoid a conflict, including the depth of cover.

e. Gravity Sewers: Station number of all manholes and services (i.e. wyes, etc.). Elevations for top of manholes and pipe inverts. Pipe size, type, slope, and distance between manholes.

f. Plants/Pump Stations: All of the items below ground level including electrical ducts, etc.

g. Field changes of dimensions, arrangements, and details.

h. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.

i. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document changes.

C. Recording Changes for Schematic Layouts:

1. In some cases, on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.

2. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.

3. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items.

4. Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.

5. Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.

6. Descriptions shall be sufficiently detailed to be related to Specifications.

7. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in Engineer’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

D. Requirements for Supplemental Drawings:

1. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings and shall be included with record documents submitted by Contractor. Supplemental record drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.

2. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.

3. When supplemental drawings developed by Contractor using computer-aided drafting/design (CADD) software are to be included in record drawings, submit

electronic files for such drawings in AutoCAD (latest version) as part of record drawing submittal.

E. Recording Changes to Specifications and Addenda

1. Mark each Section to record:

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

b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 78 23
OPERATION AND MAINTENANCE MANUALS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Description

B. Quality Assurance

C. Submittals

D. Format and Contents

1.02 DESCRIPTION

A. Scope: Furnish to the Engineer 2 hard copies and a PDF of an Operation and Maintenance Manual for all equipment and associated control systems furnished and installed.

1.03 QUALITY ASSURANCE

A. Reference Codes and Specifications: No current government or commercial specifications or documents apply.

1.04 SUBMITTALS

A. Prior to the Work Reaching 50 Percent Completion, submit to the Engineer for approval an electronic copy of the preliminary O&M manual with all specified material. Submit the approval copies with the partial payment request for the specified completion.

B. Within 30 days after the Engineer's approval of the preliminary O&M manual, furnish to the Engineer 2 hard copies and an electronic file for the final copies of the manual. Provide space in the manual for additional material. Submit any missing material for the manual prior to requesting certification of substantial completion.

1.05 FORMAT AND CONTENTS

A. Prepare and arrange each copy of the manual as follows:

1. One copy of an equipment data summary (see sample form) for each item of equipment.

2. One copy of an equipment preventive maintenance data summary (see sample form) for each item of equipment.

3. One copy of the manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.

4. List of electrical relay settings and control and alarm contact settings.

5. Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.

6. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.

7. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and frequency of required lubrication.

8. Preventive maintenance procedures and schedules.

9. Parts lists by generic title and identification number complete with exploded views of each assembly.

10. Disassembly and reassembly instructions.

11. Name and location of nearest supplier and spare parts warehouse.

12. Recommended troubleshooting and start-up procedures.

13. Reproducible prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications (if any).

14. Furnish all O&M Manual material on 8-1/2 by 11 commercially printed or typed forms or an acceptable alternative format.

B. Electronic File Copies: Electronic submittals shall be pdf format and shall be book marked and word searchable.

C. Digital O&M Manual: Contractor’s instrumentation subcontractor responsible for programming shall combine the electronic files for all equipment to create the on-line O&M

manual. Provide six copies of the combined digital O&M manual file on six separate flash drives/external hard drives.

D. Organize each manual into sections paralleling the equipment specifications. Identify each section using heavy section dividers with reinforced holes and numbered plastic index tabs. Use 3-ring, hard-back binders Type No. VS11 as manufactured by K&M Company, Torrence, CA, or equal. Punch all loose data for binding. Arrange composition and printing so that punching does not obliterate any data. Print on the cover and binding edge of each manual the project title, and manual title, as furnished and approved by the Engineer.

E. Leave all operating and maintenance material that comes bound by the equipment manufacturer in its original bound state. Cross-reference the appropriate sections of the Contractor's O&M manual to the manufacturers' bound manuals.

F. Information not applicable to the specific piece of equipment installed on this project shall be struck from the Manual by the Contractor. Information provided shall include a source of replacement parts and names of service representatives, including addresses and telephone numbers.

G. When written instructions include shop drawings and other information previously reviewed by the Engineer, only those editions which were accepted by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the O&M Manual.

H. Label binders Volume 1, 2, and so on, where more than one binder is required. Include the table of contents for the entire set, identified by volume number, in each binder.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

NOTE: Fill in name of Project.

Lee County Utilities

Equipment Data Summary

Equipment Name: Specification Reference:

Manufacturer:

Name:

Address:

Telephone:

Number Supplied: Location/Service:

Model No: Serial No:

Type:

Size/Speed/Capacity/Range (as applicable):

Power Requirement (Phase/Volts/Hertz):

Local Representative:

Name:

Address:

Telephone:

NOTES:

NOTE: Fill in name of Project.

Lee Owner Utilities

Preventive Maintenance Summary

Equipment Name: Location:

Manufacturer:

Name:

Address:

Telephone:

Model No: Serial No:

Maintenance Task	Lubricant/Part	D W M Q SA A	O&M Manual Reference

NOTES:

*D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

END OF SECTION

SECTION 01 78 36
WARRANTIES AND BONDS

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. Compile specified warranties and bonds, as in Articles 6 and 13 of the General Conditions.

B. Co-execute submittals when so specified.

C. Review submittals to verify compliance with Contract Documents.

D. Submit to the Engineer for review and transmittal to Owner.

1.02 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Two original signed copies are required.

C. Table of Contents. Neatly typed in orderly sequence. Provide complete information for each items.

1. Product or work item.

2. Firm, with name of principal, address and telephone number.

3. Scope.

4. Date of beginning warranty, bond or service and maintenance contract.

5. Duration of warranty, bond or service maintenance contract.

6. Provide information for Owner's personnel:

   a. Proper procedure in case of failure.

   b. Instances which might affect the validity of warranty or bond.

7. Contractor, name of responsible principal, address and telephone number.

1.03 FORM OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8-1/2” x 11”, punch sheets for standard 3-post binder.

a. Fold larger sheets to fit into binders.

2. Cover: Identify each packet with typed or printed title “WARRANTIES AND BONDS” list:

a. Title of Project

b. Name of Contractor

C. Binders: Commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of 2 inches.

1.04 WARRANTY SUBMITTAL REQUIREMENTS

A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer’s warranty period shall be concurrent with the Contractor’s for one (1) year, unless otherwise specified, commencing at the time of substantial completion.

B. The Contractor shall be responsible for obtaining certificates for equipment warranty for all major equipment specified under Divisions 26, 40, 41, 43, and 46 and which has a 1 HP motor or greater; or which lists for more than $1,000. The Engineer reserves the right to request warranties for equipment not classified as major. The Contractor shall still warrant equipment not considered to be “major” in the Contractor’s one-year warranty period even though certificates of warranty may not be required.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00

TRAINING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Training

1.02 TRAINING

A. Training: Provide the services of knowledgeable, technically competent, factory trained specialists to instruct Owner personnel in the operation and maintenance of the equipment and system components supplied under this Contract. The Owner will furnish training classroom space on Site.

1. Coordinate services with the Owner, with a minimum of 30 days prior notice.

2. Provide a combination of classroom and "hands-on" instruction designed to completely familiarize operating and maintenance personnel with the systems theory, standard operating procedures, safety features and emergency procedures, and general maintenance of all components.

3. Conduct all training at the Site during regular hours on weekdays.

B. Provide training where specified under the individual specifications.

C. Credentials: Submit for approval, credentials of equipment manufacturer representatives who are to be course instructors at least 14 days prior to a proposed training session.

D. Scheduling: Submit training outline and other information herein for approval at least 14 days prior to the proposed date for the training sessions. Verify scheduling with the Owner at least 14 days prior to the training sessions.

E. Number of Copies: For each training class, provide instructional material for at least ten attendees plus five extra copies, plus duplicate copies of all audio-visual aids utilized during each training course.

F. Training Outline Submission: Provide a proposed training outline including the topics presented herein. Identify specific components and procedures in the training outline.

G. Training Topic Detail: Detail specific training topics. Describe "hands-on" demonstrations planned for the training. Reference training aids to be utilized in the training (i.e. video tapes, slides, transparencies) and attach where applicable.

H. Training Handouts: Attach training handouts to the proposed training outline.

I. Training Segment Duration: Indicate the duration of each training segment.

J. Training Outline:

1. Equipment Operation

    a. Describe equipment's operating (process) function.

    b. Describe equipment's fundamental operating principles and dynamics.

    c. Identify equipment's mechanical, electrical and electronic components and features.

    d. Identify all support equipment associated with the operation of the subject equipment.

2. Detailed Component Description

    a. Identify and describe in detail each component's function.

    b. Where applicable, group related components into subsystems.

    c. Identify, and describe in detail, equipment safety features and control interlocks.

3. Equipment Preventive Maintenance

    a. Describe preventive maintenance inspection procedures required to perform and inspect the equipment in operation, and spot potential trouble symptoms (anticipate breakdowns).

    b. Outline recommended routine lubrication and adjustments (preventive maintenance).

4. Equipment Troubleshooting

    a. Define recommended systematic troubleshooting procedures.

    b. Provide component specific troubleshooting checklists.

    c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

5. Equipment Corrective Maintenance

a. Describe recommended equipment preparation requirements.

b. Identify and describe the use of special tools required for maintenance of the equipment.

c. Describe component removal/installation and disassembly/ assembly procedures.

d. Perform at least two "hands-on" demonstrations of common corrective maintenance repairs.

e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

f. Define recommended torquing, mounting, calibration, and alignment procedures and settings, as appropriate.

g. Describe recommended procedures to check/test equipment following corrective repair.

K. Certificate: Provide "Certificate of Instructional Services" signed by Engineer and equipment representative, verifying that training has been accomplished to satisfaction of all parties. Use form provided in this section, and furnish Engineer with three copies.

L. Substantial Completion: Training provided by manufacturers' representative, Engineer and Owner does not constitute substantial completion.

M. Equipment Use: Use of equipment for training shall not void manufacturers' or contract warranties.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 HANDS-ON DEMONSTRATIONS

A. Contractor’s instructor shall provide “hands-on” demonstration of operations and maintenance of equipment and materials for each training session.

B. Contractor shall furnish tools and appurtenances required for demonstrations.

3.02 CERTIFICATE OF INSTRUCTIONAL SERVICES

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment Manufacturers' Representative has instructed Owner's personnel in startup operation and maintenance of this equipment as required in the Contract Documents.

MANUFACTURER'S REPRESENTATIVE

Signature _____

Name: (print) _____

Title: _____

Representing _____

Contractor

Signature _____ Date _____

Name (print) _____

Title _____

Engineer

Signature_____Date _____

Name (print) _____

Title _____

COMMENTS:

Complete and submit three copies of this form to Engineer upon completion of training as required by Specification Section 01 79 00.

END OF SECTION

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Division 02

SECTION 02 21 13
LINES AND GRADES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. General

B. Surveys

C. Datum Plane

D. Protection of Survey Data

1.02 GENERAL

A. Construct all work in accordance with the lines and grades shown on the Drawings. Assume full responsibility for keeping all alignment and grade.

1.03 SURVEYS

A. Reference Points: The Owner will provide reference points for the work as described in the General Conditions. Base horizontal and vertical control points will be designated by the Engineer and used as datum for the Work. Perform all additional survey, layout, and measurement work.

1. Keep Engineer informed, sufficiently in advance, of the times and places at which work is to be performed so that base horizontal and vertical control points may be established, and any checking deemed necessary by Engineer may be done, with minimum inconvenience to the Engineer and at no delay to Contractor. It is the intention not to impede the Work for the establishment of control points and the checking of lines and grades set by the Contractor. However, when necessary, suspend working operations for such reasonable time as the Engineer may require for this purpose. Costs associated with such suspension are deemed to be included in the Contract Price, and no time extension or additional costs will be allowed.

2. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the Contractor.

1.04 DATUM PLANE

A. Shall be per Contract Drawings.

1.05 PROTECTION OF SURVEY DATA

A. General: Safeguard all points, stakes, grade marks, known property corners, monuments, and bench marks made or established for the Work. Reestablish them if disturbed and bear the entire expense of checking reestablished marks and rectifying work improperly installed.

B. Records: Keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Furnish copies of such data to the Engineer for use in checking the Contractor's layout. Data considered of value to the Owner will be transmitted to the Owner by the Engineer with other records on completion of the Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 02 40 00
DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: All work necessary for the removal and disposal of buildings, structures, foundations, piping, equipment and roadways, or any part thereof including masonry, steel, reinforced concrete, plain concrete, electrical facilities, and any other material or equipment shown or specified to be removed.

B. Basic Procedures and Schedule: Carry out demolition so that adjacent structures, which are to remain, are not endangered. Schedule the work so as not to interfere with the day to day operation of the existing facilities. Do not block doorways or passageways in existing facilities.

C. Additional Requirements: Provide dust control and make provisions for safety.

1.02 SUBMITTALS

A. Site Inspection: Visit the site and inspect all existing structures. Observe and record any defects which may exist in buildings or structures adjacent to but not directly affected by the demolition work. Provide the Owner with a copy of this inspection record and obtain the Owner's approval prior to commencing the demolition.

1.03 QUALITY ASSURANCE

A. Limits: Exercise care to break concrete sufficiently for removal in reasonably small masses. Where only parts of a structure are to be removed, cut the concrete along limiting lines with a suitable saw so that damage to the remaining structure is held to a minimum.

1.04 TITLE TO EQUIPMENT AND MATERIALS

A. Contractor shall have no right or title to any of the equipment, materials, or other items to be removed from the existing buildings or structures unless and until said equipment, materials and other items have been removed from the premises. The Contractor shall not sell or assign or attempt to sell or assign any interest in the said equipment, materials, or other items until the said equipment, materials or other items have been removed.

B. Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

1.05 CONDITION OF STRUCTURES AND EQUIPMENT

A. The Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.

B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practical.

C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DEMOLITION AND REMOVALS

A. The removal of all equipment and piping, and all materials from the demolition of buildings and structure shall, when released by the Owner and Engineer, shall be done by the Contractor, and shall become the Contractor's property, unless otherwise noted, for disposition in any manner not contrary to the Contract requirements and shall be removed from the site to the Contractor's own place of disposal.

B. The electrical subcontractor specifically, shall de energize all panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation such as flow, level and/or other meters, wiring, and similar power equipment prior to removal. Any electric panels or equipment which are to be retained shall be relocated or isolated by the electrical subcontractor specifically, prior to the removal of the equipment specified herein.

C. The Contractor shall proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the plant in continuous operation and shall proceed only after approval of the Engineer.

D. Any equipment piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing facilities shall be replaced to the satisfaction of the Engineer at no cost to the Owner.

E. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris. Select fill or structural fill shall be used where specifically required on Contract Drawings.

F. Burning of any debris resulting from the demolition will not be permitted at the site.

G. Where parts of existing structures are to remain in service, demolish the portions to be removed, repair damage, and leave the structure in proper condition for the intended use. Remove concrete and masonry to the lines designated by drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcing bars are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.

H. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.02 PROTECTION

A. Demolition and removal work shall be performed by competent experienced workmen for the various type of demolition and removal work and shall be carried out through to completion with due regard to the safety of Owner employees, workmen on site and the public. The work shall be performed with as little nuisance as possible.

B. The work shall comply with the applicable provisions and recommendations of OSHA, all governing codes, and as hereinafter specified.

C. The Contractor shall make such investigations, explorations, and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring and bracing requirements to prevent any damage to new or existing construction.

D. The Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.

E. The Contractor shall provide and maintain weather protection at exterior openings to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

F. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled, or equipment moved.

G. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster, and similar debris. Unaltered portions of the existing

buildings affected by the operations under this Section shall be protected by dust proof partitions and other adequate means.

H. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.

I. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs, or other means of egress. The Contractor shall conduct operations with minimum traffic interference.

J. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.03 WORKMANSHIP

A. The demolition and removal work shall be performed as described in the Contract Documents. The work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or items designated for reuse or to remain. The Contractor shall perform patching, restoration, and new work in accordance with applicable Technical Sections of the Specifications and in accordance with the details shown on the Drawings. Prior to starting of work, the Contractor shall provide a detailed description of methods and equipment to be used for each operation and the sequence thereof for review by the Engineer.

B. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately 1 inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable Sections of these Specifications, as shown on the Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate Sections of these Specifications, as shown on the Drawings, and as directed and approved by the Engineer.

C. Materials or items designated to remain the property of the Owner shall be as hereinafter tabulated. Such items shall be removed with care and stored at a location at the site to be designated by the Owner.

D. Where equipment is shown or specified to be removed and relocated, the Contractor shall not proceed with removal of this equipment without specific prior approval of the Engineer. Upon approval, and prior to commencing removal operations, the equipment shall be operated in the presence of representatives of the Contractor, Owner and Engineer. Such items shall be removed with care, under the supervision of the trade responsible for reinstallation and

protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or item. Any equipment that is removed without proper authorization and is required for plant operation shall be replaced at no cost to the Owner.

E. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.

F. Materials or items demolished and not designated to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.

G. The Contractor shall execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building.

H. In general, masonry shall be demolished in small sections, and where necessary to prevent collapse of any construction, the Contractor shall install temporary shores, struts, and bracing.

I. Where alterations occur, or new and old work join, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, to leave the altered work in as good a condition as existed prior to the start of the work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawing or specified, shall comply with that of the various respective trades which normally perform the items of work.

J. The Contractor shall finish adjacent existing surfaces to new work to match the specified finish for new work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.

K. The Contractor shall cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.

L. The Contractor shall confine cutting of existing roof areas designated to remain to the limits required for the proper installation of the new work. The Contractor shall cut and remove insulation, etc., and provide temporary weather tight protection as required until new roofing and flashings are installed.

M. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the work.

3.04 MAINTENANCE

A. The Contractor shall maintain the buildings, structures, and public properties free from accumulations of waste, debris, and rubbish, caused by the demolition and removal operations.

B. The Contractor shall provide on site dump containers for collection of waste materials, debris, and rubbish, and shall wet down dry materials to lay down and prevent blowing dust.

C. At reasonable intervals during the progress of the demolition and removal work or as directed by the Engineer, the Contractor shall clean the site and properties, and dispose of waste materials, debris, and rubbish.

3.05 EQUIPMENT AND MATERIALS RETAINED BY OWNER

A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at his expense.

END OF SECTION

SECTION 02 83 00

LEAD ABATEMENT

PART 1 – GENERAL

1.01 SUMMARY

A. This specification details the requirements for worker protection, containment, environmental protection, and waste disposal for the removal of lead paint when required by the Contract Documents before repainting or recoating. The Contractor shall implement programs and procedures which comply with the requirements of the specification and all applicable Federal, State and Local OSHA and EPA Standards and regulations. The Contractor shall perform the work with a minimal impact on the environment and protect all workers, Owner and Engineer from lead and other safety and health hazards.

B. The Contractor shall obtain the services of a Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene in comprehensive practice. The Certified Industrial Hygienist shall:

1. Certify training.

2. Review and approve lead-containing paint removal plan for conformance to the applicable referenced standards

3. Inspect lead-containing paint removal work for conformance with the approved plan

4. Direct monitoring

5. Ensure work is performed in strict accordance with specifications and applicable codes and regulations at all times.

6. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.

1.02 REFERENCES

A. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI Z88.2 1980 Respiratory Protection

B. CODE OF FEDERAL REGULATIONS

1. 29CFR 1910.134 Respiratory Protection

2. 29CFR 1910.1025 Lead

3. 29CFR 1910.1200 Hazard Communication

4. 29CFR 1926.55 Gases, Vapors, Fumes, Ducts, and Mists

5. 29CFR 1926.62 Lead Construction Industry Standard

6. 40CFR 260 Hazardous Waste Management Systems: General

7. 40CFR 261 Identification and Listing of Hazardous Waste

8. 40CFR 262 Regulations for Hazardous Waste Generators

9. 40CFR 263 Regulations for Hazardous Waste Transporters

10. 40CFR 264 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

11. 40CFR 265 Interim Status Standards for Owner's and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

12. 40CFR 266 Standards for the Management of Specific Hazardous Waste and Specific types of Hazardous Waste Management Facilities

C. RESOURCE AND RECOVERY ACT (RCRA)

1. Hazardous Waste Characterization

2. Toxic Characteristic Leaching Procedure (TCLP)

D. NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY & HEALTH (NIOSH):

1. NIOSH Method 7082

2. NIOSH 81-123, Occupational Health Guidelines for Chemical Hazards

E. OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA):

1. OSHA CPL 2-2.20A, Chapter VIII: Sampling for Surface Contamination

2. OSHA Pub 3126 Working with Lead in the Construction Industry

F. STEEL STRUCTURES PAINTING COUNCIL (SSPC)

1. Guide 5 Guide to Maintenance Painting Programs

2. Guide 61 (CON) Guide for containing Debris Generated During Paint Removal Operation

3. Guide 71 (DIS) Guide for the Disposal of Lead Containment Surface Preparation Debris.

1.03 SUBMITTALS

A. PRE-JOB SUBMITTALS: These submittals shall be made at least two (2) weeks before the start of any field work. Approval of the plan must be obtained prior to the start of any paint removal work.

B. LEAD CONTAINING PAINT REMOVAL PLAN: Submit a detailed job-specific plan of the work procedures to be used in the removal of lead-containing paint. Obtain approval of the plan prior to the start of paint removal work. Prior to beginning work, the Contractor and CIH shall meet with the Owner's representative to discuss in detail the lead containing paint removal plan, including work procedures and precautions. The plan shall include:

1. location, size, and details of lead control area.

2. location and details of decontamination rooms, change rooms, shower facilities and mechanical ventilation system.

3. eating, drinking, smoking and restroom procedures, interface of trades.

4. sequencing of lead related work,

5. collected wastewater and paint debris disposal plan

6. air sampling plan

7. respirators, protective equipment

8. a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not exceeded outside of the lead control area.

9. air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion of the plan.

C. CONTRACTOR'S TEST LABORATORY: Submit name, address and telephone number of the Contractor's testing laboratory selected to analyze the representative samples of wash water and debris by TCLP as required. This submittal must be approved by the Engineer prior to the start of lead removal work.

D. HAZARDOUS WASTE MANAGEMENT PLAN: Submit a Hazardous Waste Management Plan for Owner's approval. The Hazardous Waste Management Plan shall comply with applicable requirements of federal, state, and local hazardous waste regulations and address:

1. Identification of hazardous wastes associated with the work.

2. Estimated quantities of wastes to be generated and disposed of.

3. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA, state hazardous waste permits and EPA Identification numbers.

4. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

5. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

6. Spill prevention, containment, and cleanup contingency measures to be implemented.

7. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.

8. Cost for hazardous waste disposal according to this plan.

E. MEDICAL EXAMINATION: Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1910.1025 and 29 CFR 1910.1200. The examination will not be required if adequate records show that employees have been examined as required by 29 CFR 1910.1025 within the last year. Maintain complete and accurate medical records of employees for a period of at least 40 years or for the duration of employment plus 20 years, whichever is longer.

F. STATEMENTS:

1. Qualifications of CIH

2. Lead containing paint removal plan

3. Hazardous waste management plan

G. POST JOB SUBMITTALS:

1. Completion Date and Certificate of Completion.

2. Hazardous waste manifests (within 20 days of shipment offsite).

3. Employee Listings: An alphabetical listing of each employee used on this project and the dates that each employee worked on this project.

4. Employee Air Monitoring Results: A notarized copy of employee air monitoring results relative to OSHA respiratory level compliance.

5. Daily Sign In/Out Logs: Copies of logs showing each person who entered the work area. These logs shall contain the date, name, social security number, company represented and reason for entry into the work area.

H. SOIL TESTING

1. Soil samples shall be taken at the site before any work is started. Four (4) samples shall be given to the Owner, and four (4) to the Contractor for lead analysis. Following the abrasive blast cleaning and painting operations, four (4) additional soil samples shall be taken and analyzed for lead content. The Engineer shall determine the location of the soil samples. Soil samples shall be analyzed for lead content by a laboratory approved by the State of Florida and the Engineer. The cost of testing and analysis shall be borne by the Contractor including sampling and transporting.

2. Sampling and analysis shall be performed in accordance with a Florida Department of Environmental Protection approved comprehensive quality assurance plan.

I. DEFINITIONS

1. OSHA Occupational Safety and Health Administration.

2. NIOSH National Institute of Occupational Safety and Health.

3. CIH Certified Industrial Hygienist.

4. EPA United States Environmental Protection Agency

5. NESHAPS National Emissions Standard for Hazardous Air Pollutants.

6. TCLP Toxic Characteristic Leaching Procedure.

7. PEL Permissible Exposure Limit

8. *Abate or Abatement*: The elimination of exposure to lead-based substances that may result in lead toxicity or poisoning, by the removal of or encapsulation of lead-containing substances, by thorough cleanup procedures, and by post- cleanup treatment of surfaces.

9. *Area Monitoring*: The sampling of airborne lead concentrations within the lead control area and outside the exclusion boundary which may reach the breathing zone of Contractor employees or other personnel.

10. *Contractor*: Any business entity, public unit, or person performing the actual abatement for a lead abatement project.

11. *Containment System*: A containment system includes the tarps, screens, supports, shrouds and scaffold utilized to enclose a paint removal tool or enclose the entire worksite. Ground covers are also utilized as part of a containment system. When an existing floor, concrete slab, or the ground serves as the base of the containment, it shall be completely covered with impervious material such as solid panels of plywood or flexible materials such as tarpaulins. The materials shall be maintained throughout the project to avoid losing debris through rips, tears, or breaks in the coverings. When the structure being prepared serves as the floor (e.g. bottom interior of tank), it shall remain uncovered to provide access for surface preparation and painting. The purpose is to minimize or prevent abrasive blast debris from entering into the environment and contain the blast debris within for collection and proper disposal.

12. *Decontamination Unit*: A series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. For the purposes of this project, a decontamination unit shall consist of a free-standing enclosed room with hot and cold or warm running water suitably arranged for complete showering during decontamination which is in close proximity to the work area(s).

13. *Equipment Decontamination Enclosure System*: A decontamination enclosure system for materials and equipment, typically consisting of a washroom, an airlock, and a holding area.

14. *Enclosure*: Procedures necessary to completely enclose material containing lead-based paint behind airtight, impermeable, permanent barriers.

15. *Equipment Decontamination Enclosure System*: A decontamination enclosure system for materials and equipment, typically consisting of a washroom, an airlock, and a holding area.

16. *Equipment Room*: A contaminated area or room which is part of the worker decontamination enclosure system, with provisions for storage of contaminated clothing and equipment.

17. *HEPA filter*: A High Efficiency Particulate Absolute (HEPA) filter capable of trapping and retaining 99.97 percent of non-dispersed particles greater than 0.3 microns in diameter.

18. *HEP Vacuum Equipment*: Vacuuming equipment equipped with a HEPA-filtration system.

19. *Lead Abatement Project*: Any work performed in order to abate the presence of a lead-containing substance.

20. *Lead-Containing Substance*: Any paint, or other surface coating material containing more than 0.06 percent lead by weight calculated as lead metal in the dried solid.

21. *Lead Control Area*: An area where lead paint removal operations are performed which is isolated by physical boundaries to prevent unauthorized entry of personnel thereby preventing the exposure to, or spread of lead. Physical boundaries shall be established and located such that the level of airborne lead shall not exceed 30 micrograms per cubic meter of air outside of the established boundary at any time.

22. *Lead Permissible Exposure Limit*: The exposure limit as required by 29 CFR 1910.1026 or 29 CFR 1926.55, as applicable.

23. *Removal*: The act of removing lead containing or contaminated materials from the structure under properly controlled conditions to a suitable disposal site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 CONTRACTOR OPERATIONS

A. The Contractor will carry out the lead paint removal operations in strict accordance with the approved lead removal plan and the requirements of this contract.

3.02 TRAINING

A. Contractor and Contractor employees will be trained by the Certified Industrial Hygienist in the proper handling of lead; health hazardous and risks involved, including the illness possible from exposure to lead; use and limits of the respiratory equipment to be used; and the importance of engineering and other hazard control techniques and procedures used during lead removal. Personnel who will perform Contractor's personnel air monitoring required by this Contract shall be trained and qualified by the CIH to perform such monitoring.

B. Only properly trained personnel shall be permitted to enter the containment area.

3.03 WARNING AND CAUTION SIGNS

A. The Contractor shall provide signs posted at approaches to lead control areas. These signs shall be posted at such a distance that they may be read and necessary precautions taken prior to entering the control areas. Caution labels shall also be posted on lead waste disposal containers.

B. Warning signs shall comply to 29CFR 1910.145 paragraph (d) (4) and shall display the following legend:

WARNING
LEAD WORK AREA

POISON

NO SMOKING, EATING, OR DRINKING

3.04 DISPOSAL OF USED ABRASIVE

A. Test used abrasive in accordance with 40 CFR 261 to determine if it is a hazardous waste. Handle and dispose of hazardous waste in accordance with local State rules and regulations for Hazardous Waste Generation, Transportation, Treatment, Storage and Disposal, 40 CFR 260, 261, 262, 263, 264, 265, and 266.

3.05 DISPOSAL OF WASH WATER

A. Residual water from pressure washing operations shall be collected and filtered with a two stage filter. The first filter stage being a 100 micron unit and the second, a 1 micron unit. The filtered water shall be tested and disposed of properly according to the test results. The filtered out paint chips and debris shall be tested and disposed of as specified in section 3.4.

END OF SECTION

Division 03

SECTION 03 01 30
CONCRETE REPAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all materials, labor, equipment, tools, etc., required for the repair, renovation, and replacement of concrete and/or reinforcing steel as indicated on the Drawings, specified herein, and determined by field survey.

B. The Contractor, in conjunction with the Engineer, shall determine the extent of cracked or deteriorated concrete to be rehabilitated and/or resurfaced. A summary of the work to be performed shall be submitted to the Engineer for review, and such summary shall be approved by the Engineer prior to commencement of the Work.

C. Concrete rehabilitation shall include surface preparation, concrete repair work, reinforcement replacement, proper disposal of all debris and all other work required to complete structural rehabilitation of the surfaces of each structure identified for repair, to its original profile.

D. Concrete repairs shall be as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Section 01 22 13 – Measurement and Payment

C. Division 03 – Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Shall be as specified in Section 01 42 00 – Reference Standards.

B. ICRI CSP – International Concrete Repair Institute Concrete Surface Profile.

1.04 SUBCONTRACTOR/APPLICATOR QUALIFICATIONS

A. The Contractor shall furnish the name of all subcontractors/applicators which he proposes to use for this work, including necessary evidence and/or experience records to ascertain their qualifications in the application. Approved applicator qualifications shall include:

1. A minimum of 5 years of experience in applying epoxy, urethane, and polymer-modified and cement-based repair materials similar to those specified in this Section.

B. 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 applying the product, including surface preparation and mixing, placing, curing, and caring for the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

1.05 SUBMITTALS

A. Material certifications and technical data sheets on all grouts, mortars, epoxy resins, aggregates and repair products specified in this Section.

B. Subcontractor/Applicator qualifications as specified in Section 1.04.

C. Shop Drawings detailing any planned deviation from the proposed construction sequence and/or method of repair.

D. The Contractor, based on their experience in their profession, and/or recommendation from product manufacturers, may submit to the Engineer for approval, alternative materials and/or methods of work to assure the durability and watertight integrity of the repair work performed.

E. A rehabilitation plan detailing the methods, materials, and procedures proposed for each repair type.

F. Letter from repair material manufacturer(s) certifying that all repair materials to be used to create single repairs are compatible for use together

1.06 ADDITIONAL GUARANTEE

A. The Contractor shall guarantee all repair work performed under this Contract against defects in workmanship resulting in leakage and/or failure of concrete bond for a period of three (3) years from the date of the Certificate of Substantial Completion.

PART 2 – MATERIALS

2.01 GENERAL

A. All concrete repair materials, when used in combination to create a single repair, shall be compatible.

2.02 WATER

A. The water used for mixing concrete repair products shall be clear, potable, and free of deleterious substances.

2.03 AGGREGATE

A. All aggregate shall conform to ASTM C-33. The aggregate supplier shall submit to the Engineer documentation that the proposed aggregates comply with ASTM C-33 and the requirements listed below:

B. Pea Gravel - Pea gravel shall meet the gradation and material requirements of Standard Size 14 as defined by ASTM C-33. Pea gravel shall be clean and free from deleterious matter and shall contain no limestone.

2.04 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C-881 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. The epoxy resin shall be "Sikadur Hi-Mod Series" as manufactured by the Sika Corp, Lyndhurst, NJ, "Duralbond" as manufactured by Euclid Chemical Company, Cleveland, OH, "Euco #452 Series" by the Euclid Chemical Company, or "MasterEmaco ADH series" by Master Builder Solutions.

2.05 ANTI-CORROSION REBAR COATING

A. Anti-corrosive coating shall be a two-component, polymer-modified cementitious material such as "Sika Armatec 110 EpoCem " manufactured by Sika Corp., Lyndhurst, NJ, Atlanta, GA, "Duralprep A.C." by the Euclid Chemical Company, or "MasterEmaco P 124" by Master Builder Solutions.

2.06 TYPE I CRACK REPAIR - CEMENTITIOUS SURFACE SEAL

A. Type I Crack Repair - Cementitious Surface Seal shall be a one- or two-component, polymer-modified or silica fume enhanced trowel grade cementitious mortar. Type I Crack Repair material shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Verticoat" or "Verticoat Supreme" by Euclid Chemical Company; or "Emaco S88 CI" or by BASF Master Builder Solutions.

2.07 TYPE II CRACK REPAIR – EPOXY INJECTION CRACK REPAIR

A. Type II Crack Repair – Epoxy Injection Crack Repair shall be a two-component, 100% solids, high-modulus, low viscosity, moisture insensitive epoxy adhesive designed for structural repair. The epoxy adhesive shall be "Sikadur 52" manufactured by Sika Corp., Lyndhurst, NJ, "Duralcrete LV" manufactured by Euclid Chemical Company, Cleveland, OH, "Eucopoxy Injection Resin" by the Euclid Chemical Company, or "MasterInject 1500" by BASF Master Builder Solutions.

2.08 TYPE III CRACK REPAIR - WATERPROOF INJECTION GROUT

A. Type III Crack Repair - Waterproof Injection Grout shall be a one-component, water-activated, extra-low viscosity polyurethane or methacrylic acrylate hydrophilic injection grout capable of 400% expansion. Injection grout shall form a tough flexible foam seal that is impenetrable to water. Hydrophilic injection grout shall be "Prime Flex 900 XLV" manufactured by Prime Resins, Conyers, GA, "AV-333 Injectaflex" manufactured by Avanti International, Webster, TX, or "DeNeef Sealfoam PURe" or “Gelacryl Superflex” manufactured by Grace Construction Products/GCP Applied Technologies or “SikaFix HH Hydrophilic” manufactured by Sika Corp., Lyndhurst, NJ,.

2.09 SPALL REPAIR PATCHING MATERIAL

A. All spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified non-shrink cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar for use in horizontal applications shall be "Sikatop 122 Plus" manufactured by Sika Corp., Lyndhurst, NJ, “Eucocrete Supreme” or “Duraltop Flowable Mortar” by the Euclid Chemical Company, or “MasterEmaco T-302” or “Emaco R310” by BASF Construction Chemicals. Spall repair mortar for use in vertical and overhead applications shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, “Verticoat or Verticoat Supreme” by the Euclid Chemical Company, or “MasterEmaco N 425” or “MasterEmaco N 400” by BASF Master Builder Solutions.

B. All spall repairs requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar shall be "SikaTop 111 PLUS" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme” manufactured by Euclid Chemical Company, Cleveland, OH, or “MasterEmaco T 310 CI” by BASF Master Builder Solutions.

2.10 STORAGE OF MATERIALS

A. The Contractor shall provide an area for repair material storage free from exposure to moisture in any form, before, during, and after delivery to the site. Manufactured materials shall be delivered in unbroken containers labeled with the manufacturer's name and product type. All mortar products shall be stored on raised platforms. Materials susceptible to damage by freezing shall be stored in a dry, heated, insulated area. Any material that has hardened, partially set, become caked and/or has been contaminated or deteriorated shall be rejected. All aggregates shall be stored in clean bins, scows or platforms.

PART 3 – INSTALLATION

3.01 GENERAL REQUIREMENTS

A. No repair work shall be undertaken when ambient temperatures are below manufacturer's safe recommendations. No admixtures, except those required by the manufacturer, shall be used in the repairs specified herein.

B. All products shall be applied in strict accordance with manufacturer's recommendations. The Contractor shall furnish and install safe scaffolding and ladders for the Engineer's prework inspection, the repair work activities, and the Engineer's final inspection.

C. Sandblast or waterblast (3000-5000 psi waterjet) or use low impact hand chipping tools to clean deteriorated areas to remove all loose concrete, existing coatings, unsound material, debris, and laitance. All surfaces shall be clean, free of dirt, grease, loose particles, and deleterious substances and shall be prepared according to manufacturer's requirements.

3.02 EPOXY BONDING AGENT

A. An epoxy bonding agent shall be used when applying fresh concrete to previously placed concrete unless otherwise recommended by the manufacturer.

B. Existing concrete surfaces shall be roughened (1/16” or CSP 5 minimum profile) unless otherwise recommended by the manufacturer prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.

C. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4 "Standard Specification for Repairing Concrete with Epoxy Mortars" (latest edition), except as modified herein.

3.03 ANTI-CORROSION REBAR COATING

A. Exposed reinforcing steel shall have all loose or deteriorated concrete, including ¾-inch around the entire circumference of the exposed steel, removed in accordance with ICRI Guidelines No. 310.R. Reinforcing steel cut or exposed during demolition and/or repair operations shall be sandblasted and cleaned prior to coating with an anti-corrosive coating. Anti-corrosive coating shall be applied as soon as the reinforcement is exposed and cleaned. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

3.04 TYPE I CRACK REPAIR – CEMENTITIOUS SURFACE SEAL

A. Where indicated on the Drawings, or as directed by the Engineer, existing nonstructural cracks 1/16" and wider in vertical and overhead surfaces or existing cracks between 1/16" and 1/4" wide in horizontal surfaces shall be repaired with Type I Crack Repair Material. Rout crack to 3/4" wide by 3/4" deep V-notch to expose sound concrete. Where rebar has deteriorated, or where deteriorated concrete extends below the top of rebar,

crack shall be routed to expose 3/4" all around rebar. The resulting void in concrete shall be patched flush with the existing concrete surface using Type I Crack Repair material.

3.05 TYPE II CRACK REPAIR – EPOXY INJECTION

A. Vertical and Overhead Surfaces

1. Where indicated on the Drawings, or as directed by the Engineer, existing structural cracks 1/4" wide or narrower shall be repaired by pressure injecting Type II Crack Repair material into the prepared crack. Seal crack surface using epoxy resin binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has fully cured, inject crack with Type II Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

B. Horizontal Surfaces

1. Where indicated on the Drawings, or as directed by the Engineer, existing structural cracks 1/4" wide or narrower shall be repaired using Type II Crack Repair by pressure injecting Type II Crack Repair material into the prepared crack. Seal crack surface using epoxy resin binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has fully cured, inject crack with Type II Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

2. Where indicated on the Drawings, or as directed by the Engineer, existing structural cracks wider than 1/4" shall be repaired by gravity feeding Type II Crack Repair material into the prepared crack. First rout the concrete surface to form a 1/4" wide by 1/4" deep v-notch and clean the crack to remove all loose and foreign particles. Fill the crack with clean, dry sand and then pour structural crack repair binder into V-notch, completely filling crack. As binder penetrates into crack, additional binder shall be applied to the V-notch.

3.06 TYPE III CRACK REPAIR – WATERPROOF INJECTION GROUT

A. Existing, leaking cracks 1/4" or smaller, identified as nonstructural by the Engineer, shall be repaired by pressure injecting a Type III Crack Repair material into the prepared crack. Seal crack surface with epoxy binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the

abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, clean, potable water shall be injected into the ports to flush the crack and provide the water necessary for chemical reaction of the grout. Immediately following injection of water, inject the crack with Type III Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

B. All existing, leaking cracks larger than 1/4", not identified as structural by the Engineer, shall be repaired by first soaking oakum rope or open cell backer rod in waterproof injection grout, and then tightly packing the soaked oakum into the crack so as to completely fill the crack.

3.07 SPALL REPAIR PATCHING MATERIAL

A. All voids or spalled areas to be repaired shall be chipped back to sound concrete a minimum 1/8" deep, with a minimum surface profile of CSP-5, cleaned and repaired with spall repair patching material according to manufacturer's recommendations. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface. Prior to commencing repair surface preparation, saw cut or grind a 1/2" deep groove around the perimeter around the repair area, perpendicular to the finished concrete surface to provide a square shoulder to the repair area. Repair areas shall be formed using clean, straight rectangular edges where possible. Final patching on horizontal surfaces shall receive a broom finish consistent with the finish on the existing structure.

3.08 CURING

A. All repair products shall be cured in strict accordance with manufacturer recommendations. Wet curing is preferred where possible.

3.09 WORK IN CONFINED SPACES

A. The Contractor shall provide and maintain safe working conditions for all employees and subcontractors. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or by direct air supply to individual workers. Fumes shall be exhausted to the outside from the lowest level of the confined space. Electrical fan motors shall be explosion-proof if in contact with fumes. No smoking or open fires shall be permitted in or near areas where volatile fumes may accumulate.

END OF SECTION

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SECTION 03 30 05

CONCRETE AND GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the ENGINEER, all in accordance with the Contract Documents.

B. The following types of concrete shall be covered in this Section:

1. Structural Concrete (Class A): Concrete to be used in all cases except where noted otherwise in the Contract Documents.

2. Sitework Concrete (Class B): Concrete to be used for curbs, gutters, catch basins, sidewalks, fence and guard post embedment, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise shown or noted on the Drawings.

C. The following types of grout are covered in this Section:

1. Cement Grout: This type of grout shall be used for grout toppings and for patching of fresh concrete.

2. Non-Shrink Grout: Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy Grout: This type of grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy Base Plate Grout: This type of grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy machinery, etc.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. Commercial Standards:

ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete for Buildings.
ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 309	Guide for Consolidation of Concrete
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures.
ACI 318	Building Code Requirements of Reinforced Concrete.
ACI 347	Recommended Practice for Concrete Formwork.
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM C 31	Test Methods for Making and Curing Concrete Test Specimens in the Field.
ASTM C 33	Specification for Concrete Aggregates.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 88	Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
ASTM C 94	Specification for Ready-Mixed Concrete.
ASTM C 114	Method for Chemical Analysis of Hydraulic Cement
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregate
ASTM C 143	Test Method for Slump of Portland Cement Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C156	Test Method for Water Retention by concrete Curing Materials
ASTM C 157	Test Method for length Change of Hardened Cement Mortar and Concrete
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 227	Standard Test Method for Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar-Bar Method).
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete.
ASTM C 289	Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C 494	Specification for Chemical Admixtures for Concrete.
ASTM C 579	Test Methods for Compressive Strength of Chemical Resistant Mortars and Monolithic Surfacings.
ASTM C 595	Standard Specification for Blended Hydraulic Cements
ASTM C 618	Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
ASTM C 827	Test Method for Early Volume Change of Cemetitious Mixtures.
ASTM C 989	Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
CRD C 621	Non-Shrink Grout
CRSI	Manual of Standard Practice.

C. Any procedure, materials or operation specified by reference to the American Society for Testing and Materials (ASTM), the American Concrete Institute (ACI), Building Code or other references shall comply with the requirements of the current and most recent specifications or standards. In conflicts between listed standards and this specification, the more stringent requirements shall govern.

D. The CONTRACTOR is expected to obtain the most recent issue of all standards, recommendations, codes or specifications referred to within this specification.

1.03 SUBMITTALS

A. Concrete Mix Designs: The design mixes to be used shall be prepared by qualified persons and submitted for review. The design of the mix is the responsibility of the CONTRACTOR subject to the limitations of the specifications. Review processing of this submission will be required only as evidence the mix has been designed by qualified persons and that the minimum requirements of the specifications have been met. Such review will in no way alter the responsibility of the CONTRACTOR to furnish concrete meeting the requirements of the specifications. If in the progress of the work the sources of materials change in characteristics or the CONTRACTOR requests a new source in writing, the CONTRACTOR shall, at his expense submit new test data and information for the establishment of a new design mix. Submit mix designs for all classes of concrete to be used under this Contract. Mix design submittals shall include the following:

1. Sources of all materials and certifications of compliance with specifications for all sources of each material.

2. Certified current (less than one year old) chemical analysis of Portland Cement or Blended Cement to be used.

3. Certified current (less than one year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e. sieve analysis, aggregate soundness tests, etc.

5. Manufacturer's data on all admixtures stating compliance with required standards and are compatible with one another. Written conformance to the above-mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the ENGINEER.

6. Field experience records and/or trial mix data for the proposed concrete mixes.

B. Grout: The CONTRACTOR shall submit shop drawings for all types of grout for use in this Project. Shop drawings shall include certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

C. Accessories: The CONTRACTOR shall submit shop drawings for all types of concrete accessories to be used for this project including, but not limited to, form ties, water stops, joint materials and curing agents.

D. Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall submit delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the State certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.

E. Reinforcing Steel: The CONTRACTOR shall submit shop drawings of shop bending diagrams, placing lists, and Drawings of all reinforcing steel prior to fabrication.

1. The CONTRACTOR shall submit detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66) for all reinforcing steel. These drawings shall be made to such a scale as to clearly show joint locations, openings, the arrangement, spacing and splicing of the bars. Where opening sizes are dependent on equipment selection the CONTRACTOR shall indicate all necessary dimensions to define steel lengths and placing details.

2. Details of the concrete reinforcing steel and concrete inserts shall be submitted by the CONTRACTOR at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

3. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

4. Proposed supports for each type of reinforcing.

5. Certification that all installers of dowel adhesives are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

6. International Code Council-Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

F. Curing: Submit the following:

1. Proposed procedures for protection of concrete under wet weather placement conditions.

2. Proposed normal procedures for protection and curing of concrete.

3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

4. Proposed method of measuring concrete surface temperature changes.

5. Manufacturer's literature and material certification for proposed curing compounds.

1.04 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be as specified in Part 2 – Products.

B. The cost of initial trial mixes and initial laboratory tests to design the mixes including compression tests, sieve analysis, and tests on trial mixes shall be included in the Contract Price.

C. The cost of all laboratory tests on cement, aggregates, and concrete, will be borne by the OWNER. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications.

D. Field quality control tests, as specified in Article 1.05, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

E. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall provide assistance to the ENGINEER in obtaining samples. The CONTRACTOR shall dispose of and clean up all excess material.

F. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 347.

1.05 QUALITY CONTROL

A. Compressive Strength

1. Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the ENGINEER to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each placement, or for each fifty (50) cubic yards of concrete placed, or for each 5000 square feet of surface area for slabs or walls, whichever is greater.

2. Samples of freshly mixed concrete shall be obtained in accordance with ASTM C 172, and compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall consist of at least five 6-inch diameter by 12-inch high cylinders, or eight 4-inch diameter by 8-inch high cylinders. Each cylinder shall be identified by a tag attached to the side of the cylinder.

3. The CONTRACTOR shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the CONTRACTOR. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

4. Compression test shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at 7 days and 2 at 28 days. For 4x8 cylinders, three test cylinders will be tested at 7 days and three at 28 days. The remaining cylinders will be held to verify test results, if needed.

B. Consistency

1. Consistency of the concrete will be checked by the ENGINEER by standard slump cone tests. The CONTRACTOR shall make any necessary adjustments in the mix

as the ENGINEER may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for delays, material or labor costs due to such eventualities.

2. Slump tests shall be made in accordance with ASTM C 143. Slump tests shall be performed as deemed necessary by the ENGINEER and each time compressive strength samples are taken.

C. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the ENGINEER in accordance with ASTM C 231.

2. Air content tests will be performed as deemed necessary by the ENGINEER and each time compressive strength samples are taken.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 215 and ACI 318, Chapter 5 "Concrete Quality Mixing and Placing", and as specified herein.

2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.

3. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at the cost of the CONTRACTOR. Additional testing may also be required to verify compressive strength of concrete. Additional testing shall involve extraction and testing of concrete cores in accordance with ASTM C 42. ENGINEER shall determine locations where concrete cores shall be taken. Nondestructive test methods shall not be used to verify strength of in-place concrete.

PART 2 – PRODUCTS

2.01 FORMWORK

A. Forms and Falsework:

1. All forms shall be smooth surface forms unless otherwise specified.

2. Wood materials for concrete forms and falsework shall be new material and shall conform to the following requirements:

a. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.

b. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

3. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

B. Formwork Accessories:

1. Unless otherwise shown, exterior corners in concrete members shall be provided with ¾-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

2. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.

3. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "Bug Holes" in cast-in-place concrete.

2.02 CONCRETE MATERIALS

A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.

B. All materials furnished for the work shall comply with the requirements of ACI 301, as applicable.

C. Storage of materials shall conform to the requirements of ACI 301.

D. Hydraulic Cement: Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

1. Portland Cement

a. Portland Cement shall be Type II conforming to ASTM C 150.

b. For concrete mixed with only Portland Cement, the total alkalies in the cement (calculated as the percentage of NA2O plus 0.658 times the percentage of K2O) shall not exceed 0.40%

c. For concrete mixed with Portland Cement and an appropriate amount of fly ash or slag cement the total alkalies in the Portland Cement (calculated as the percentage of NA2O plus 0.658 times the percentage of K2O) shall not exceed 0.85%.

2. Blended Cement

a. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.

b. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

c. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.

d. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 E and 2.02 F, respectively.

E. Fly Ash

1. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.

2. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.

3. When fly ash is used, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash.

F. Slag Cement

1. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.

2. When slag cement is used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag.

3. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

G. Water

1. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/1 TDS) shall not be used.

2. Water shall not contain more than 100 PPM chloride.

3. Water shall not contain more than 500 PPM dissolved solids.

4. Water shall have a pH in the range of 4.5 to 8.5.

5. Water shall meet requirements of ASTM C 1602.

H. Aggregates

1. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be nonreactive, and shall conform to the FBC and ASTM C 33. Lightweight sand for fine aggregate will not be permitted. Maximum size of coarse aggregate shall be as specified herein.

2. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33

3. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.

4. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.

5. When tested for soundness in accordance with ASTM C 88, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

6. When tested in accordance with "Potential Reactivity of Aggregates (Chemical Method)" (ASTM C 289), the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

7. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C 40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

8. When tested in accordance with "Resistance to Abrasion of Small size Coarse Aggregate by Use of the Los Angeles Machine" (ASTM C 131), the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.

9. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed

I. Admixtures

1. Air-entraining Admixture shall be added to all concrete unless noted otherwise. Air-entraining admixture meeting the requirements of ASTM C 260 shall be used. The ENGINEER reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.

2. Water reducing and retarding admixtures shall be required at the ENGINEER's discretion or, if not required, may be added at the CONTRACTOR's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at no additional cost to the OWNER. The use of an admixture shall be subject to acceptance by the ENGINEER. Admixtures permitted shall conform to the requirements of ASTM C 494 (chemical admixtures). Admixtures shall contain no free chloride ions, be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air entraining admixture.

2.03 CURING MATERIALS

A. Materials for curing concrete conform to ASTM C 309 Type 1-D, Class B with a minimum solids content of 30% and shall contain a fugitive dye. Curing compound shall be SureCure 30 by Kaufman Products, Inc., CA D.O.T. Acrylic Cure by Symons

Corporation, Sealtight CS-309-30 by W. R. Meadows, or approved equal.

B. Polyethylene sheet for use as a concrete curing blanket shall be white and have a nominal thickness of 6 mils.

2.04 JOINT MATERIALS

A. Materials for joints in concrete above grade nonhydraulic structures shall conform to the following requirements:

1. Preformed joint filler shall be a non-extruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.

2. Joint sealer shall be in accordance to Section 07 90 00 – Sealants and Caulking.

2.05 REINFORCING STEEL

A. General: All reinforcing steel for all reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement, and shall be manufactured in the United States. All reinforcing steel shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on the Drawings

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only. All welded wire fabric reinforcement shall be galvanized.

B. Field welding of reinforcing steel will not be allowed

C. Accessories: Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).

D. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

2.06 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a

dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer’s instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer’s requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer’s instructions.

F. Embedment Depth:

1. The embedment depth of the bar shall be as show on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on “SET-XP” by Simpson Strong-Tie Co. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer’s ICC-ES ESR.

3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer’s ICC-ES ESR.

G. Engineer’s approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete, must comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report. The adhesive system shall be "Epcon System C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Injection Adhesive Anchor System" as manufactured by Hilti, Inc. “SET-XP” as

manufactured by Simpson Strong-Tie Co. or “Pure 110+ Epoxy Adhesive Anchor System” by DeWalt. Fast-set epoxy formulations shall not be acceptable.

I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

2.07 READY-MIXED CONCRETE

A. Ready-mixed concrete shall conform to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

B. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one half hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In hot weather, or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 60 minutes.

2.08 GROUT

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one-part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.

3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.

4. Sand shall conform to the requirements of ASTM C33.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "Sikagrout 212" by Sika

Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “MasterFlow 928” by BASF Corporation.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by BASF Corporation.

2. Epoxy grout shall be modified as required for each application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be “Sikadur 42, Grout-Pak” by Sika Corporation, or “MasterFlow 648” by BASF Corporation.

2.09 CONCRETE DESIGN REQUIREMENTS

A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. The CONTRACTOR is cautioned that the limiting parameters specified below are not design mixes. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR's construction methods. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

Concrete Class A	4,000 psi (minimum)
Concrete Class B	3,000 psi (minimum)

2. Water/cementitious materials ratio, by weight

	Maximum	Minimum
Concrete Class A	0.45	0.39
Concrete Class B	0.50	0.39

3. Slump range

   a. 4" nominal unless high range water reducing admixture is used

   b. 8” max if high range water reducing admixture is used.

4. Air Content

Concrete Class A	6% ±1.5%
Concrete Class B	3% Max (non air-entrained)

PART 3 – EXECUTION

3.01 GENERAL FORMWORK REQUIREMENTS

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed and replaced at the CONTRACTOR's expense. All design, construction, maintenance, preparation, and removal of forms shall be in accordance with the FBC, ACI 347 and the requirements specified herein.

B. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.02 FORMWORK CONSTRUCTION

A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for by the ENGINEER.

B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete.

C. Form Ties: Wire ties for holding forms will not be permitted. No form-tying device or

part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spilling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.

3.03 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.

3.04 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members which must support their own weight shall not have their forms removed until they have attained at least 75 percent of the 28-day strength of the concrete as specified herein. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the ENGINEER.

3.05 FABRICATION OF REINFORCING STEEL

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the ENGINEER.

3.06 PLACING REINFORCING STEEL

A. Reinforcing steel shall be accurately positioned as shown on the Drawings, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to

support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcing steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Bars additional to those shown which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.

E. Reinforcement placing tolerances shall be within the limits specified in ACI 318, unless otherwise directed by the ENGINEER.

F. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs as specified herein. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane shown.

G. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.07 SPLICING

A. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the ENGINEER.

B. Lap length for reinforcement bars shall be in a Class B Splice in accordance with ACI 318, unless otherwise shown. Laps of welded wire fabric shall be in accordance with the ACI 318.

3.08 CLEANING AND PROTECTION OF REINFORCING STEEL

A. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and

other foreign substances immediately before the concrete is placed. Where there is a delay in depositing concrete, reinforcing shall be reinspected and, if necessary, recleaned.

3.09 PREPARATION OF SURFACES FOR CONCRETING

A. General: No concrete shall be placed until the reinforcement steel and formwork have been erected in a manner acceptable to the ENGINEER. The CONTRACTOR shall notify the ENGINEER not less than two working days prior to concrete placement, allowing for inspection and any corrective measures which are required. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the ENGINEER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by sandblasting, followed by thorough washing. All pools of water shall be removed form the surface of construction joints before the new concrete is placed.

C. Existing concrete surfaces upon or against which concrete is to be placed shall be given a roughened surface for good bond. Joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by hydroblasting. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

D. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent work, provided that construction joints shall be made only where acceptable to the ENGINEER.

E. Embedded Items: No concrete shall be placed until all formwork, installation of parts to - be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by shop drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is

the responsibility of the CONTRACTOR.

G. Casting Against Old Concrete: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.

H. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited under water nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.

I. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.

J. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items, and any part of the concrete reinforcement will not be permitted.

K. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.10 MIXING, HANDLING, TRANSPORTING, AND PLACING

A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section.

B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of ACI 301.

C. Retempering: Retempering of concrete or mortar which has partially hardened will not be permitted.

D. Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the CONTRACTOR.

E. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the OWNER. The CONTRACTOR shall notify the

ENGINEER in writing at least 24 hours in advance of placement of any concrete.

F. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screened in an up-slope direction.

G. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing, and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.

H. The surface of the concrete -shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4 inch thick shall be tacked to the forms on these surfaces. The concrete shall be carded about 1/2 inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

I. Conveyor Belts and Chutes: All end of chutes, hopper gates and all other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete, at the places of deposit, is visible from the deck or runway.

J. Temperature of Concrete: The temperature of concrete, when it is being placed, shall not be more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in whether during which the mean daily temperature drops below

40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessarily to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.

3.11 PUMPING OF CONCRETE

A. If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. The minimum diameter of the hose (conduits) shall be 4 inches.

C. Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified herein. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 1 0 percent passing the number 1 00 screen. The fineness modulus of sand shall not be over 3.00.

3.12 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense homogeneous mass, filling all comers and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8,000 or 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.

B. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified with 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.13 FINISHING CONCRETE SURFACES

A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the aligranent, profiles, and dimensions shown on the Drawings are defined as tolerances and are specified herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Formed Surfaces: After removal of forms, the finishes described below shall be applied in accordance with Article 3.13, D. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The ENGINEER shall be the sole judge of acceptability of all concrete finish work.

1. Type I - Rough: All fins, burrs and other projections left by the forms shall be removed. All holes left by removal of ends of ties, and all other holes, depressions, or voids shall be filled solid with cement grout after first being thoroughly wetted. Honeycombs shall be chipped back to solid concrete as directed, prior to patching with cement grout. Holes shall be filled with a small tool that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface. At locations where concrete coatings are specified to be applied, epoxy based patch material or filler surfaces compatible with the coating shall be used in lieu of cement grout specified herein. Concrete finish shall be in strict conformance to the coating / paint manufacturer's recommendations.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Any surplus shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.

3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type I finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted.

C. Unformed Surfaces: The finishes described below shall be applied to unformed surfaces such as floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The ENGINEER shall be the sole judge of acceptability of all

such finish work.

1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to ½" minimum deep grooves prior to final set.

2. Type "B" - Wood Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood float until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. The finished surface shall be true, even, and free from blemishes and other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas, which are to receive a floor covering such as tile, resilient flooring, or carpeting, only one troweling operation is required. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish.

6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03315 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the CONTRACTOR shall notify the ENGINEER and the equipment manufacturer of the details of the operation and obtain approval and recommendations of the equipment manufacturer.

7. Type "G" - Hardened Finish: Either a liquid hardened finish or an aggregate hardened finish shall be provided at the CONTRACTOR's option.

a. Liquid hardened finish shall be provided by application of a liquid floor hardener. Floors to receive this finish shall have previously received a Type "D" finish. Liquid hardener shall be applied between 30 to 60 days after concrete placement. Surface to be treated shall be dry, clean and free of all loose dust, dirt, oil, wax, sealers and curing compounds. Application procedure shall be in accordance with manufacturer's instructions and shall consist of a three-coat treatment.

b. Aggregate hardened finish shall be provided by applying an aggregate floor hardener concurrently with the application of a Type "D" finish. Application procedure shall be in accordance with manufacturer's instructions.

8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip shake-on aggregate concurrently with the application of a Type "D" finish. Application procedure shall be in accordance with manufacturer's instructions.

9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of +/-1/4-inch.

D. CONCRETE FINISH SCHEDULE

Item	Type of Finish
Exterior concrete walls below grade	I
Exterior exposed concrete walls and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
All interior exposed concrete vertical surfaces in buildings	III
Interior exposed ceiling, including beams	III
Slabs to receive roofing material or waterproof membranes	B
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	C
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Floors to receive tile, resilient flooring, or carpeting	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Precast concrete form panels, hollow core planks, double tees	J

3.14 CURING AND DAMPPROOFING

A. All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the work, and described in detail in the following paragraphs.

FINISH SCHEDULE

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4

B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used, the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 4.

C. Method 2: The surface shall be covered With burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.

E. Method 4: The surface shall be sprayed with a liquid curing compound. It shall be applied in accordance with the manufacturers printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.

F. Care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

G. Wherever curing compound may have been applied by mistake to faces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by hydroblasting just prior to the placing of new concrete.

H. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on uniformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing

compound has been applied, the area involved shall first be wet-sand blasted to remove the curing compound, following which repairs shall be made as provided herein.

3.15 PROTECTION

A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the ENGINEER. Fresh concrete shall be protected from damage due to rain. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.16 TREATMENT OF SURFACE DEFECTS

A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.

B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions, by means of an efficient sandblast. The material used for repair proposed shall be acceptable to the ENGINEER.

C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed, but shall be repaired in an approved manner with dry-packed cement grout.

D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.17 CARE AND REPAIR OF CONCRETE

A. The CONTRACTOR shall protect all concrete against injury or damage from excessive

heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the CONTRACTOR's expense. This stipulation includes concrete experiencing cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an epoxy injection system approved by the ENGINEER. Non-structural cracks shall be repaired using a hydrophilic resin pressure injected grout system approved by the ENGINEER, unless other means or repair are deemed necessary and approved by the ENGINEER.

3.18 GROUT INSTALLATION

A. All surface preparation, curing, and protection of cement grout shall be as specified herein. The finish of the grout surface shall match that of the adjacent concrete.

B. The CONTRACTOR through the manufacturer of non-shrink grout, epoxy grout, and epoxy base plate grout shall provide on-site technical assistance upon request, at no additional cost to the OWNER.

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE STRUCTURES

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all materials, labor, and equipment and construct manholes, wet wells, valve pits, meter pits, and accessory items, consisting of precast sections as shown on the Drawings and as specified herein.

B. The forms, dimensions, concrete, and construction methods shall be approved by the Engineer in advance of construction.

C. These specifications are intended to give a general description of what is required, but do not purport to cover all of the structural design details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, shop testing, delivery, and complete installation of all precast structures whether specifically mentioned in these specifications or not.

D. The supplier of the precast manholes, wet wells, valve pits, meter pits, and accessory items shall coordinate his work with that of the Contractor to the end that the unit will be delivered and installed in the excavation provided by the Contractor, in accordance with the Contractor's construction schedule.

E. Coordinate the precast structures fabrication with the equipment supplied to achieve the proper structural top slab openings, spacings, and related dimensions for the selected equipment frames and covers. The top slabs, frames, covers, and subsurface structures shall be capable of supporting a live load of 150 pounds per square foot.

1.02 SUBMITTALS

A. Submit to the Engineer, as provided in the General Conditions, shop drawings showing details of construction, reinforcing and joints.

B. Shop Drawings

1. Content:

a. Dimensions and finishes

b. Estimated camber

c. Reinforcing and connection details

d. Anchors

e. Lifting and erection inserts

f. Other items cast into members

2. Show location of unit by same identification mark placed on member.

3. Include design calculations.

C. Manufacturer's Literature: Manufacturer's recommended installation instructions.

D. Manufacturer's certificates of material conformance with specifications.

E. Test Reports: Reports of tests on concrete.

F. Testing

1. Certification: The supplier shall provide the certified results of testing (7 day, 28 day) for the test cylinders stated herein. Random test cylinders may be taken at any time by the Engineer at the Owner's expense.

1.03 INSPECTION

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representatives of the Owner. Such inspection may be made at the place of manufacture, or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected, and if already installed, shall be repaired, if permitted and accepted by Engineer, or removed and replaced, entirely at the Contractor's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with ASTM C478 designation and these Specifications, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

C. Imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days, Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

PART 2 – PRODUCTS

2.01 PRECAST CONCRETE SECTIONS FOR CIRCULAR WET WELLS

A. Wet wells shall meet the requirements of ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections, with the exclusion of Section 10(a), except as modified herein. Cement shall meet the requirements of ASTM C150-74, Specification for Portland Cement, Type II. Concrete shall meet the minimum requirement for 4000 psi concrete. Minimum wall thickness shall be 8 inches or 1/8 the inside manhole diameter as shown, whichever is greater. The required minimum strength of concrete shall be confirmed by making and testing three standard cylinders at seven days. Rings shall be custom made with openings to meet indicated pipe alignment conditions and invert elevations. Submit shop drawings, consisting of manufacturers' standard details of various sections for approval prior to placing order for wet wells. Drawings of individual wet wells showing invert elevations, pipe sizes and similar details will not be required.

B. Joints

1. Form joint contact surfaces with machined castings. Surfaces shall be exactly parallel with nominal 1/16 inch clearing and the tongue equipped with a proper recess for the installation of a rubber gasket. Gaskets shall meet the requirements of Specification for Joint for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets. An approved sealing compound (see LCU Approved Materials List) conforming to Federal Specification S-SS-210 (GSA-FSS), Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints may be used in lieu of rubber gaskets. If joints are sealed with an approved sealing compound the recess in the tongue for a gasket may be omitted.

C. Wet Well Liners and Coatings

1. Coat or line the interior of all wet wells with Owner approved system as shown in the Owner-Approved Materials List.

2. Furnish, install, test and inspect liners and coating in accordance with manufacturer's recommendations. Extend coating and liner and seal onto wet well hatch frame, around pipe openings and other protrusions to prevent contact of wet well surface with corrosive sewer gases.

2.02 PIPE CONNECTIONS AT STRUCTURES

A. Where pipes are to extend into or through structures from the exterior, flexible connections (mechanical or push-on type joints) shall be provided at the exterior wall face.

B. For pipes passing through structural walls, wall pipes with water stops shall be installed where the location is below the surface of the ground or at any point where fluid levels will exceed

that elevation. Neoprene sleeves with watertight caulking and 316 Series SS stainless steel clamps will be suitable at other locations.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for control of ground water to provide firm, dry subgrade for the structure, shall prevent water rising on new poured in place concrete or grouted joint sections within 24 hours after placing, and shall guard against flotation or other damage resulting from ground water or flooding.

B. A minimum of a 12 inch layer of crushed stone or shell as specified under Section 31 23 23 shall be placed as a foundation for the wet well base slabs, valve pits, and meter pits.

C. Backfill material around the wet well and above the pipe bedding shall be selected material as specified in Section 31 23 23.

D. Precast bases, conforming to all requirements of ASTM C478 and above listed requirements for precast sections, may be used. The base shall be set in place on a thoroughly compacted crushed stone sub-base and adjusted in grade for the correct structure elevation.

E. The station shall not be set into the excavation until the installation procedure and excavation have been approved by the Engineer.

F. The base may be cast-in-place concrete as specified in Division 03, placed on a thoroughly compacted crushed stone sub-base. The tops of the cast-in-place bases shall be shaped to mate with the precast barrel section, and shall be adjusted in grade so that the top slab section is at the approximately correct elevation.

G. Precast concrete structure sections shall be set so as to be vertical and with sections in true alignment with a 1/4 inch maximum tolerance to be allowed. The outside and inside joint shall be filled with a non-shrink grout and finished flush with the adjoining surfaces. Allows joints to set for 24 hours before backfilling. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. If leaks appear in the structures, the inside joints shall be caulked with lead wool to the satisfaction of the Engineer. Install the precast sections in a manner that will result in a watertight joint.

H. Holes in the concrete sections required for handling or other purposes shall be plugged with a non-shrinking grout or by grout in combination with concrete plugs.

I. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done by core drilling prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.

END OF SECTION

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Division 05

SECTION 05 05 23
METAL FASTENING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 12 00 – Structural Steel

D. Section 05 14 00 – Structural Aluminum

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements

3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

4. ACI 318 – Building Code Requirements for Structural Concrete

5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete

6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete

7. AISC 348 – The 2009 RCSC Specification for Structural Joints

8. AISC – Code of Standard Practice

9. AWS D1.1 – Structural Welding Code – Steel

10. AWS D1.2 – Structural Welding Code – Aluminum

11. AWS D1.6 – Structural Welding Code – Stainless Steel

12. Aluminum Association – Specifications for Aluminum Structures

13. ASTM A572/A572M-94C – Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50

14. ASTM A36 – Standard Specification for Carbon Structural Steel

15. ASTM A489 – Standard Specification for Eyebolts

16. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts

17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe

18. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

19. ASTM F436 – Standard Specification for Hardened Steel Washers

20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use

21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs

22. ASTM F594 – Standard Specification for Stainless Steel Nuts

23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.

2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Florida. Only required if design not shown on Contract Drawings.

3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.

4. Manufacturer's installation instructions.

5. Copy of valid certification for each person who is to perform field welding.

6. Certified weld inspection reports, when required.

7. Welding procedures.

8. Installer qualifications.

9. Certification of Installer Training.

10. Inspection Reports.

11. Results of Anchor Proof Testing.

12. For outdoor equipment, anchorage calculations to resist wind loads, signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (for mechanical anchors) or 355.4 (for adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).

C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installers for anchor installations in horizontal to vertically overhead applications shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

D. Installer Training: For concrete anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.

6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information

7. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

G. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

I. Inspections of the adhesive dowel system shall be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 – PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

A. For all conditions throughout this Contract, all anchor bolts shall be Type 316 stainless steel conforming to ASTM F-593 unless noted otherwise.

B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.

C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

D. Equipment manufacturers, fabricators, and suppliers shall design and furnish anchor bolts as required to install the supplied units. The anchor bolt layout shall be coordinated with concrete work as specified herein.

E. Drilled in type anchor bolts, either adhesive types or mechanical types shall not be used unless approved in writing by the manufacturer/fabricator of equipment or covers, subject to acceptance by the Engineer. All operating pieces of equipment such as pumps, generators, motors etc. shall not be anchored with wedge anchors or other mechanical anchors. Drilled in type anchor bolts shall be Type 316 stainless steel.

2.02 HIGH STRENGTH BOLTS

A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125. Bolts, nuts and washers shall meet the requirements of RCSC Specification for Structural Joints Using High Strength Bolts".

B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F-593 Grade A325 or F1852. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:

    a. Mechanical anchors include any of the following anchors:

        i. Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.

        ii. Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one piece, heavy duty screw anchors with a finished head.

    b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.

3. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire-resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.

4. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Wedge Anchors:

    a. Do not use when subjected to vibration.

    b. Do not use in exterior locations or locations subjected to freezing.

    c. Do not use in submerged, intermittently submerged, or buried locations.

    d. Suitable for use in overhead applications.

C. Screw Anchors:

a. Do not use when subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Do not use in overhead applications.

D. Sleeve Anchors:

a. Do not use when subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Suitable for use in overhead applications.

E. Undercut Anchors:

a. Suitable for use where subjected to vibration.

b. Do not use in exterior locations or locations subjected to freezing.

c. Do not use in submerged, intermittently submerged, or buried locations.

d. Suitable for use in overhead applications.

F. Adhesive Anchors in Concrete:

a. Suitable for use where subjected to vibration.

b. Suitable for use in exterior locations or locations subjected to freezing.

c. Suitable for use in submerged, intermittently submerged, or buried locations.

d. Do not use in overhead applications, unless otherwise shown or approved by Engineer.

e. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

G. Adhesive Anchors in Masonry

a. Suitable for use where subjected to vibration.

b. Suitable for use in exterior locations or locations subjected to freezing.

c. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

d. Suitable for use in precast hollow core planks.

H. Concrete Anchor Design:

1. An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

a. The Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State or Commonwealth in which the project is located. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Chapter 17.

b. Embedment Depth

a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on ""Pure 110+ by DeWalt" ESR 3298 issued 7/2017. If the Contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).

c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long-term temperature of 110 degrees F, and maximum short-term temperature

of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

I. Anchors:

1. Mechanical Anchors:

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Power-Stud+SD1" or "Power-Stud+ SD-2" by DeWalt.

b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" or "Stainless Steel Titen HD" by Simpson Strong-Tie Co., or "Screw-Bolt+" by DeWalt. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by DeWalt.

d. Shallow Embedment Internally Threaded Insert (3/4" max embedment): "Mini-Undercut +Anchor" by DeWalt, "HSC-A" by Hilti, Inc. or approved equal.

e. Concrete Undercut Anchors: Concrete undercut anchors shall be "HDA Undercut Anchors" by Hilti, Inc, "DUC Ductile Undercut Anchor", by USP Structural Connectors, or approved equal.

f. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193 and shall have a valid evaluation report in accordance with the applicable building code.

2. Adhesive Anchors:

a. Adhesive anchors shall be "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-3G Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt.

b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308 and shall have a valid evaluation report in accordance with the applicable building code.

c. No “or equal” products will be considered unless prequalified and approved by the Engineer and Owner.

J. Concrete Anchor Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

3. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.

B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust prior to installation of adhesive and anchor. Contractor shall follow manufacturer’s installation instructions. The adhesive system shall be “HIT HY-270 System” as manufactured by Hilti, Inc., or “AC100+ Acrylic Adhesive” by DeWalt, “SET-XP” as manufactured by Simpson Strong-Tie Co.

C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

E. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

F. Although all manufacturers listed are permitted, the masonry anchor design is based on "SET-XP" by Simpson Strong-Tie ER 265 Revised 1-31-2017. If the Contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the proposed product and the Contractor shall provide the conditions stipulated by the Engineer specific to the approved adhesive anchor.

2.06 WELDS

A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).

B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.

C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.01 MEASUREMENTS

A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 FASTENER INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.

3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.

4. All stainless-steel threads shall be coated with anti-seize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with RCSC “Specification for Structural Joints Using High Strength Bolts”. All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Stainless Steel Bolts

1. Where connections indicate the use of stainless-steel bolts, the bolts shall be installed to the snug tight condition. Connections shall include stainless steel washers under both the bolt head and the nut head. Lock washers shall be utilized for all connections and shall be placed under the nut head.

D. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.

2. Concrete Anchor Testing:

a. At all locations, at least 25 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.

b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located. The Contractor's Engineer shall also submit documentation indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.

d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.

3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets

in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

5. All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 D.9.2.2. Current AAI Certificate must be submitted to the Engineer of Record prior to commencement of any adhesive anchor installations.

E. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with an approved dielectric.

2. All stainless-steel bolts shall be coated with anti-seize lubricant.

3.03 WELDING

A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

C. Welds shown on the Drawings with a field weld symbol shall be field welded. All other welds shall be shop welded unless specifically approved by the Engineer.

3.04 INSPECTION

A. High strength bolting will be visually inspected in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". Rejected bolts shall be either replaced or retightened as required.

B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION

SECTION 05 10 00
METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Materials for fasteners are included in Section 05 05 23 – Metal Fastening.

B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM A36 – Standard Specification for Structural Steel

B. ASTM A47 – Standard Specification for Malleable Iron Castings

C. ASTM A48 – Standard Specification for Gray Iron Castings

D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality

I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

L. ASTM A536 – Standard Specification for Ductile Iron Castings

M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

O. ASTM A992 – Standard Specification for Structural Steel Shapes

P. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings

S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings

T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings

U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes

V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate

W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod

Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials, the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 – PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

Steel W Shapes	A992
Steel HP Shapes	A572 Grade 50
Steel M, S, C,and MC shapes and Angles, Bars, and Plates	A36
Rods	F 1554 Grade 36
Pipe - Structural Use	A53 Grade B
Hollow Structural Sections	A500 Grade C or A1085
Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

A. All stainless steel fabrications shall be Type 316, unless noted otherwise.

B. Material types and ASTM designations are listed below:

Plates and Sheets	ASTM A167 or A666 Grade A
Structural Shapes	ASTM A276
Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

Structural Shapes	ASTM B308
Castings	ASTM B26, B85, or B108
Extruded Bars	ASTM B221 - Alloy 6061
Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
Plates	ASTM B209 - Alloy 6061
Sheets	ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05 14 00 – Structural Aluminum.

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

Gray	ASTM A48 Class 30B
Malleable	ASTM A47
Ductile	ASTM A536 Grade 60-40-18

2.05 BRONZE

A. Material types and ASTM designations are listed below:

Rods, Bars and Sheets	ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

2.07 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			●	●	●	●	●	●	●
Galvanized Steel			●	●	●	●	●	●	●
Aluminum	●	●		●	●	●	●	●	●
Cast Iron	●	●	●				●	●	●
Ductile Iron	●	●	●				●	●	●
Mild Steel/ Carbon Steel	●	●	●				●	●	●
Copper	●	●	●	●	●	●			●
Brass	●	●	●	●	●	●			●
Stainless Steel	●	●	●	●	●	●	●	●	

1. "●" signifies dielectric isolation is required between the two materials noted.
2. Consult Engineer for items not listed in table.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Florida Building Code

2. AISC – "Code of Standard Practice"

3. AISC – "Specification for Structural Steel Buildings"

4. AISC 348 – "The 2009 RCSC Specification for Structural Joints”

5. AWS – "Structural Welding Code"

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

4. Certified weld inspection reports.

5. No fabrication shall be started until shop drawings have been approved by the Engineer.

6. Where structural design of the steel is not indicated on the Drawings, the Contractor shall submit design drawings of the steel framing, connections and anchor bolts. Such drawings shall be signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

B. The Owner may engage inspectors to inspect welded connections and to perform tests and prepare test reports.

1. Ten percent of all butt and bevel welds which extend continuously for 24 inches or less will be completely tested in accordance with AWS D1.1, Part B, Radiographic Testing of Welds, Chapter 6. All butt and bevel welds which extend continuously for more than 24 inches will be spot tested at intervals not exceeding 36 inches.

2. Welds that are required by the Engineer to be corrected shall be corrected or redone and retested as directed, at the Contractor's expense and to the satisfaction of the Engineer and/or an acceptable independent testing lab.

C. The erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector, Category ACSE.

D. The fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Plant, Category STD.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural Steel

1. Structural steel for W shapes shall conform to ASTM A992 unless otherwise indicated.

2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.

3. Structural steel for S, M, C, and MC shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.

4. Steel pipe shall be ASTM A53, Grade B.

5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.

6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.

7. Fasteners for structural steel shall be in accordance with Section 05 05 23 – Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05 05 23 – Metal Fastening.

PART 3 – EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods, vent and drain holes or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

E. Where galvanizing of structural steel is required, it shall be done in accordance with Section 05 05 13 – Galvanizing.

F. Anchor Bolts:

1. All anchor bolts for structural steel erection and other incidental items of the structural steel required to be built into concrete shall be properly set and securely held in position in the forms before the concrete is placed.

2. Anchor bolts and setting plans for steel columns shall be provided at the site, marked or tagged for ready identification.

3. Bolts shall be accurately set to template and at elevation to provide suitable projection above concrete and/or grout. Maximum tolerances allowable from indicated locations are: (tolerances may be tighter for manufactured/fabricated elements of work):

   a. Elevation of concrete before grouting: $\pm$ 1/4 inch.

   b. Elevation of top of anchor bolts: + 1/2 inch to 0 inch under.

   c. Line of anchor bolt: $\pm$ 1/8 inch.

4. All holes in structural steel members required for anchors, anchor bolts, bolt holes, sag rods for securing wood or other members or for passing of other work noted on the drawings shall be provided by the fabricator and detailed on the Shop Drawings.

5. Where misalignment between anchor bolts and bolt holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that

might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened.

C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23 – Metal Fastening.

F. All bolted connections shall use high strength bolts in accordance with Section 05 05 23 – Metal Fastening. High strength bolts shall be installed in accordance with AISC 348 “The 2009 RCSC Specification for Structural Joints”. Bolts specified or noted on the Drawings to be a tension or slip critical “SC” type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 30 05 – Concrete and Grout.

4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09 90 00 – Painting and the following additional requirements.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.

2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.

3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

END OF SECTION

SECTION 05 14 00
STRUCTURAL ALUMINUM

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 09 90 00 – Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. Florida Building Code

2. Aluminum Association "Specifications for Aluminum Structures"

3. AWS D1.2 – "Structural Welding Code"

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural aluminum shall comply with Section 05 10 00 – Metal Materials.

B. Fasteners for structural aluminum shall be in accordance with Section 05 05 23 – Metal Fastening.

C. Electrodes for welding shall be in accordance with Section 05 05 23 – Metal Fastening.

PART 3 – EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural aluminum members required for anchors, anchor rods, bolts, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened.

C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23 – Metal Fastening.

F. All bolted connections shall comply with Section 05 05 23 – Metal Fastening.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 30 05 – Concrete and Grout.

4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09 90 00 – Painting.

B. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 09 90 00 – Painting.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.

B. Work shall include but may not be limited to lintels, guard posts, hoppers, and chutes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 05 13 – Galvanizing

D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specifications for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used in metal fabrications shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal fabrication shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 LINTELS

A. Provide lintels as shown on the Drawings and specified herein with 8 inches minimum bearing each side unless noted otherwise.

B. All lintels shall be steel in accordance with Section 05 12 00 – Structural Steel and shall be galvanized in accordance with Section 05 05 13 – Galvanizing, unless noted otherwise.

2.04 GUARD POSTS (BOLLARDS)

A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.

B. Guard posts shall be concrete filled and crowned, as detailed in the Drawings.

C. Provide bollard cover post, as detailed on Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal work shall be field painted when as specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

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SECTION 05 50 01
GALVANIZING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: All galvanizing of metals when such coating is specified, except as otherwise shown, specified or required.

1.02 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 123 - Specification for Zinc-Coated (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. ASTM A 153 - Specification for Zinc Coating (Hot-Dip) On Iron and Steel Hardware

3. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

4. ASTM A 385 - Practice for Providing High-Quality Zinc-Coatings (Hot-Dip)

5. ASTM A 392 - Specification for Zinc-Coated Steel Chain-Link Fence Fabric

6. ASTM A 53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated Welded and Seamless

7. ASTM A 121 - Specification for Zinc-Coated (Galvanized) Steel Barbed Wire

8. ASTM A 143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

9. ASTM A 384 - Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanization of Steel Assemblies

10. ASTM B 6 - Specification for Zinc (Slab Zinc)

11. MIL-P-21035B - Paint High Zinc Dust Content, Galvanizing Repair

12. MIL-P-26915C - Primer Coating Zinc Dust Pigmented for Steel Surfaces

PART 2 – PRODUCTS

2.01 MATERIALS

A. Standard: Meet the requirements of ASTM B 6 and "Prime Western" grade, or equal, for zinc for galvanizing, zinc coating or plating.

PART 3 – EXECUTION

3.01 PREPARATION

A. General: Blast clean or grind smooth wrought metals and castings. Tumble and grind flush all high spots when a smooth coat is required for castings. Normalize castings to prevent cracking.

B. Base Metal Cleaning: Thoroughly clean base metal. Remove all welding slag and burrs. Remove surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation, by blast cleaning, by immersion in a caustic bath, acid pickle and flux or other approved method.

C. Product Preparation: Fabricate structural steel products and assemblies to be galvanized in accordance with ASTM A 143, A 384, A385 and Class I guidelines as shown in "Recommended Details of Galvanized Structures" as published by American Hot-Dip Galvanizers Association, Inc.

3.02 APPLICATION

A. Hot Dip: Use the hot-dip process for galvanizing as required by the appropriate ASTM and American Hot-Dip Galvanizers Association, Inc. specifications.

1. Do not allow the dipping to come in contact with or rest upon the dross during the operation.

2. Do not use procedures tending to agitate the dross.

B. Required Facilities: Perform the galvanizing and coating in a plant having the required facilities to produce the quality of coatings specified and with ample capacity for the volume of work required. Handle and ship galvanized material in a manner which will avoid damage to the zinc coating.

C. Requirements: Perform galvanizing in accordance with the requirements of the following specifications:

	Item	ASTM
1.	Iron and steel products	A 123

2.	Iron and steel hardware	A 153
3.	Chain for chainwheel operators	A 153
4.	Chainwheels and Guides	A 123
5.	Steel sheets	A 924
6.	Assembled products	A 385 & A
7.	Steel chain link fence fabric	A 392 Class II
8.	Steel pipe	A 53
9.	Steel barbed wire	A 121

3.03 INSTALLATION

A. Field Coating for Touch-Up: Coat all field welds, abraided areas where damage is more than 3/16-inch wide or uncoated cut edges in material more than 1/10-inch thick with an organic zinc-rich paint complying with MIL-P-21035B or MIL-P-26915C in multiple coats to dry film thickness of 8 mils.

END OF SECTION

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SECTION 05 51 00
METAL STAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

D. Section 05 12 00 – Structural Steel

E. Section 05 14 00 – Structural Aluminum

F. Section 05 52 00 – Guards and Railings

G. Section 05 53 00 – Metal Gratings, Trench Covers, and Floor Plates

H. Section 05 55 00 – Stair Treads and Nosings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specification for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for metal stairs shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal stairs shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 METAL STAIRS AND LANDINGS

A. Stair stringers and structural framing of landings shall be fabricated from aluminum as indicated on the Drawings.

1. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6 in accordance with Section 05 14 00 – Structural Aluminum.

B. All stair treads shall be aluminum in accordance with Section 05 55 00 – Stair Treads and Nosings.

C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to Section 05 53 00 – Metal Grating, Trench Covers, and Floor Plates.

D. Handrails for metal stairs shall conform to Section 05 52 00 – Guards and Railings. Contractor shall coordinate attachment of handrails to metal stairs.

E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.

F. Closure plates shall be provided for all exposed ends of stringers.

G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.

H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

2.04 STEEL PAN STAIRS

A. General

1. All steel stairs and landings with concrete filled steel pan risers and treads shall meet all applicable OSHA, ANSI, and NFPA codes.

2. Stair assemblies shall conform to the dimensions and arrangements shown on the Drawings.

3. Stair assemblies shall be designed to support a minimum 100 psf live load unless otherwise indicated on the Drawings.

4. Steel framing, hangers, columns, struts, clips, brackets, bearing plates, and other necessary appurtenances shall be provided for support of stairs and platforms as shown on the Drawings.

5. Exposed portions of steel pans, platforms, framing system stringers, and portions of aluminum nosings in contact with concrete, steel, or masonry shall be painted in accordance with Section 09 90 00 – Painting.

6. Concrete fill shall be 3-inches thick for platforms and 1-1/2 inches thick for pan treads.

7. Cast-in-place safety stair nosings in accordance with Section 05 55 00 – Stair Treads and Nosings, shall be provided for treads and platforms.

8. Metal pan treads, platforms, and risers shall be fabricated from 0.1084-inch thick (12 gauge minimum), galvanized structural steel sheets.

9. Risers and treads shall be supported by steel angle brackets welded to the stringers. Metal pans shall be secured to the brackets with welds.

10. Closure pieces shall be provided for ends of stringers.

B. Connections

1. All connections shall be welded unless otherwise shown on the Drawings or specified herein. All welds shall be continuous and ground smooth where exposed. Welding shall conform to Section 05 05 23 – Metal Fastening.

2. Assemblies shall be fabricated such that bolts and other fastenings do not appear on finished surfaces.

3. All joints shall be true and tight, and connections between parts shall be light-proof tight.

C. Handrails for steel pan stairs shall conform to Section 05 52 00 – Guards and Railings. Contractor shall coordinate connection of handrails to stairs.

2.05 ALTERNATING TREAD STAIRS

A. Stairs, landings, and platforms shall be designed to carry a live load of 100 lbs. per square foot, unless noted otherwise on the Drawings.

B. The stairs shall be welded, alternating tread type stairs having a center spine and a cast integrally welded combination mounting plate and top landing, flush with the upper floor level. Handrails shall be custom formed and contoured to provide close body support and shall be welded on to the balusters which extend directly from the treads. All risers shall be equal, including the first and last risers, and treads shall have anti-skid surfaces. The stringer bottoms shall be bent and/or cut and welded to a floor plate. All exposed connections shall be welded and ground smooth.

C. Treads, floor plate castings, and landing shall be aluminum alloy AAF356F. Half treads shall be at least 9-inches wide and 10-inches deep. The central stringer shall be aluminum alloy 6063-T52, 1-3/4-inches x 4 inches x 1/8-inch box shape. Handrails shall be aluminum alloy 6061-T4. Finish shall be Aluminum Association M12C22A41.

D. The alternating tread type stairs shall be Model 68AL, as manufactured by Lapeyre Stair, Harahan, Louisiana.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal stairs shall field painted when specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

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SECTION 05 52 00
GUARDS AND RAILINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal guards and railings in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

3. Structural calculations on guard and handrail system sealed by a Professional Engineer currently licensed in the State of Florida.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain handrails and railing systems from a single manufacturer.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for guards and railings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in guards and railings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 GUARDS AND RAILINGS

A. General - Guard systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation.

1. All guard systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 finish, unless otherwise noted.

2. Metal railings shall be fabricated from 1-1/2 inch Schedule 40 minimum pipe. Metal railing support posts shall be fabricated from 1-1/2 inch Schedule 80 minimum pipe.

3. The top of the upper guard rail shall be 42 inches above the walking surface for level guards. For stair guards, the top of the upper guard rail shall be 42 inches above the leading edge of the tread nosing. The top of stair handrail shall be 34 inches above the leading edge of the tread nosing.

4. Posts

    a. Maximum horizontal spacing between posts for level rail shall be six feet.

    b. Maximum horizontal spacing between posts for stair rail shall be five feet.

5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

6. Toeboards

    a. Toeboards shall project 4-inches above the walking surface and shall not infringe on the minimum required walkway width.

    b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

c. Toeboards shall have a minimum thickness of 1/8" at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.

7. Expansion joint splices shall be provided at 30 foot maximum spacing and at all expansion joints in the structure supporting the guards.

8. The guard system shall be designed to resist the design loads specified by both OSHA and the Florida Building Code.

9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the Florida Building Code.

B. The Contractor shall have the option of providing a guard system of either an all welded type construction or a component type construction.

1. With both the all welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.

2. Component Type System

a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.

b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match guard material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.

c. Component type guards shall be as manufactured by Thompson Fabricating Company, Inc., or Hollaender Manufacturing Company, Inc.

3. Welded guards may be field assembled using component type fittings as described herein.

C. Where gates are required in guards as shown on the Drawings, they shall be self-closing and shall be provided by the same manufacturer as the guards. Gates shall swing away from the opening being protected by the guards.

D. Where safety chains are required in guards as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be 3/8-inch bolts with 3/4-inch eye diameter welded to the railing posts. Two (2) chains, four inches longer than the anchorage spacing shall be supplied for each guarded area.

2.04 FREE STANDING RAILING SYSTEM

A. Free standing railing system shall be installed on roof ledges where accessible equipment is provided on roof and roof does not have a perimeter parapet wall of a minimum height of 42 inches. Free standing railing system shall be Safety Rail 2000 Guardrail System by BlueWater Mfg., Inc. or approved equal.

B. Toe Board brackets shall be used when the parapet wall is less than 3-1/2” in height.

C. Performance Characteristics: Shall meet and exceed OSHA (Standards - 29 CFR) 1926.502 (b).

1. Railing System shall be designed to withstand a minimum 200 pounds of test load in any direction.

2. Railing System shall consist of a top rail and rail at mid height between top rail and walking surface.

3. Railing system shall extend to a height of at least 42" from the finished roof deck.

4. Railing system shall be free of sharp edges and snag points.

D. Railing and Base

1. Rail shall be 1 5/8” O.D. Hot Rolled Pickled Electric Weld Tubing

2. Each support post shall have a free standing base cast from Class 30 Gray Iron material.

3. Each base shall have four (4) receiver posts for accepting the rails.

4. The receiver posts shall have a positive locking system. A friction locking system will not be acceptable.

5. The receiver posts shall have a slot to enable the rails to be mounted in any direction.

E. Hardware

1. The securing pins shall be made from 1010 carbon steel. The pins shall be zinc plated and yellow chromate dipped. The pins shall consist of a collared pin and a lanyard that connects to a lynch pin.

2. For Gate Assemblies Only. Bolts and washers shall be 3/8" x 3 ½" and 3/8" x 3" grade 5, zinc plated.

3. Finish

a. Rails: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

b. Bases: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. Concrete anchors and bolts for attachment of guard baseplates to supporting members shall conform to Section 05 05 23 – Metal Fastening.

G. All fabricated items shall be shop painted in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of guards and railings shall be performed in strict accordance with manufacturer's recommendations.

B. All guards and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

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SECTION 05 53 00
METAL GRATING, TRENCH COVERS, AND FLOOR PLATES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Technical requirements for metal grating, trench covers, and floor plates.

1.02 REFERENCES

A. General: References to standards, specifications, manuals, or codes of any technical society, organization or association, or to the Laws or Regulations of any government authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

B. ANSI/NAAMM Standards

1. ANSI/NAAMM MGB 53 1 Metal Bar Grating Manual

1.03 SYSTEM DESCRIPTION

A. Furnish and install metal grating, trench covers, floor plates, and appurtenances required to complete work shown and specified.

B. Furnish and install metal grating, trench covers, floor plates, and appurtenances as shown on the Drawings and specified in this Section

C. New aluminum grating shall be same type as existing aluminum grating.

1.04 SUBMITTALS

A. Submit the following:

1. Product data for manufactured products.
2. Shop drawings showing plans, elevations and details of sections and connections. Show type and location of fasteners.

PART 2 – PRODUCTS

2.01 GRATING

A. Grating, General.

1. Grating bar section, depth and spacing shall be based upon a uniformly applied load of 200 pounds per square foot over the full span unless a greater loading is noted on the Drawings. Grating deflection shall not exceed L360 or 1/4 inch whichever is less. Provide stiffener angles as required to meet load requirements specified in this Section.

2. Bearing bars and cross bars shall be continuous.

3. Exposed ends of grating bearing bar and cut outs shall be banded with a bar of the same depth and thickness as the main bearing bars. When welded construction is used, weld cut bar to band bar. When crimped or swaged construction is used, limit protrusion of bars at edges to 1/16-inch, maximum, and peen or grind protruding bars to a smooth surface.

4. Provide cutouts in grating for valve operators, conduits, pipes, and other penetrations. Band edges of cutouts.

5. Grind rough weld beads and sharp metal edges smooth.

6. Punch bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. Whenever needed, because of metal thickness, sub-punch and ream holes, or drill holes.

7. Fabricate grating in sections, which do not exceed *75* pounds each.

B. Aluminum Grating

1. Aluminum Grating Manufacturers listed in Owner-Approved Materials List.

2. Aluminum Grating Material

   a. Aluminum grating bearing and crossbars shall be 6063-T6 aluminum alloy.

   b. Aluminum grating shall have mill finished.

3. Aluminum Grating Fabrications

   a. Aluminum grating fabrications and tolerances shall meet the requirements of NAAMM Metal Bar Grating Manual.

   b. Maximum allowable deflection for aluminum grating specified in this Section shall be based on an allowable stress of 12,000 pounds per square inch.

c. Grating depth shall be not less than the depth indicated on the Drawings. In no

4. Aluminum I-Bar Grating

   a. Aluminum I-Bar grating shall have extruded aluminum I-shaped bearing bars with square cross bars swage-locked at right angles to bearing bars.

   b. Bearing bars and cross bars shall be spaced as follows, unless otherwise shown on the Drawings.

      1) Bearing Bar Spacing: 1-3/16 inches center-to-center.

      2) Cross Bar Spacing: 4 inches center-to-center.

   c. Surface shall have a no skid finish.

5. Aluminum Rectangular Bar Grating

   a. Aluminum rectangular bar grating shall be pressure backed grating with rectangular bearing bars and square, or rectangular, cross bars swage-locked at right angles to bearing bars.

   b. Bearing bars and cross bars shall be spaced as follows, unless otherwise shown on the Drawings.

      1) Bearing Bar Spacing: 1-3/16 inches center-to-center.

      2) Cross Bar Spacing: 4 inches center-to-center.

   c. Surface shall have a no skid finish.

6. Aluminum Grating Frame

   a. Aluminum grating set in concrete floor shall be furnished with aluminum grating frame. Aluminum grating manufacturer shall furnish angle frame.

   b. Grating frames shall be mitered and welded flush at comers for a finish appearance.

   c. Furnish angle frames with AISI 316 stainless steel anchor straps.

7. Aluminum Grating Accessories

   a. Provide saddle clips and grating clamps necessary to secure grating.

b. Clamps and bolts used for attaching the grating to supporting members shall be stainless steel, and as recommended by the manufacturer.

2.02 TRENCH COVERS

A. Trench Covers, General

1. Trench covers shall be designed for a uniformly applied load of 300 pounds per square foot over the full span unless a greater loading is noted on the Drawings.

2. Trench cover deflection shall not exceed L/360 or ¼-inch whichever is less.

3. Provide stiffener angles as required to meet load requirements specified in this Section.

B. Aluminum Trench Covers

1. Aluminum Trench Cover Material

a. Aluminum trench covers shall be 6063-T6 aluminum alloy, unless otherwise shown or specified.

b. Aluminum trench covers shall have mill finished, unless otherwise shown or specified.

2. Aluminum Trench Covers, General

a. Maximum allowable deflection for aluminum trench covers specified in this Section shall be based on an allowable stress of 12,000 pounds per square inch. Trench cover thickness shall be as shown on the Drawing, but in no case shall trench covers be less than 1/4-inch thick.

b. Aluminum trench covers shall be aluminum checkered plate equal to ALCOA C-102 aluminum tread plate and Reynolds diamond tread plate.

c. Punch or drill bolt holes in aluminum trench covers for fasteners that secure trench cover to trench cover frame. Punch or drill bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. If holes are punched, sub-punch and ream holes whenever needed because of metal thickness. Counter sink bolt holes for flat head bolts or screws.

3. Aluminum Trench Cover Frame

a. Aluminum trench covers shall be furnished with fabricated aluminum frames.

b. Trench cover frames shall be mitered and welded flush at comers for a finish appearance.

c. Furnish trench cover frames with AISI 316 stainless steel anchor straps.

4. Aluminum Trench Cover Accessories

a. Provide fasteners necessary to trench covers to trench cover frames.

b. Fasteners used for attaching aluminum trench covers to trench cover frame shall be AISI 316 stainless steel

2.03 FLOOR PLATES

A. Floor Plates, General

1. Floor plates shall be designed for a uniformly applied load of 200 pounds per square-foot over the full span unless a greater loading is noted on the Drawings. Floor plate deflection shall not exceed L/360 or ¼-inch whichever is less. Provide stiffener angles as required to meet load requirements specified in this Section.

2. Provide cutouts in floor plates for valve operators, conduits, pipes, and other penetrations.

3. Grind sharp metal edges smooth.

4. Punch bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. Whenever needed, because of metal thickness, sub-punch and ream holes, or drill holes.

5. Fabricate floor plates in sections, which do not exceed 75 pounds each.

B. Aluminum Floor Plates

1. Aluminum Floor Plate Material

a. Aluminum floor plates shall be 6063-T6 aluminum alloy: unless otherwise shown or specified.

b. Aluminum floor plates shall have mill finished, unless otherwise shown or specified.

2. Aluminum Floor Plates, General

a. Maximum allowable deflection for aluminum floor plates specified in this Section shall be based on an allowable stress of 12,000 pounds per square inch. Floor

plates thickness shall be as shown on the Drawing, but in no case shall floor plates be less than 1/4- inch thick.

b. Aluminum floor plates shall be aluminum checkered plate equal to ALCOA C-102 aluminum tread plate and Reynolds diamond tread plate.

c. If aluminum floor plates are to be secured to supporting members or frame, punch or drill bolt holes in floor plates for fasteners that secure floor plate to supporting members or frame. Punch or drill bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. If holes are punched, sub-punch and ream holes whenever needed because of metal thickness. Counter sink bolt holes for flat head bolts or screws.

3. Aluminum Floor Plate Frame

a. Aluminum floor plate set in concrete floor shall be furnished with fabricated aluminum frame.

b. Floor plate frame shall be mitered and welded flush at comers for a finish appearance.

c. Furnish floor plate frames with AISI 316 stainless steel anchor straps.

4. Aluminum Floor Plate Accessories

a. If Drawings indicate floor plate is to be secured to supporting members or frame, provide fasteners necessary to secure floor plate. If code, Laws, or Regulations require floor plate to be secured to supporting members or frame, provide fasteners necessary to secure floor plate.

b. Fasteners used for attaching aluminum floor plate to supporting members or frame shall be AISI 316 stainless steel.

PART 3 – EXECUTION

3.01 INSPECTION

A. Field Measurements

1. Take field measurement prior to preparation of shop drawings.

2. Verify opening locations, opening sites, and dimension tolerances are acceptable.

B. Grating and Floor Plates

1. Verify grating, trench cover, and floor plate dimensions.

2. Check grating, trench covered, and floor plates for damage.

C. Mounting surfaces, supports, and Anchors

1. Inspect surfaces, supports, and anchors on which grating, trench covers, and floor plates are to be mounted and secured.

2. Verify supports and anchors are properly located and oriented.

3. Correct defects prior to installation of grating, trench covers, and floor plates.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Place frames in correct position, plumb and level.

C. Set perimeter closure flush with top of grating and surrounding construction.

D. Secure grating to prevent movement.

3.03 CLEANING

A. Clean paint spatter, concrete slobbers, grease, oil, or any other debris from exterior surfaces of grating, trench covers, and floor plates.

END OF SECTION

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SECTION 05 55 00
STAIR TREADS AND NOSINGS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all stair treads and nosings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 51 00 – Metal Stairs

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. Aluminum Association Specifications for Aluminum Structures.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Complete fabrication and erection drawings of all work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for stair treads and nosings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for stair treads and nosings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 SAFETY STAIR NOSINGS

A. Abrasive cast aluminum, safety stair nosings shall be provided on all concrete or concrete filled steel pan stairs, including the top stair of metal stairs that attach to concrete, and as shown on the Drawings unless noted otherwise.

B. Nosing shall be 3 inches wide and shall extend the full width of the stairway minus 3 inches on either side. Nosing shall be cast into the concrete and held in place with butterfly type extruded anchors.

C. The nosing shall be "Style 231-A", by Amstep Products, “Alumogrit Type 101", by Wooster Products, Inc., "Type AX", by Safe-T-Metal Company. For steel pan concrete filled stairs, nosing shall be "Type 101-SP", Wooster Products, Inc., or "Type AXPE", by Safe-T-Metal Company. For pan stairs, nosing shall be continuous over corner of stair treads to fully protect corner of treads from abrasion. All exposed fasteners shall be Type 304 stainless steel.

2.04 STAIR TREADS

A. Stair treads shall be aluminum with an abrasive nosing as shown on the Drawings.

B. Stair treads shall be designed for the live load specified in Section 05 51 00 – Metal Stairs.

C. Stair treads shall be as manufactured by IKG Industries, or Safe-T-Metal Company.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

E. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of stair treads and nosings shall be performed in strict accordance with manufacturer's recommendations.

B. All stair treads and nosings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

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SECTION 05 56 00
METAL CASTINGS

PART 1 – GENERAL

SUMMARY

A. Section Includes: Miscellaneous ferrous and nonferrous castings.

This classification includes wheel guards, valve boxes, manhole frames and covers, manhole steps, stop plank grooves, brackets and supports for piping and gutter inlets, floor drains, cleanouts and special malleable iron castings and inserts.

REFERENCES

Codes and standards referred to in this Section are:

1. ASTM A 27/A27M - Specification for Steel Castings, Carbon for General Applications
2. ASTM A 47 - Specification for Ferric Malleable Iron Castings
3. ASTM A 48 - Specifications for Gray Cast Iron Castings
4. ASTM A 148/A148M - Specifications for Steel Castings
5. ASTM A 536 - Specifications for Ductile Iron Castings
6. ASTM B 26/B26M - Aluminum
7. ASTM B 148 - Aluminum Bronze Sand Castings
8. ASTM B 138 - Manganese Bronze

PRODUCTS

WORKMANSHIP

Provide castings accurately made to the approved dimensions, and plane or grind castings where marked or where otherwise necessary to secure flat and true surfaces. Make allowance in the patterns so that the specified thickness is not reduced. Provide manhole covers which conform to the details shown and which are true and seat at all points. Supply castings showing the name of the manufacturer and the country of manufacture. No plugging or welding of defective castings will be permitted.

WEIGHTS

Reject castings with a weight which is less than the theoretical weight based on required dimensions by more than 5 percent. Provide facilities at the site for weighing castings in the presence of the Engineer, or furnish invoices showing true weights, certified by the supplier.

EXECUTION

INSTALLATION

Erect all castings to accurate grades and alignment, and when placing in concrete carefully support castings to prevent movement during concreting.

PAINTING

Clean metal castings thoroughly before painting. Give manhole frames and covers and valve boxes one coat of primer and two coats of an approved asphaltum varnish or other approved coating at the point of manufacture. Deliver all other castings to the job site unpainted. Paint all other castings as specified in Section 09 90 00.

END OF SECTION

v

Division 07

SECTION 07 90 00
JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 05 – Concrete and Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C-920 – Elastomeric Joint Sealants

2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber

3. SWRI – Sealant and Caulking Guide Specification

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittals, submit the following:

1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.

2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened labeled packages.

B. Store materials in location protected from freezing or damages.

C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.

2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.

3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.

4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by Master Builders Solutions.

5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by Master Builders Solutions.

6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.

7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.

8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type M, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by Master Builders Solutions.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.

E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.

F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

A. Coordinate work with details shown on approved shop drawings prepared by other trades.

B. Verify conditions in the field.

C. Schedule work to follow closely the installation of other trades.

D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.

E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

A. Protect finished surfaces adjoining by using masking tape or other suitable materials.

B. Clean and prime joints before starting any caulking or sealing work.

C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.

D. Joint Requirements

1. All joints and spaces to be sealed in exterior work shall be less than ½-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and

spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.

2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than ¼-inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the ¼-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

	Sealant Depth	
Joint Width	**Minimum**	**Maximum**
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.

B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.

C. All joints shall be waterproof and weathertight.

D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.

E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.

F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2”.	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Interior – wood trim and finish joints.	Type 5	Color to be selected by Owner
Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes.[1]	Type 4	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit.[2]	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids.[4]	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm) or wastewater.	Type 7	Manufacturer’s standard

Schedule of Sealants

Application	Sealant	Color
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

[1] Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.
[2] Provide UL approved sealants for penetrations thru fire-rated walls.
[3] Sealants which will come in contact with potable water shall meet the requirements of NSF 61.
[4] Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

END OF SECTION

Division 09

SECTION 09 90 00
PAINTING AND COATING

PART 1 – GENERAL

1.01 INTENT

A. The intent of this Specifications is to provide the material and workmanship necessary to produce complete protection of the surfaces to be coated for Owner. This includes all surface preparation, pre-treatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, clean-up, and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.02 PURPOSE

A. The purpose of this Specification is to generally outline the work contemplated for the painting and protective coating work performed for Owner as defined under Scope below; together with the General Conditions, Special Conditions and all other Technical Specifications included herewith. All paints and materials used on interior tank or treatment unit surfaces shall conform to AWWA and/or Florida Department of Environmental Protection (FDEP) regulations as they may apply to potable water or wastewater service. The manufacturer furnishing the coating material may be required to furnish certification to the Engineer that the materials meet these provisions.

1.03 DESCRIPTION

A. The extent of painting work is shown on the project drawings, contracts and schedules, and as specified herein.

B. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise specified or shown on the drawings.

1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of the work.

C. The work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, tanks, vessels, and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise indicated.

D. Paint all exposed surfaces normally painted in the execution of a building project whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, or are not specifically excluded from the painting work, paint these the same as

adjacent similar materials or areas. If color or finish is not designated, the Owner will select these from standard colors available for the materials systems specified.

1.04 PAINTING NOT INCLUDED

A. The following categories of work are not included as part of the field-applied finish work, unless otherwise noted on the drawings or in the Contract Documents.

1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, metal fabrications, hollow metal work, and similar items. Also, for fabricated components such as shop-fabricated or factory-built mechanical and electrical equipment or accessories.

2. Pre-Finished Items: Unless otherwise shown or specified, do not include painting when factory-finishing or installer finishing is specified for such items as, but not limited to, finished electrical equipment including light fixtures, switchgear and distribution cabinets.

3. Concealed Surfaces: Unless otherwise shown or specified, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas. Painting of galvanized work that will be concealed in the completed work is not required. Do not paint structural steel to be encased in concrete, nor structural steel specified not to be painted under Division 5. Except for touch-up as specified in Part 3, painting of shop primed structural steel and ferrous metals that will be concealed in the completed work is not required.

4. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plating, copper, bronze and similar finished materials will not require finish painting, unless otherwise specified.

5. Operating and Machined Parts and Labels: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, machined surfaces, grease fittings, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting unless otherwise specified.

    a. Do not paint over any code-requiring labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

    b. Other Surfaces: Do not apply to glass, manhole frames and covers, aluminum platform gratings, stair treads, door thresholds, concrete wearing surfaces, or other walking surfaces unless otherwise specified.

1.05 CODES, STANDARDS AND REGULATIONS

A. The work herein specified shall be performed in a legally acceptable manner, and it shall be the responsibility of the Contractor to obtain any and all licenses, permits, and legal approvals required to perform the work specified.

B. All material and work covered by this specification shall comply with all currently approved or accepted provisions of applicable codes and standards published by the following organizations:

ANSI - American National Standards Institute
11 West 42nd

New York, NY 10036
212-642-4900

API - American Petroleum Institute

1220 L Street N.W.
Washington, DC 20005

202-682-8000

ASTM - American Society for Testing and Materials
100 Barr Harbor Dr.

West Conshohocken, PA. 19428
610-832-9500

AWS - American Welding Society

550 N.W. LeJeune Rd.
Miami, FL 33126

305-443-9353

AWWA - American Water Works Association

6666 West Quincy Avenue
Denver, CO. 80235

303-794-7711

FM - Factory Mutual Research

1151 Boston-Providence Turnpike

Norwood, MA 02062

617-762-4300

NACE - National Association of Corrosion Engineers

PO Box 218340

Houston, TX 77218
1440 South Creek Dr.

Houston, TX. 77084-4906

713-492-0535

NEMA - National Electrical Manufacturer's Association

2101 L Street N.W. Ste. 300

Washington DC 20037

202-457-8400

NFPA - National Fire Protection Association

1 Batterymarch Park

Quincy, MA 02269-9101

617-770-3000

OSHA - Occupational Safety and Health Act

U.S. Department of Labor

Occupational Safety & Health Administration
8040 Peters Rd. Bldg. H-100

Fort Lauderdale, FL 33324
954-424-0242

SAE - Society of Automotive Engineers

400 Commonwealth Dr.

Warrendale PA. 15096-0001

412-776-4841

SSPC - Steel Structures Painting Council

40 24th Street

Pittsburgh, PA 15222

412-281-2331

SSPWC - Standard Specifications for Public Works Construction
Building News, Inc.

3055 Overland Avenue
Los Angeles, CA 90034
310-202-7775

UBC - Uniform Building Code

Published by ICBO

UL - Underwriters Laboratories Inc.

333Psingsten Rd.
Northbrook IL. 67062

312-273-4255

C. The Contractor shall comply with all applicable Federal, state, and local laws and ordinances.

1.06 ACCEPTABLE COATING MANUFACTURERS

A. Material manufacturers specified herein represent the standard of quality for the industrial coating systems approved by the Engineer. For proposed substitutes, it is the responsibility of the Contractor to furnish satisfactory documentation from the manufacturer of the

proposed substitute or “or-equal” product that the material meets the specified requirements and is equivalent or better than the listed materials in the following properties:

1. Quality
2. Durability
3. Resistance to abrasion and physical damage
4. Life expectancy
5. Ability to recoat in future
6. Solids content by volume
7. Dry film thickness per coat
8. Compatibility with other coatings
9. Suitability for the intended service and environment
10. Resistance to chemical attack
11. Temperature limitations in service and during application
12. Type and quality of recommended undercoats and topcoats
13. Ease of application
14. Ease of repairing damaged areas
15. Stability of colors

B. The cost of all testing and analyzing of any proposed substitute materials that may be required by the Engineer, shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution. These substitutions for other manufacturers must be made and approved prior to the bid date opening.

1.07 SUBMITTALS

A. Coating Materials List: The Contractor shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating schedule herein, for approval of the Engineer. The submittals shall be made sufficiently in advance of the coating operations to allow ample time for checking, correcting, resubmitting and rechecking.

B. Paint Manufacturer's Information: For each paint system to be used, the Contractor shall submit the following listed data prior to beginning painting operations.

1. Paint manufacturer's data sheet for each product used.

2. Technical and performance information that demonstrates compliance with the system performance and material requirements.

3. Paint manufacturer's instructions and recommendations on surface preparation and application.

4. Colors available for each product (where applicable).

5. Compatibility of shop and field applied coatings (where applicable).

6. Material safety data sheet for each product used.

C. Samples and Manufacturer's Certificate: Provide all submittals, including the following, as specified in Division 01.

1. Submit manufacturer's standard color chart for color selection.

2. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

3. Where equipment is customarily shipped with a standard finish, submit samples of the proposed color and finish for approval prior to shipping.

4. Furnish affidavits from the manufacturer certifying that materials furnished conform to the requirements specified and that paint products have been checked for compatibility.

5. Submit a supplementary schedule of paint products with mil thickness, and solids by volume, including all paint applied in the shop and in the field. Provide a schedule that is in accordance with the recommendations of the paint manufacturer.

6. Furnish affidavits from the manufacturer certifying that coatings in immersion service contain no water-soluble solvents or corrosion inhibitive (active) pigments with slight water solubility.

D. Experience Requirements of the Field Applicator:

1. Three references which verify that the coating subcontractor has demonstrated successful application of the specified coating system in the past 3 years. Provide

the size (area of coating), time of completion, name, the owner's address, and telephone number for each installation referenced.

2. A written statement from the Contractor stating that they are qualified and experienced in the application of the specified coating systems. The letter shall state the manufacturer and model number of mixing, heating, and pumping equipment to be used to apply the specified coating systems.

3. A written statement from the manufacturer certifying that the coating subcontractor's onsite foreman and each applicator performing work on the project has been trained and approved to apply the selected coating system.

4. Contractor shall provide SSPC QP 1 Certification or the manufacturer's certification of the applicator for the specified coating system.

E. Experience Requirements of the Shop Applicator:

1. NACE Coating Inspector Program certification documents for the person responsible for Quality Assurance/Quality Control at the facility. This person will be responsible for submitting inspection reports to the Owner.

2. A copy of a typical Quality Assurance/Quality Control inspection report containing items listed in Part 3.18 of this Specification.

3. Three references which verify that the shop painting facility has demonstrated successful application of the specified coating systems in the past 3 years. Provide the structure name and size (area of coating), time of completion, the owner's name, address, and telephone number for each installation referenced.

4. The manufacturer shall provide written certification that the shop painting facility's supervisor and each applicator performing Work on the project have been trained and approved by the manufacturer to apply the selected coating system.

5. The manufacturer shall state whether or not it has verified that the Contractor is going to use the proper mixing, coating application, heating, and environmental control equipment for the specified coating products. Only heated plural component equipment shall be used for the 100% solids coating application. Equipment shall be capable of performing a ratio test.

6. The Shop Coating Applicator shall provide SSPC QP 3 Certification or the coating manufacturer's certification of the applicator for selected coating system.

1.08 DELIVERY AND STORAGE

A. Deliver all coating materials to the job site in original, new and unbroken, sealed packages and containers bearing manufacturer's name and label, and the following information, all of which shall be plainly legible at the time of use:

1. Name or title of material.
2. Fed. Spec. number, if applicable.
3. Manufacturer's stock number and date of manufacturer.
4. Manufacturer's formula or specification number.
5. Manufacturer's batch number.
6. Manufacturer's name.
7. Contents by volume, for major pigment and vehicle constituents.
8. Thinning instructions.
9. Application instructions.
10. Color name and number.
11. Expiration date.

B. Store paint materials and painting tools and equipment, including solvents and cleaning materials, in a well ventilated, dry area and away from high heat. Do not store in building or structure being painted, nor leave overnight therein. Follow manufacturer's recommendations for the safe storage of paints and solvents. Contractor shall store materials in compliance with all local, state, and federal regulations.

1.09 QUALITY ASSURANCE

A. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

B. Inspection Devices: The Contractor shall furnish, until final acceptance of the work, inspection devices in good working condition for the detection of holidays, measurement of surface profile, and measurement of dry film thicknesses of the protective coatings. Surface preparation comparison visual standards, profile and dry film thickness devices shall be made available for the Engineer's use at all times while coating is being done. The Contractor shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the Engineer.

C. Surface Cleanliness: Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS 1 (ASTM D2200), and as described herein. The Contractor shall furnish the photographic standards. To facilitate inspection, the Contractor shall, on the first day of abrasive blasting operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8.5 inches by 11 inches. Panels meeting the requirements of the Specifications shall be initialed by the Contractor and the Owner's representative and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as a comparison standard throughout the project. The Contractor shall provide SSPC-VIS 1 Surface Preparation Standards for use during the abrasive blasting operations.

D. Surface Profile: The blast abrasive shall be suitable to achieve the blast profile as required for the coating system used. The Contractor shall furnish for the Engineer's use, a Keane-Tator Surface Comparator No. 372 or approved equal.

E. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" (SSPC-PA2), using a magnetic-type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, Positector 2000 or approved equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least eight (8) hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

F. Holiday Testing: The Contractor shall holiday test all coated ferrous surfaces inside a steel reservoir, or other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

    1. Coatings With Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

    2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M-1 non-destructive type holiday detector, K-D Bird Dog or approved equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal shall be added to the water prior to wetting the detector sponge.

1.10 MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support and as may be necessary to resolve field problems attributable or associated with the manufacturer's products furnished under this contract or the application thereof.

1.11 SAFETY AND HEALTH REQUIREMENTS

A. General: The Contractor shall provide and require use of personal protective and safety equipment for persons working in or about the project site, in accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR 1910, 1915, and 1926) its revisions, and all other applicable regulations. The Contractor shall also comply with the coating manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets in the handling of potentially hazardous or harmful materials.

B. Head and Face Protection and Respiratory Devices: The Contractor shall require all persons to wear protective helmets while in the vicinity of the work. In additions, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying, half-mask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion proof. Forced air ventilation shall be provided to reduce the concentration of air contaminants to the degree such that a hazard does not exist and to assist in the proper curing of coatings applied in a confined area. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels permitted under OSHA regulations, the Contractor shall provide and require the use of approved hearing protection devices.

E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer.

F. Temporary Access: All temporary ladders and scaffolding shall conform to applicable safety requirements. Scaffolding shall be erected where requested by the Engineer to facilitate inspection and shall be moved by the Contractor to locations as requested by the Engineer.

G. Cloths and cotton waste that might constitute a fire hazard shall be placed in fire resistant closed metal containers until removed from the project site or destroyed at the end of each work day.

1.12 WARRANTY

A. All work covered under the Contract shall be guaranteed against defective workmanship and materials for a period of one (1) year after completion and acceptance of the work. A first anniversary inspection shall be scheduled by the Contractor during the eleventh (11th) month following acceptance of the work. A report shall be furnished to the Owner describing the condition of the paint system and other work covered under the Contract. Any latent defects found during this inspection shall be promptly repaired by the Contractor at no additional cost to the Owner. Any location where coats of paint have peeled off, bubbled or cracked, and any location where rusting is evident, shall be considered a failure of the paint system. The Contractor shall make repairs at all points where failures are observed by removing the deteriorated coating, cleaning the surfaces and recoating with the same paint system. Any such repair work shall be completed by the Contractor within thirty (30) days after written notice of such defects unless otherwise negotiated.

B. Failure on the part of the Contractor to schedule this warranty inspection will not relieve him of warranty responsibility and any defects found by the Owner after the normal warranty period will be assumed to have occurred during the one (1) year while the warranty was in effect.

PART 2 – PRODUCTS

2.01 GENERAL

A. Definitions: The term "paint", "coatings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pre-treatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.

B. Suitability: The Contractor shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

C. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the Contractor shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

D. Compatibility: In any coating system, only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the Engineer, a barrier coat shall be applied between all existing prime coats and subsequent field coats to insure compatibility.

E. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

F. Substitute or "Or-Equal" Products

1. To establish equality under Section 01 60 00 – Materials and Equipment, the Contractor shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

   a. Minimum and maximum recoat times

   b. Minimum and maximum cure time for immersion

   c. Abrasion resistance per ASTM D4060 using CS17 Wheel

   d. Maximum and minimum dry film thickness per coat

   e. Compatibility with other coatings

   f. Suitability for the intended service

   g. Resistance to chemical attack

   h. Temperature limitations during application and in service

   i. Type and quality of recommended undercoats and topcoats

   j. Ease of application

   k. Ease of repairing damaged areas

   l. Stability of colors

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the Contractor shall provide the Engineer with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the Work, the Contractor shall bear such costs involved as part of the Work.

2.02 COLORS AND FINISHES

A. All colors and shades of colors for all coats of paint shall be as selected or specified. Paint colors, surface treatment, gloss, and finishes, are indicated or specified in the "schedules" of the contract documents. Color and gloss not indicated or specified will be selected by the Owner.

B. Each coat shall be of a slightly different shade, as directed by the Engineer, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples or shall be customer mixed to match color samples furnished by the Engineer. Final acceptance of colors will be from samples applied on the job.

C. Color Pigments: Pure, non-fading, applicable types to suit the substrates and service indicated.

D. Paint Coordination: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Furnish information to manufacturers, fabricators, suppliers and others where necessary on the characteristics of the finish materials to be used, to ensure compatible prime coats of use. Provide barrier coats over incompatible primers or remove and re-prime as required.

E. Color Coding: All exposed piping in structures, aboveground or in pipe trenches, shall be color code painted in strict accordance with the color code chart presented in Paragraph 3-15 of this section. All colors shall be as specified or as selected by the Owner.

2.03 UNDERCOATS AND THINNERS

A. Undercoats: Provide undercoat paint produced by the same manufacturer as the finish coats.

B. Thinners: Use only thinners approved by the paint manufacturer and use only within recommended limits.

2.04 INDUSTRIAL COATING SYSTEMS

A. The Contractor shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.

B. Protective Coating Materials: Products shall be standard coatings produced by recognized manufacturers regularly engaged in production of such materials for application on essentially identical facilities to those proposed in this project. Where requested, the Contractor shall provide the Engineer with the names of not less than ten (10) successful applications of the proposed manufacturer's products, which have been proven over a three (3) year period of time, demonstrating compliance with this specification requirement.

C. System 1 - Alkyd Enamel

1. Materials

Primer	Manufacturer's recommendation

Finish Coat	1 component alkyd enamel
Type	high quality alkyd, medium long enamel
Demonstrated suitable for	ferrous and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance
VOC Content, max	420 grams per liter

2. Application and manufacturers

Prime Coat (DFT = 2 to 4 mils)	Finish Coat (DFT = 2 to 4 mils)	Total System DFT
PPG Amercoat 5105	Amercoat 5450	4 to 8 mils
Tnemec Series L69	Tnemec Series 2H	
Devoe Devprime 1401	Devoe Devlac 1431	
Carboline Carbocoat 150	Carbocoat 45	
Sherwin Williams Kem Bond HS	S-W Industrial Enamel HS	

D. System 2 - Aluminum Silicone

1. Material

Type	High heat silicone with aluminum
Demonstrated suitable for	Ferrous surfaces, continuous temperatures of 1000 deg F
VOC Content, max	637 grams per liter

2. Application and manufacturers

Total System DFT = 3 mils
Carboline Thermaline 4700 - Aluminum, 2 coats
International Intertherm 50, 2-3 coats
Sherwin William Hi-Temp Coatings 1000V, 2 coats.

E. System 3 - Epoxy/Polyurethane

1. Materials

Primer type	rust-inhibitive, 2 component epoxy
VOC Content, max	285 g/L
Finish type	2 component aliphatic polyurethane
VOC Content, max	300 g/L
Demonstrated suitable for	ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 3 - 4 mils)	TOTAL SYSTEM DFT
PPG- Amerlock 400/2	PPG- Amershield	6 - 9 MILS
Carboline Carboguard 893	Carboline Carbothane 134 HG (2 coats)	
Devoe Devran 224V	Devoe Dethane 379H	
Tnemec Hi-Build Epoxoline II Series L69	TNEMEC SERIES 750UVX	
Sherwin Williams Macropoxy 646	Sherwin Williams Hi-Solids Polyurethane	

F. System 4 - Inorganic Zinc/Epoxy/Polyurethane

1. Materials

Prime Coat	Inorganic zinc silicate, water or solvent based, 2 component
zinc content in dry film	83 percent, minimum
VOC Content, max	325 grams per liter
Demonstrated suitable for	Ferrous metal, providing superior corrosion, chemical, and abrasion resistance, recommended for use as primer under epoxy
Intermediate Coat	2 component epoxy, high build, recommended by manufacturer for application over inorganic zinc primer
VOC Content, max	276 grams per liter
Demonstrated suitable for	Outstanding chemical, corrosion, and abrasion resistance
Finish Coat	2 component aliphatic or acrylic polyurethane
VOC Content, max	315 grams per liter
Demonstrated suitable for	Superior color and gloss retention, resistance to chemical fumes and severe weathering, abrasion resistance

2. Application and manufacturers

Surface preparation for primer	SSPC SP 6		
Anchor profile for primer	per manufacturer		
Prime Coat (DFT = 2 - 4 mils)	Intermediate Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 2 - 4 mils)	Total System DFT
PPG- Dimetcote 9HS or Dimetcote 21-5	Amercoat 385	Amercoat 450H	
Carboline Carbozinc 11HS or 11WB	Carboguard 890	Carbothane 134HG	
Devoe Cathacote 302H	Devran 224V	Devthane 379H	

Tnemec Tneme- Zinc 94H20	Tnemec Series L69	Tnemec Series 750 UVX	7 - 13 mils
Sherwin Williams Zinc Clad II Plus	S W Macropoxy 646	S W Hi-Solids Polyurethane	

G. System 5 - Inorganic Zinc, Water Based

1. Materials

Type	water based zinc silicate, 2 component
Percent Zinc in dry film	83, min
VOC Content, max	0 grams per liter
Demonstrated suitable for	Severe weathering and moderate chemical fumes, continuous temperatures of 750 deg F

2. Application and manufacturers

Product (2 coats at 2 - 4 mils each)	Total System DFT
PPG- Dimetcote 21-5	4 - 8 mils
Devoe Cathacoat 305	
Carboline Carbozinc 11 WB	
Sherwin Williams Zinc Clad XI	

H. System 6 - Acrylic Latex

1. Materials

Primer	Product, surface preparation, and DFT as recommended by manufacturer for the surface
Finish Type	Single component, water based acrylic latex, with fungicide
VOC Content, max	180 grams per gallon
Demonstrated suitable for	PVC piping, weather and mild chemical resistance, excellent color and gloss retention

2. Application and manufacturers

Finish (at least 2 coats required)	Total System DFT
PPG- Amercoat 220	primer plus 6 mils
Carboline Carbocrylic 3359	
Tnemec Series 1028 Enduratone	
Sherwin Williams Metalatex	
Devoe Devcryl 530	

I. System 7 - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy, recoatable up to one year
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	330
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	330

2. Application and manufacturers

Prime Coat (DFT = 4 to 6 mils)	FINISH COAT (DFT = 3 TO 4 MILS)	TOTAL SYSTEM DFT
PPG-Amerlock 400	Amerlock 400	7 to 10 mils
Tnemec Series L69	Tnemec Series L69	
Devoe Devran 224V	Devran 224V	
Carboline Carboguard 888	Carboguard 888	
Sherwin Williams Macropoxy 646	S W Macropoxy 646	

J. System 8 - Inorganic Zinc/Epoxy, Equipment

1. Materials

Primer type	Water or solvent-based inorganic, self-curing zinc silicate
Zinc content in dry film, min	84 percent
VOC content, g/L, max	323
Demonstrated suitable for	Superior corrosion, chemical and abrasion resistance, recommended as primer under epoxy
Finish type	2 component polyamide epoxy available in many colors
VOC content, g/L, max	250
Demonstrated suitable for	Good resistance to chemical attack, weathering, splash, washdown, and condensation

2. Application and manufacturers

Prime Coat (DFT = 3 to 4 mils)	Finish Coats (2 or more) (DFT = 4 to 8 mils each)	Total System DFT
PPG- Dimetcote 9 HS	Amerlock 400	

Carboline Carbozinc 11HS	Carboguard 890	11 to 20 mils
Tnemec Hydro-Zinc 94H2O	Tnemec Series L69	
Sherwin Williams Zinc Clad II Plus	S W Macropoxy 646	
Devoe Cathacote 302H	Devoe Devran 224V	
International Interzinc 22HS	International Interseal 670HS	

K. System 9 - Acrylic, Concrete

1. Materials

Filler-Sealer Type	Epoxy or acrylic masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	as recommended by manufacturer
VOC Content, g/L, max	75
Finish Type	single component waterborne acrylic, industrial grade, high molecular weight
VOC Content, g/L, max	180
Demonstrated suitable for	concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Prime Coat (Filler-Sealer)	Finish Coat (DFT = 5 - 7 mils) (2 or more coats)	Total System DFT
Tnemec EnviroFill 130	Tneme-Crete 180 Series	5 - 7 mils plus primer
PPG- Amerlock 400BF and Amercoat 114A	Amercoat 220P	
Carboline Sanitile 500	Carbocrylic 3359DTM	
Sherwin Williams Cement Plex 875 (acrylic) and Kem Cati Coat (epoxy)	S W Metalatex	
Devoe Tru-Glaze 4015	Devoe Devcryl 1449	

L. System 10 - Polyurethane, Fiber Glass

1. Materials

Primer Type	as recommended by manufacturer
Finish Type	2 component aliphatic polyurethane
Demonstrated suitable for	Fiberglass, superior color and gloss retention, resistance to acid and alkali splash, fumes, and severe weathering, no immersion
VOC content, g/L max	300

2. Application and manufacturers

Prime Coat	Finish Coats	Total System DFT
(3 to 4 mils)	(4 to 6 mils)	
PPG- Amerlock 400	Amershield	7 to 10 mils
Tnemec Series 750 UVX	Tnemec Series 750 UVX	
Carboline Carbocrylic 120 (2 coats)	Carbothane 134 HG (2 coats)	
SHERWIN WILLIAMS MACROPOXY 646	S-W Hi-Solids Polyurethane	
DEVOE DEVRAN 224V	Devoe Devthane 379H	

2.05 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	high build, amine cure epoxy
VOC content, g/L max	220
Demonstrated suitable for	steel, long term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	Total System DFT
PPG- Amercoat 133	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Carboline Carboguard 891HS	
International Bar-Rust 233H	
Tnemec Epoxoline Series L69	
Sherwin Williams Macropoxy 646 PW	

B. System 101 - Polyamide Epoxy

1. Materials

Type	high build polyamide cure epoxy
VOC content, max, g/L	366
Demonstrated suitable for	long term immersion in water and wastewater, resistant to corrosion and chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	Total System DFT

PPG- Amercoat 370	11 - 13 mils
Tnemec Pota-Pox Series 20	
Carboline Carboguard 61	
Sherwin Williams Macropoxy 646 PW for water and Dura-Plate 235 for wastewater	
Devoe Bar-Rust 233H	

C. System 102 - Epoxy, Steel Reservoirs

1. Materials: In accordance with AWWA D102 - Coating Steel-Water Storage Tanks, System ICS-2.

Type	2 component epoxy, polyamide or amine-cure type
Demonstrated suitable for	Steel, long-term immersion in potable water
VOC content, g/L max	366
Certification required	NSF 61

2. Application and manufacturers

First Coat (2 - 4 mils)	Second Coat (3 - 5 mils)	Finish Coat (4 - 6 mils)	Total System DFT
PPG- Amerlock 2	Amerlock 2	Amerlock 2	9 - 15 mils
Carboline Carboguard 891	Carboguard 891	Carboguard 891	
Tnemec Pota-Pox L140F	Tnemec L140F	Tnemec L140F	
Sherwin Williams Macropoxy 646 PW	S-W Macropoxy 646 PW	S-W Macropoxy 646 PW	
Devoe Bar Rust 233H	Devoe Bar-Rust 233H	Devoe Bar-Rust 233H	

a. All lap roof plate edges, both sides, shall be pre-coated. If necessary, primer exposed on exterior of roof may be removed prior to welding. Pre-coating shall extend at least 6-inches from plate edges.

b. Touch-up coating shall be done for areas damaged during erection, or areas not pre-coated. The Contractor shall spot sandblast to SSPC SP-5 - White Metal Blast Cleaning, before application of coating. Material used for touch-up shall be the indicated material or a compatible primer recommended by the manufacturer.

c. All edges, nuts, bolts, lap joints, weld seams, and the roof rim angle shall receive one brush-applied coat prior to the application of the first complete spray coat.

d. Curing Period: Prior to immersion, the completed system shall be subjected to at least 240 hours of curing time with the metal temperature at a minimum of 70 degrees F, or 480 hours at a minimum of 60 degrees F, both conditions at a maximum relative humidity of 50 percent and under the forced ventilation conditions required by the paragraph entitled Curing of Coatings. More curing time or a higher temperature shall be provided if recommended by the epoxy coating manufacturer. If the environmental conditions do not provide the necessary minimum temperature, use heated air to provide the necessary heat for curing. Other combinations of curing time and temperature may be used if the coating manufacturer presents satisfactory documentation and test results to substantiate that the degree of curing is equal or greater than curing for 240 hours at 70 degrees F.

D. System 103 - Fusion Bonded Epoxy

1. Material

Type	100 percent solids fusion bond epoxy
Demonstrated suitable for	fluidized bed or electrostatic spray application, recommended for pumps, valves, pipe appurtenances, tanks, pipe hangers, flow meters, and hydrants
Certification requirement	NSF 61

2. Application in accordance with AWWA C213 and the following:

Product	Surface and DFT
3M Scotchkote 134 or 206N	Valves 12-mils
	All others 16-mils

E. System 104 - Polyurethane, Concrete

1. Materials

Filler-sealer type	epoxy material with portland cement and aggregate
Primer type	Phenolicamine or polyamidoamine epoxy
VOC content, g/L max	250
Finish type	aromatic elastomeric polyurethane
Demonstrated suitable for	concrete and concrete block masonry, long term immersion in water and wastewater and service where subject to splash and spill of water and wastewater treatment chemicals
VOC content, g/L max	250
Certification requirement, where coating will be in contact with potable water	NSF 61

2. Application and manufacturers

Filler-Sealer	Primer DFT = 3 - 7-mils	Finish Coat DFT = 100 - 125 mils, 75 mils for potable water
Tnemec MortarClad 218	Tnemec Pota-Pox L140 (potable water) Epoxoprime 201 (wastewater)	Elasto-Shield 406 (max 75 mils for potable water)
PPG-Amerlock 400/BF	Amerlock 400/2	Amerlock 490
Sherwin Williams Steel Seam FT 910	S-W Dura-Plate 235	S-W Sherflex (Max 100 mils for potable water)
International Ceilcote 400 Corocrete	Polibrid 670-S	Polybrid 705

F. System 105 - Epoxy, Concrete

1. Materials

Filler-sealer type	Epoxy material with portland cement and aggregate
Primer type	100% solids epoxy
VOC content, g/L max	100
Finish type	Amine cure epoxy/aggregate-filled epoxy
Demonstrated suitable for	Sewer manhole & wastewater facility, long term immersion in wastewater service where subject to chemical and bacteriological attack found in municipal sanitary sewer system
VOC content, g/L max	100

2. Application and manufacturers

Filler-Sealer	Primer DFT = 5 – 10 mils	Finish Coat DFT = 125 – 150 mils
RLS Raven 210	RLS Raven 155	Raven 405 FS
Sauereisen Filler Compound 209 or 209FS	Per Sauereisen	SewerGard 210
		Warren Environmental

2.06 SPECIAL COATING SYSTEMS

A. System 200 - Acrylic, Wood and Gypsum Board

1. Materials

Primer type	as recommended by manufacturer
Finish type	Single component, water based, acrylic, fungicide added
VOC content, max, g/L	250

Demonstrated suitable for	wood, mild to moderate exposure inside and outside building, and gypsum board, inside

2. Application and manufacturers

Prime Coat (1.5 to 2.5 mils)	Finish Coat (4 to 6 mils) (2 coats)	Total System DFT
PPG- Amercoat 220P	Amercoat 220P	5.5 to 8.5 mils
Carbocrylic 120	Carbocrylic 3359	
Tnemec Series 115 Unibond	Tnemec Series 1028 Enduratone	
Sherwin Williams PrepRite ProBlock	S-W Metalatex	
Devoe Devcryl 520	Devoe Devcryl 1449	

PART 3 – PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

A. The Contractor shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

B. For submerged and severe service coating systems, the Contractor shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 6 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.02 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating Work.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a

film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition.

3.03 STORAGE, MIXING AND THINNING OF MATERIALS

A. Manufacturer's Recommendations: Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed. No substitutes or other deviations will be permitted without written permission of the Engineer. The Contractor shall supply the Engineer with copies of each manufacturer's instructions.

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and mixing of paint or other coating materials shall be performed only in those areas designated by the Engineer.

3.04 PREPARATION FOR COATING

A. General: All surfaces to receive protective coatings shall be cleaned as specified herein prior to application of said coatings. The Contractor shall examine all surfaces to be coated and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Do not paint over dirt, rust, scale, oil, grease, moisture, scuffed surfaces or other foreign material or in conditions otherwise detrimental to the formation of a durable paint bond and film.

B. Protection of Surfaces Not to be Coated: Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations. All hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

C. Protection of Adjacent Work and Areas: Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly

repair to the satisfaction of the Owner any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

D. Protection of Painted Surfaces: Cleaning and coating shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.05 ENVIRONMENTAL REQUIREMENTS

A. No coating work shall be performed under the following conditions:

1. Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.

4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

5. Ambient temperature that is expected to drop below 50°F or less than 5°F above the dew point within 8 hours after application of coating.

3.06 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this Specification:

1. Solvent Cleaning (SSPC-SP1): The method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces through the use of solvent, vapor, emulsion, alkaline, and/or steam.

2. Hand Tool Cleaning (SSPC-SP2): The method for removing all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter through the use of non-power hand tools.

3. Power Tool Cleaning (SSPC-SP3): The method for removing all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter through the use of power assisted hand tools.

4. White Metal Blast Cleaning (SSPC-SP5): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint.

5. Commercial Blast Cleaning (SSPC-SP6): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, mill scale, and previously applied paint may remain on no more than 33% of the surface.

6. Brush-off Blast Cleaning (SSPC-SP7): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface.

7. Near-White Blast Cleaning (SSPC-SP10): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, mill scale, and previously applied paint may remain on no more than 5% of the surface.

3.07 SURFACE PREPARATION

A. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

1. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

2. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly painted surfaces. Remove mildew in accordance with the paint manufacturer's recommendations.

3.08 NEW FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as specified in the coating system schedules included at the end of this section. Where there is a conflict between these Specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers (NACE) Standard TM-01-70.

C. All oil, grease, welding fluxes and other surface contaminants shall be removed by alkaline cleaning per SSPC-SP1 prior to blast cleaning.

D. All sharp edges shall be rounded or chamfered and all burrs, surface defects and weld splatter shall be ground smooth prior to blast cleaning.

E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Contractor shall submit data and samples for approval on abrasives to be used on the Project. Abrasives that are used shall be designed for the specific purpose of blast cleaning. Abrasives shall be free of contaminants and chlorides. Ordinary builder's sand shall not be considered to be approved abrasive material. Engineer will periodically sample abrasives used at the job site for comparison with approved submitted materials.

F. The abrasive shall not be reused unless otherwise approved by the Engineer. For automated shop blasting systems, clean oil and moisture-free abrasives shall be maintained.

G. The Contractor shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil/moisture separators which remove all contaminants.

I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or other approved method prior to painting.

J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

K. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.

L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, the SSPC-SP2, Hand Tool Cleaning, or SSPC-SP3, Power Tool Cleaning, will be permitted.

M. Shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied. Valves, castings, ductile iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings.

Temporary coatings shall be completely removed by Solvent Cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.

N. Shop primed equipment shall be alkaline cleaned in the field before finish coats are applied.

3.09 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. All installation and erection caused blemishes to galvanized surfaces shall be touched up in accordance with ASTM A780 prior to coating.

B. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

3.10 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL TANK OR TREATMENT UNIT INTERIORS (IN ADDITION TO REQUIREMENTS IN PARAGRAPHS 3-05 AND 3-06).

A. General: All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The Contractor shall determine the generic type of the existing coatings by laboratory testing, at no additional cost to the Owner.

B. Abrasive Blast Cleaning: The Contractor shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6, Commercial Blast Cleaning. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, Brush-Off Blast Cleaning, with the remaining thickness of existing coating not to exceed 3 mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings, the Contractor shall apply intermediate coatings per the paint manufacturer's recommendation for the specified abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

3.11 SURFACE PREPARATION FOR REPAINTING EXISTING STEEL

A. The entire structure is to be completely pressure washed at 3,000 to 5,000 psi with potable water.

B. All areas shall be cleaned/sandblasted to the surface preparation standards as specified herein, or superseded by the bid form.

C. All cleaned areas are to be primed the same work day that they are cleaned and blasted.

3.12 PRESSURE WASH CLEANING FOR REPAINTING EXISTING CONCRETE

A. The entire structure is to be pressure washed at 3,000 to 5,000 psi with a solution of 50% water and bleach to yield a mixture with a minimum concentration of 2-1/2% sodium hypochlorite.

B. The entire structure is to be completely rinsed by pressure washing at 3,000 to 5,000 psi with potable water.

3.13 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 days after the concrete has been placed.

B. All efflorescence, chalk, dust, dirt, oil and grease shall be removed by Detergent Cleaning per SSPC-SP1 before abrasive blast cleaning.

C. Concrete, concrete block masonry surfaces, previously painted concrete and masonry and deteriorated concrete and masonry surfaces to be coated shall be abrasive blast cleaned to remove laitance, paint, deteriorated concrete, and roughen the entire surface equivalent to the surface of the No. 80 grit flint sandpaper. Concrete shall have a consistent, even texture (void free) and shall be patched where needed.

D. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

E. If acid etching is required by the coating application instructions, the treatment shall be made after sandblasting. After acid etching, rinse surfaces with clean water to neutralize the acid and test the pH. The pH shall be between 7.0 and 8.0.

F. Surfaces shall be clean and dry and as recommended by the coating manufacturer before coating is started.

G. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhors Model DB or approved equal.

3.14 PLASTIC, FIBERGLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and Fiberglass surfaces shall be sanded or Brush Off Blast Cleaned, SSPC-SP7, prior to solvent cleaning with a chemical compatible with the coating system primer. If blast cleaned, use 60-80 mesh abrasive.

B. Non-ferrous metal surfaces shall be Solvent Cleaned, SSPC-SP1, followed by sanding or Brush Off Blast Cleaning, SSPC-SP7.

C. All surfaces shall be clean and dry prior to coating application.

3.15 WOOD SURFACE PREPARATION

A. Clean wood surfaces to be painted of all dust, dirt, grease, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooths those finished surfaces exposed to view, with either manual or mechanical means, as applicable, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of the priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sandpaper smooth when dried and dust off.

B. Prime or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood.

3.16 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on all work.

B. Clean drop cloths shall be used. All damage to surfaces resulting from the work hereunder shall be leaned, repaired, and refinished to the complete satisfaction of the Engineer, at no cost to the Owner.

C. All coatings shall be applied under dry and dust-free conditions. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure that they have been thoroughly cleaned and that they receive an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, alligatoring, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other approved precautionary measures.

3.17 SHOP COATING REQUIREMENTS

A. All items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the specified or approved color. The methods, materials, application, equipment and all other details of

shop painting shall comply with these Specifications. If the shop primer requires top-coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

B. All items of equipment, or parts and surfaces of equipment which are submerged when in service, with the exception of pumps and valves shall have all surface preparation and coating work performed in the field.

C. The interior surfaces of steel water reservoirs shall have all surface preparation and coating work performed in the field.

D. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switch-gear or main control boards, submerged parts of the pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. Such equipment shall be shop primed and finish coated in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these Specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.

E. For certain small pieces of equipment, the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

F. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 6 months before finish coating, or less time if recommended by the coating manufacturer.

G. Damage to shop-applied coatings shall be repaired in accordance with this section and the coating manufacturer's printed instructions prior to finish painting.

H. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.

3.18 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with "Paint Application Specification No. 1", (SSPC-A-1), Steel Structures Painting Council.

B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The Contractor shall schedule such inspection with the Engineer in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be painted in the same working day.

D. Coatings shall be prepared, mixed and applied in accordance with the manufacturer's instructions and recommendations, and these Specifications. If directions differ, the most stringent requirements shall be followed.

E. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

F. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the coating materials. Remove the film, and if necessary, strain the material before using.

G. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe (brushed or gloved) painting for these areas.

H. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.

I. Job Conditions: The following job conditions will be strictly enforced during the application of coatings for the project.

1. Apply water-base coatings only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the paint manufacturer's printed instructions.

2. Apply solvent-thinned coatings only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F and 95 degrees F unless otherwise permitted by the paint manufacturer's printed instructions.

3. Do not apply paint in dust or smoke laden atmosphere, high winds, rain, fog or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

4. Do not apply coatings when the temperature is less than 5 degrees F above the dewpoint. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Weather Bureau psychometric tables.

5. Do not apply coatings when the outside air temperature is expected to drop below 45 degrees F or less than 5 degrees F above the dewpoint, within 8 hours after application of the coating.

6. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

J. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust-free.

K. General Considerations:

1. Apply paint as specified and in accordance with the manufacturer's directions. Use brushes for applying first coat on wood and on metals other than steel and sheet metal and items fabricated from steel and sheet metal. For other coats on wood, metal and other substrates, use applicators and techniques best suited for the type of material being applied.

2. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Paint surfaces behind movable equipment the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment with prime coat only before final installation of equipment.

4. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

5. Paint the back sides of removable or hinged covers to match the exposed surfaces.

6. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated or specified.

7. Sand lightly between each succeeding enamel coat.

8. Omit the field prime coat on shop-primed surfaces and touch up painted metal surfaces which are not to be finished painted and which will not be exposed to view in the completed work. Do not omit primer on metal surfaces specified to be finish coated or on metal surfaces that will be exposed to view in the completed work.

L. Scheduled Painting:

1. Apply the first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

M. Minimum Coating Thickness: Apply each material at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness as specified or, if not specified, as recommended by coating manufacturer.

N. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed in mechanical equipment rooms and in occupied spaces, and on the outside or exterior of buildings or structures:

1. Mechanical items to be painted include, but are not limited to, the following:

a. Piping, valves, pipe hangers, and supports.

b. Pumps

c. Tanks

d. Duct work, insulation

e. Motors, mechanical equipment, and supports

f. Accessory items

2. Electrical items to be painted include, but are not limited to, the following:

a. Conduit and fittings

b. Switchgear

O. Prime Coats: Apply a prime coat to material, equipment and surfaces which are required to be painted or finished, and which have not been prime coated by others. Clean and prime unprimed ferrous metals as soon as possible after delivery of the metals to the job site. Recoat primed and sealed surfaces where there is evidence of suction spots or /unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

P. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surfaces imperfections.

Q. Pigmented, Opaque Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

R. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.19 CURING OF COATINGS

A. The Contractor shall provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by these Specifications, whichever is the more stringent requirement, prior to placing the completed coating system into service.

B. Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures: Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During curing periods, continuously exhaust air from a manhole in the lowest shell ring or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which time the forced air ventilation system shall operate continuously. For additional requirements, refer to the specific written instructions of the manufacturer for the coating system being applied.

3.20 COLOR CODING

A. All exposed piping shall be color coded. After the finish coat has been applied, label each line with stenciled legends identifying the nature of the pipe contents and the direction of flow. This stenciled identification shall appear in one or more places in the line as deemed necessary by the Engineer. Stencil legends shall be white for all pipe except white color coded pipe, which shall have black legends. Labels shall occur a minimum of every 15 feet of straight piping and at all bends. Minimum stencil size shall be two-inch letters for 4-inch and larger diameter piping and one-inch letters for 2-inch to 3-1/2-inch diameter piping. Piping 1-1/2-inch diameter and smaller shall be identified using plastic wrap-around pipe markers.

B. Items to be coded but not specifically mentioned shall be coated in a color selected by the Engineer or Owner.

C. All paints/coatings used in potable water contact areas must have AWWA and EPA classification and approvals.

D. All requirements of the Occupational Safety and Health Act (OSHA) concerning color coding and safety markings shall be considered part of these Specifications unless specifically excluded.

E. Any paint/coating requirements/specifications not specifically addressed in the foregoing shall be decided upon as required by the Engineer.

F. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per General Industry Safety Orders, Article 112, OSHA Occupational Safety and Health Standards 29CFR1910.

3.21 COATING SYSTEM SCHEDULES

A. COATING SYSTEM SCHEDULE, FERROUS METAL - NOT GALVANIZED (FM):

	Item	Surface Prep.	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3	(1) alkyd enamel or (3) epoxy/ polyurethane
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Near white metal blast cleaning SSPC SP 10/NACE 2	(4) inorganic zinc/epoxy/polyurethane
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Manufacturer recommendation	(6) acrylic latex
FM-2	Surfaces in chlorination room, chlorine storage room.	Commercial blast cleaning SSPC SP 6/NACE 3	(100) amine cure epoxy
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-4	Surfaces exposed to high temperature (between 150 and 600 degrees F).	Near white metal blast cleaning SSPC SP 10/NACE 2	(5) inorganic zinc, water- based
FM-5	Surfaces exposed to high temperature (between 600 and 1000 degrees F).	Near white metal blast cleaning SSPC SP 10/NACE 2	(2) aluminum silicone
FM-6	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves	White metal blast cleaning SSPC SP 5/NACE 1	(101) polyamide epoxy
FM-7	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-8	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2	(103) fusion bond epoxy

FM-9	All ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White metal blast cleaning SSPC SP 5/NACE 1	(101) polyamide epoxy
FM-10	Buried surfaces that are not indicated to be coated elsewhere.	Near white metal blast cleaning SSPC SP 10/NACE 2	(100) amine cure epoxy
FM-11	External surfaces of buried steel tanks.	White Metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-12	Indoor architectural sheet metal, flashings, doors, frames, and exposed ducts	Commercial Blast Cleaning SSPC SP 6/NACE 3	(1) Alkyd Enamel
FM-13	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP 6/NACE 3	(7) epoxy, equipment

B. COATING SYSTEM SCHEDULE, FERROUS METAL - GALVANIZED (FMG): All galvanized surfaces except for the following items shall be coated unless required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	Surface Prep.	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1	(1) alkyd enamel or (3) epoxy/polyurethane
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Solvent cleaning SSPC SP 1	(100) amine cure epoxy
FMG-3	Indoor architectural sheet metal, flashings, doors, frames, and exposed ducts	Solvent cleaning SSPC SP 1	(1) Alkyd Enamel
FMG-4	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high-water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC SP 1 followed by brush- off grade blast cleaning SSPC SP 7/NACE 4	(100) amine cure epoxy

C. COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBERGLASS (NFM): Where isolated non-ferrous parts are associated with equipment or piping, the Contractor shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	Surface Prep.	System No.
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP 1	(1) alkyd enamel or (4) epoxy/polyurethane
NFM-2	Chlorination room, chlorine storage room.	Solvent cleaned SSPC SP 1	(100) amine cure epoxy
NFM-3	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC SP 1	(6) acrylic latex

D. COATING SYSTEM SCHEDULE - CONCRETE AND CONCRETE BLOCK MASONRY (C):

	Item	Surface Prep.	System No.
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.13	(9) acrylic, concrete or (104) polyurethane, concrete
C-2	Surfaces submerged in water or wastewater, including (a) between 2-feet above high water elevation and 2-feet below low water elevation in an open structure and (b) all surfaces above 2-feet below low water elevation in an enclosed structure.	Per paragraph 3.13	(104) polyurethane, concrete
C-3	Floor slab and walls, exposure to chemicals, where indicated.	Per paragraph 3.13	(104) polyurethane, concrete
C-4	Walls, floors, exposure to chemical splash, washdown, where indicated	Per paragraph 3.13	(104) polyurethane, concrete

C-5	Interior surfaces of sewer manholes, including sidewalls, bottom, and metal appurtenances, for manholes indicated.	Per paragraph 3.13	(105) epoxy, concrete

E. COATING SYSTEM SCHEDULE – MISCELLANEOUS SURFACES (MS):

	Item	Surface Prep.	System No.
MS-1	Wood, indoors and outdoors, and gypsum board indoors.	Per manufacturer's printed instructions	(200) acrylic

3.22 CLEAN-UP AND PROTECTION

A. Clean Up: During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day. Upon completion of painting work, clean window glass and other paint-spattered surfaces located on site and off site. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Protection: Protect work of other trades located on site and off site, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting.

1. Provide "Wet Paint" signs, as required, to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

2. At the completion of work of other trades, touch up and restore all damaged or defaced painted surfaces.

3.23 APPEARANCE AND INSPECTION

A. All painting shall be accomplished in a workmanlike manner and shall be free of unsightly sags, runs, bubbles, drips, waves, laps, alligatoring, unnecessary brush marks and overspray or other physical defects and shall be uniform in color.

B. The Contractor shall provide all rigging, scaffolding and other equipment necessary for a satisfactory inspection of a complete paint system and acceptance by the Engineer/Owner.

C. Inspection shall be conducted by an inspector selected by the Engineer/Owner in the presence of the Owner's representative and the Contractor or his representative. Provisions for calibrated and functional test equipment is the responsibility of the Contractor.

D. The paint film shall be free of pinholes and holidays as determined by the use of an approved holiday detector as defined in Paragraph 1-09 of this Section.

E. The paint film shall be randomly checked for dry film thickness as stipulated in the "Coating System" sections of these specifications. Thicknesses shall be checked with a properly calibrated and approved magnetic gauge as defined in Paragraph 1-09 of this Section.

3.24 REPAIR OF DEFECTS IN PAINT

A. Any defects discovered during inspection, such as low film millage, holidays or pinholes, shall be repaired with the same materials as used for the original finish coat(s). Excessive low millage could require extra full coat(s) of paint.

B. A final inspection will be conducted by the Engineer/Owner or his representative after any necessary repairs and prior to final acceptance of the job.

3.25 DISINFECTION OF POTABLE WATER STORAGE TANKS

A. Description: This paragraph specifies disinfection procedures for potable water storage tanks.

B. Quality Assurance: The following documents are a part of this section as specified and modified. In case of conflict between the requirements of this paragraph and those of the listed documents, the requirements of this paragraph shall prevail.

Reference	Title
AWWA D105, latest revision	Disinfection of Water Storage Facilities

C. Information to be Provided: Affidavit of Compliance as described in AWWA D105.

D. After the tank has been painted and the interior surfaces have thoroughly dried, the Contractor shall remove all visible dirt and contaminating materials. The interior of the tank shall be disinfected in accordance with Chlorination Method 2 of AWWA D105. The Contractor shall furnish all of the chlorine required.

E. The Contractor shall be responsible for obtaining proper disinfection as determined by bacteriological testing. Samples for bacterial analyses will be taken and analyzed by the Owner. Two consecutive samples are required to pass the bacteriological tests for the tank to comply with these disinfection requirements.

F. Water for filling the tank after the initial disinfection will be provided by the Owner. If bacteriological testing shows the presence of coliform bacteria, the tank shall be re-disinfected. The Contractor shall pay the Owner for water required to fill the tank after the first filling at currently approved General Service water rates for the Owner.

END OF SECTION

SECTION 09 96 35
IET COATING SYSTEM

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. This section provides details for furnishing and installing a specialty coating system where shown on the drawings for protection of concrete structures against hydrogen sulfide corrosion. Installation shall be performed by workers experienced in the application of the coating to be used.

1.02 SUBMITTALS

A. Submit experience of coating system manufacturer-approved applicator.

PART 2 – PRODUCTS

2.01 IET COATING SYSTEM

A. The IET Coating System shall be as distributed by Integrated Environmental Technologies, Santa Barbara, CA, or equal.

B. Polymorphic Resin shall be a 100% solids, two-component, highly modified polyester resin system, exhibiting no adhesion-interfering shrinkage upon curing. Resin shall cure rapidly within fifteen minutes to one hour without the use of heat or cooling at surface temperatures ranging from –30 degrees Fahrenheit to over +150 degrees. Excellent resistance to a broad range of corrosive chemicals, including sulfuric acid created by hydrogen sulfide gas as well as other chemicals typically found in sanitary sewers, and impact and abrasion attack shall be provided.

PART 3 – EXECUTION

3.01 IET COATING

A. All pipes in service shall be plugged or bypassed before any work is started on the structure. No debris is to be flushed down the line.

B. Anyone entering the structure must conform to all OSHA requirements for “Confined Space Entry” equipment and permitting.

C. Surface preparation shall meet the requirements of IET Systems Data Sheets on Concrete Preparation and interior surfaces of manhole shall be sound, porous, dry, and free of dust, dirt, oil, grease and other contaminants prior to application of lining.

D. Interior surface of structure must be pressure washed at 5,000 psi and must be abrasive-blasted with an approved abrasive material (see LCU Approved Materials List) to remove all loose patching, old coatings and any contamination in the concrete. No silica sand shall be used.

1. "New" structures shall be abrasive-blasted to remove all oils and patch mud and to open pin holes and expose aggregate.

2. "Rehab" structures shall be abrasive-blasted to remove all loose patching, old coatings, and any contamination that penetrated the concrete. The finished interior of the structure shall be gray. The exposed invert/floor shall also be coated. Where there is severe deterioration of the mortar, place new concrete to match the original interior dimensions after abrasive-blasting and removal of all loose material and by-products of corrosion. Restore invert/floor to the original elevation.

3. Vacuum to remove all abrasives and debris.

E. Repair all leaks by injecting grout using an approved grout (see Owner-approved Materials List). Hydraulic cement shall not be used to stop any water leaks.

F. Clean and remove dust material with pressure washing for maximum adhesion. Blow dry concrete at 250 cfm with 120 psi.

G. Apply IET Systems Coating by the use of the IET Systems Spray Unit and IET Systems Spincaster. Apply IET coating at least three different intervals – prime coat, intermediate coat and finish coat, per IET Systems manufacturer instructions and specifications. The total thickness of the IET coating shall be at least 125 mils.

H. Inspect lining system for holidays, cracks and pinholes. Take particular care to check lining over brick, block, heavy spalled surfaces, and other very rough surfaces and locate holes in the lining caused by voids in bricks, block, concrete and structure joints. Fill voids and holidays in accordance with the lining system manufacturer's instructions.

I. Provide a five (5) year unlimited warranty on all workmanship and products. The work includes the surface preparation and application of the IET coating system, shall protect the structure for at least five (5) years from all leaks, and from failure due to corrosion from exposure to corrosive gases such as hydrogen sulfide.

END OF SECTION

Division 26

SECTION 26 05 02

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: General requirements for providing basic electrical materials and methods.

B. Related Work Specified in Other Sections Includes:
   1. Certain items of equipment, and various control devices including conduit and wiring which are indicated on electrical drawings to be connected, but are specified in other sections pertaining to plumbing, heating, ventilating, air conditioning, temperature control systems, process equipment, process control systems, and instrumentation. Install and connect these items to the electrical system as indicated or required in accordance with the Contract Documents.

C. Overall Application of Specifications: This section applies to all sections of Division 26, Electrical and to other sections that include electrical equipment requirements except when in these individual sections requirements are otherwise specified to provide and install all materials necessary for a complete operational system.

D. Temporary Requirements: This section applies to any temporary circuits, overcurrent devices, conduit, wiring, and other equipment required during changeover from existing to a new electrical system. This section also applies to temporary rewiring of lighting and power circuits, instruments and devices.

1.02 DEFINITIONS

A. Hazardous Areas: Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503. Hazardous areas are as defined by NFPA.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design requirements are specified in the applicable sections.

B. Performance Requirements: Performance requirements are specified in the applicable sections.

1.04 SUBMITTALS

A. General: Provide submittals in accordance with Section 01_78_24. Provide submittals for all electrical material and devices. Including the following:
   1. Submit Technical Information Documents, electronically, at start of construction or within 30 days after Award of the Contract. Provide correct project and equipment designation on outside cover and on end of brochure. Specific shop drawing submittals may be submitted separately after technical information document but before any equipment is purchased; provide index and schedule of shop drawings to be submitted within the technical information brochures.
   2. First section of the document shall be prepared by the Contractor, and shall list Project Addresses and phone numbers with key personnel for this project. Second section shall be the individual referenced specification section which equipment is being submitted under. The specification shall be annotated utilizing a spec check system in which check marks are placed beside each line item indicating the Contractor is complying or else noted with an exception number. All exceptions and clarifications shall be compiled into a single document at the of the section.
   3. Provide bookmarked document tabbed with the appropriate specification reference number or section number.
   4. The Contractor shall review the document before submitting to the Engineer. No request for payment will be considered until the document has been submitted and reviewed completely.
   5. Submit cost breakdown "Schedule of Values" for electrical work in the Technical Information Document. Cost of material and labor for each major item shall be shown.
   6. Acceptance: When returned to Contractor, submittals will be marked with Engineer's stamp. If box marked "returned for correction resubmit" is checked, submittal is not approved and Contractor is to correct and resubmit as noted, otherwise submittal is approved and Contractor is to comply with notation making necessary corrections on submittal and resubmit for final record.
   7. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not assure that the Engineer, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved, the ability of the material or equipment involved or the Mechanical/Electrical performance of equipment. Approval of shop drawings does not invalidate the plans and specifications if in conflict with the submittal. It is the Contractor’s responsibility to request in writing and seek written approval from the engineer for all deviations of the plans and specifications.

B. Product Data and Information: Provide complete list of electrical equipment and materials to be furnished showing manufacturer, catalog number, size, type, voltage rating and other pertinent information.
   1. Provide catalog data on manufacturer's standard equipment and materials. Clearly indicate on catalog cuts the equipment and devices being proposed.
   2. Identification: Provide complete schedule and listing of system and equipment identification labels with legends.
   3. Material shall not be ordered or shipped until the shop drawings have been approved.

4. The Engineer's Shop Drawing review 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.
5. Shop Drawings shall be stamped with the date checked by the Contractor 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.

C. Contractor's Shop Drawings: Provide shop drawings on items manufactured for the Contract.
1. Provide connection diagram and schematic for each piece of electrical equipment. A manufacturer's standard connection diagram or schematic showing more than one method of connection is not acceptable unless it is clearly marked to show the intended method of connection.
2. Provide diagrams showing connections to field equipment. Clearly differentiate between manufacturer's wiring and field wiring.
3. Provide raceway layout drawings showing conduits, boxes, and panels which contain the conductors to be provided. Include schedules listing conduit sizes and conductor content and identification.
4. Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new Work.

D. Coordination Drawings: Prepare to scale coordination drawings (1/4"=1'-0"); detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:
1. Indicate the proposed locations of major raceway systems, equipment, and materials. All dimensions shall be field verified at the job site and coordinated with the work of all other trades. Include the following:
    a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
    b. Exterior wall and foundation penetrations.
    c. Fire-rated wall and floor penetrations.
    d. Equipment connections and support details.
    e. Sizes and location of required concrete pads and bases.

E. Record Documents: Prepare record documents, and in addition to the requirements specified in Division 1, General Requirements. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, (the "Record Drawings"). Indicate installed conditions for:
1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, and actual equipment and materials installed.

4. Record Drawings shall accurately show the installed condition of the following items: Power Riser Diagram(s). Equipment elevations (front views). Raceways and pullboxes. Conductor sizes and conduit fills. Control Wiring Diagram(s). Underground raceway and duct bank routing. Plan view, sizes and locations of distribution transformers and outdoor electrical equipment enclosure.
5. Submit a schedule of control wiring raceways and wire numbers, including the following information: Circuit origin, destination and wire numbers. Field wiring terminal strip names and numbers.
6. 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. Comply with PLC tag designation on all instrumentation and control cabling in and out of PLC racks.
7. The schedule of control wiring raceways and wire numbers and the point to point connection diagrams shall be in electronic Autocad and Word format (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted)

F. Operation and Maintenance Manuals: Prepare operation and maintenance manuals, and in addition to the requirements specified in other Divisions, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and catalog numbers of replacement parts. Complete parts list with stock numbers, including spare parts. A complete bill of material supplied, including serial numbers, ranges and pertinent data.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. A comprehensive index.
5. A complete "As Built" set of approved shop drawings.
6. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.
7. A complete listing of “As left” programmable parameters for all drives, soft-starters and other microprocessor controlled equipment.
8. System schematic drawings "As Built", illustrating all components, piping and electric connections of the systems supplied under this section.

1.05 QUALITY ASSURANCE

A. Codes: Provide all electrical Work in accordance with applicable local codes, regulations and ordinances. If there is a conflict between the requirements specified in the Contract Documents and the codes, follow the more stringent requirements as determined and approved.

B. Testing: As a minimum, provide standard factory and field tests for each type of equipment. Other tests may be specified in the applicable equipment section.

C. Labeling: Provide all electrical equipment and materials listed and approved by Underwriters Laboratories with the UL label or other OSHA recognized testing laboratories attached to it.

D. Standard Products: Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. When two or more units of the same class of material and equipment are required, provide the products of the same manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1, General Requirements and as follows:

B. Shipping and Packing: Provide materials and equipment suitably boxed, crated or otherwise completely enclosed and protected during shipment, handling, and storage. Clearly label such boxes, crates or enclosures with manufacturer's name, and name of material or equipment enclosed.

C. Acceptance at Site: Conform to acceptance requirements as required in Division 1, General Requirements. Repair or replace all materials and equipment damaged by handling and storage as directed at no additional Contract cost.

D. Storage and Protection: Protect materials and equipment from exposure to the elements and keep them dry at all times. Handle and store to prevent damage and deterioration in accordance with manufacturer's recommendations.

1.07 PROJECT CONDITIONS

A. General: The Drawings indicate the extent and general arrangement of the principal electrical elements, outlets and circuit layouts. Connect and install all electrical elements and devices to form a workable system as required by the Contract Documents whether the connections and installations are specifically stated in the Specifications or shown. Provide necessary materials and installation wherever required to conform to the specific requirements of the furnished equipment and for proper installation of the Work.

B. Schematics: In general the runs of feeders are shown schematically and are not intended to show exact routing and locations of raceways. Verify actual and final arrangement, equipment locations, and prepare circuit and raceway layouts before ordering materials and equipment. Equipment locations are approximate and are subject to modifications as determined by equipment dimensions.

C. Coordination of Work: Coordinate the Work so that the electrical equipment may be installed without altering building components, other equipment or installations.

D. Coordinate arrangement, mounting, and support of electrical equipment: To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated. To provide for ease of disconnecting the equipment with minimum interference to other installations. To allow the right of way for piping and conduit installed at the required slope. To clear connecting raceways, cables, wireways, cable trays, and busways of obstructions and of the working and access space of other equipment. Coordinate the installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed. Coordinate electrical testing of electrical, mechanical, and architectural items, so that functionally interdependent equipment and systems demonstrate successful interoperability.

E. Departure from Design: If departures are deemed necessary due to structural conditions, obstructions or other problems, provide details of such departures and the reasons for requesting approval as soon as practicable but not later than the submittal of the raceway layout drawings. Do not make any departures without written approval.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 ROUGH-IN

A. Final Location: Verify final locations for rough-ins with field measurements, vendor shop drawings and with the requirements of the actual equipment to be connected.

B. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

C. Install each 3 phase circuit in a separate conduit unless otherwise shown.

D. 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.

E. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

F. All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45 degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

G. All “LB” type fitting hardware to be stainless steel or brass. All junction box hardware to be aluminum or stainless steel only.

3.02 ELECTRICAL INSTALLATIONS

A. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate electrical systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements. 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.
   3. 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.
   4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
   5. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.
   6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
   7. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
   8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
   9. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer for resolution.
   10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
   11. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
   12. Install access panel or doors where units are concealed behind finished surfaces.
   13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Homeruns: Drawings show most homerun circuits to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer. Changes shall be documented on record drawings. Homerun circuits shown on Drawings indicate functional wiring requirements for all circuits. Lighting and receptacle Circuits; no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.

3.03 CUTTING AND PATCHING

A. Perform cutting and patching as specified in Division 1, General Requirements. In addition to the requirements specified in Division 1, General Requirements, the following requirements apply:
   1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
      a. Uncover Work to provide for installation of ill-timed Work.
      b. Remove and replace defective Work.
      c. Remove and replace Work not conforming to requirements of the Contract Documents.
      d. Remove samples of installed Work as specified for testing.
      e. Install equipment and materials in existing structures.
      f. Locate existing structural reinforcing where core drilled penetrations are required so as not to cut the steel reinforcing.
   2. Cut, remove, and properly dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work. Deliver all the existing removed to the Owner as directed.
   3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
   4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
   5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
   6. Patch finished surfaces and building components using new materials as specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

SECTION 26 05 11

SPECIAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems for the Lee County Utilities Department as shown on the Drawings and as specified herein.

B. The work shall include furnishing, installing and testing the equipment and materials specified in other sections of the Specifications and shown on the Drawings.

C. 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. The Work shall include but not be limited to furnishing and installing the following:

1. Partial demolition of electrical equipment, conduit and wire at the sludge pump and belt filter press facilities.
2. Furnish and install Concrete encased ductbank system for power, fiber optic, instrumentation and control signal distribution.
3. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these Specifications.
4. 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.
5. A complete raceway system for the Data Network Cables and specialty cable systems. Install the Data Network Cables and other specialty cable systems furnished under other divisions in accordance with system integrator and the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the system integrator and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished.
6. Provide a complete grounding system and special grounds as required or noted.
7. Provide Power and signal Surge Suppression systems.
8. Provide Concrete work for pad mounted equipment.
9. Provide complete electrical testing of all new equipment.
10. Provide Lightning protection, bonding and grounding systems.
11. Provide complete set of electronic and hard copy Project Record Drawings and Vendor Operation and Maintenance manuals.
12. Provide detailed training sessions.

D. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing site 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 and structures and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing the work.

E. Field verify all existing underground electrical and mechanical piping.

F. The Contractor shall prepare and furnish electrical and instrumentation conduit layout Shop Drawings for yard electrical, within and under all roads, buildings and structures to the Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, 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 22 by 34 sheets.

G. 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.

H. A single manufacturer shall provide new panelboards, main breakers, transformers, disconnect switches, etc. When modifying existing equipment, match the manufacturer of the equipment.

I. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved by the engineer. Any temporary added shall be removed at job completion.

J. Complete coordination with other contractors. Contractor shall coordinate with all other contractors equipment submittals and obtain all relevant submittals.

K. Mount transmitters, process instruments, operator’s stations, etc. furnished under other Divisions of these Specifications.

L. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in this Division.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
   2. National Electrical Manufacturers Association (NEMA):
   3. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

4. Z535.4, Product Safety Signs and Labels.
5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. Underwriters Laboratories, Inc. (UL).

1.03 RELATED WORK

A. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in other Divisions.

B. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and reinforcing steel, is specified in other Divisions.

1.04 REFERENCE STANDARDS

A. 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:
1. National Electrical Safety Code (NESC).
2. Occupational Safety and Health Administration (OSHA).
3. National Fire Protection Association (NFPA).
4. National Electrical Manufacturers Association (NEMA).
5. American National Standards Institute (ANSI).
6. Insulated Cable Engineers Association (ICEA).
7. Instrument Society of America (ISA).
8. Underwriters Laboratories (UL).
9. Factory Mutual (FM).
10. International Electrical Testing Association (NETA).
11. Institute of Electrical and Electronic Engineers (IEEE).
12. American Society for Testing and Materials (ASTM).
13. Electrical Safety in the Workplace (NFPA70E).
14. State and Local Codes and Ordinances.

B. 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. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:
1. NEMA 1 for dry, non-process indoor locations.
2. NEMA 12 for "DUST" locations.
3. NEMA 4X 316 stainless steel powder coated white with continuous hinge, 3 point latch, screw down door clamps for all outdoor locations, rooms below grade (buried vaults), "DAMP" and "WET" locations.
4. NEMA 4X 316 SS powder coated white with continuous hinge, 3 point latch, screw down door clamps for "CORROSIVE" locations.

5. 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.

B. Unless otherwise specified herein or shown on the Drawings, junction boxes shall have the following ratings:
   1. NEMA rating as applicable and specified above.
   2. Have continuous hinge with quick connect door clamp. Flush mounted screw down fronts are not acceptable.

1.06 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. Completed electrical installation shall be inspected and certified by all applicable agencies that it is in compliance with all codes.

B. Contractor shall obtain all necessary permits and Lee County will pay all fees required for permits and inspections.

1.07 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 26, Electrical and other divisions supplying electrical equipment. Repair or replace all defective work and equipment. Refer to section 26_08_00, Acceptance Testing and Performance Verifications and the individual equipment sections for additional specific testing requirements.

B. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

C. In addition to the specific testing requirements listed in section 26_08_00, Acceptance Testing and Performance Verifications and the individual sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing in accordance with Section 26_08_00, Acceptance Testing and Performance Verifications.
   1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.
   2. 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 driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.
   3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.
   4. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.
   5. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.

6. 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.
7. 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.
8. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.
9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.
10. Check all wire and cable terminations. Verify to the Engineer connections meet the equipments torque requirements.
11. Field set all transformer taps as required to obtain the proper secondary voltage.
12. Infra-red hot spot inspection shall be made of all electrical equipment including but not limited to switchgear, motor control centers, transformers, switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the Owner.

1.08 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified herein.

1.09 EQUIPMENT IDENTIFICATION

A. Identify equipment (disconnect switches, control stations, etc) furnished under Division 26, Electrical with the name of the equipment it serves. Control panels, panelboards, main breakers, junction or terminal boxes, etc, shall have nameplate designations as shown on the Drawings. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the Drawings, inscription and size of letters shall be as shown and Shop Drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277/480V, 3-phase, 4-wire". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch with 3/16-inch high white letters on a black background. Attach with Stainless Steel nuts and bolts.

C. Electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks. Electrical contractor is responsible for nameplates on electrical equipment supplied by other divisions and installed and wired by electrical including all instrumentation and controls equipment. A portion of existing equipment affected by this contract shall also receive nameplates as determined by the Engineer.

D. 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.

E. All voltages (e.g. 480 volts, 240 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1-inch high.

F. All receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, etc. shall be identified with the panel and circuit to which it is connected. Identification shall be with machine generated labels with 1/4-inch high letters.

1.10 SAFETY REQUIREMENTS

A. 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:
   1. 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.
   2. 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.
   3. 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.
   4. 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.

1.11 ABBREVIATIONS OR INITIALS USED

A/C	Air Conditioning
A.C.	Alternating Current
AFF	Above Finished Floor
AFG	Above Finished grade

AHU	Air Handler Unit
AIC	Amps interrupting Capacity
AL	Aluminum
AMP	Ampere
ANSI	American National Standards Institute
ATS	Automatic Transfer Switch
AUX	Auxiliary
AWG	American Wire Gauge
BKR	Breaker
°C	Degrees Centigrade
CAB	Cabinet
C.	Conduit or Conductor
C.B.	Circuit Breaker
CFM	Cubic Feet per Minute
CKT.	Circuit
COND.	Conductor
Conn.	Connection
CP	Control Panel
CPT	Control Power Transformer
CT	Current Transformer
CU.	Copper
DC	Direct Current
Deg.	Degree
Disc.	Disconnect
DO	Draw Out
DPST	Double Pole Single Throw
EMT	Electric Metallic Tubing
E.O.	Electrically Operated
°F	Degrees Fahrenheit
FLA	Full Load Amperes
FHP	Fractional Horsepower
FT.	Feet
FVNR	Full Voltage Non-Reversing
GFI (GFIC)	Ground Fault Interrupting
gnd.(GD.)	Ground
hp.	Horsepower
hr.	Hour
IEEE	Institute of Electrical and Electronic Engineers
in.	Inches
JB	Junction Box
KV	Kilovolt

KVA	Kilo-Volt-Amps
KW	Kilowatts
LCP	Local Control Panel
LED	Light Emitting Diode
max.	Maximum
MCB	Main Circuit Breaker
MCC	Motor Control Center
MCP	Motor Circuit Protector
min.	Minimum
MLO	Main Lugs Only
N.	Neutral
NEC	National Electric Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NIC.	Not in Contract
NF	Non Fused
No.	Number
ph	Phase
OCU	Odor Control Unit
OL	Overload
OSHA	Occupational Safety and Health Act
PB	Pullbox
Ph.	Phase
PNL	Panelboard
PR	Pair
PWR	Power
PF	Power Factor
Pri	Primary
psi	Pounds Per Square Inch
PT	Potential Transformer
PVC	Polyvinyl Chloride
RLA	Running Load Amps
RMS	Root-Means-Square
RPM	Revolutions Per Minute
Recept.	Receptacle
RTD	Resistance Temperature Device
RVNR	Reduced Voltage Non-Reversing
SCA	Short Circuit Amps
SCC	Short Circuit Current
SCCR	Short Circuit Current Rating

Sec.	Secondary
S/N	Solid Neutral
SPST	Single Pole Single Throw
SSRV	Solid State Reduced Voltage
SW.	Switch
SWBD	Switchboard
SWGR	Switchgear
TEFC	Totally Enclosed Fan Cooled
TSP	Twisted Shielded Pair
TYP	Typical
Temp.	Temperature
UL	Underwriters Laboratories
UNO	Unless Noted Otherwise
V	Volt
VFD	Variable Frequency Drive
WP	Weatherproof
XFMR	Transformer

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SLEEVES AND FORMS FOR OPENINGS

A. 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.

B. 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.

C. 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.

D. Seal all openings, sleeves, penetration and slots as specified in Section 26 05 33.

3.02 INSTALLATION

A. 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.

B. 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 supplied and all cost associated with replacement shall be borne by the Contractor.

C. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.

D. 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 Section 09_90_00, Painting and Coating at no additional cost to the Owner.

E. All “LB” type fitting hardware to be stainless steel or brass. All junction box hardware to be aluminum or stainless steel only.

3.03 MANUFACTURERS SERVICE

A. Provide manufacturer's services for testing and start-up of all major electrical equipment: VFDs, ATS, Gensets, MCCs, Switchboards, Switchgear, Etc.

B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturer’s warranty repairs.

C. The manufacturers of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:
   1. 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.
   2. 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.
   3. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.

4. 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.

3.04 TRAINING

A. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

B. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the Project.

C. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance including trouble-shooting of each system.

D. 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. The training shall be conducted with record "as-built" drawings sufficient for each class member.

E. The Contractor shall submit an overview of the proposed training plan. This overview shall include, for each course proposed:
   1. An overview of the training plan.
   2. Course title and objectives.
   3. Recommended types of attendees.
   4. Course Content - A topical outline.
   5. Course Format - Lecture, laboratory demonstration, etc.
   6. Schedule of training courses including dates, duration and locations of each class.

F. The Work under this Division shall include a warranty period of one year or the manufacturer's standard warranty period, whichever is greater. This warranty shall be by the Contractor to the Owner for any defective workmanship or material that has been furnished under this Contract at no cost to the Owner for a period of one year or the manufacturer's standard warranty period, whichever is greater, from the date of Partial Clearance or Substantial Completion of the System, as applicable. This guarantee shall not include light bulbs or batteries in service after six months from date of Substantial Completion of the System.

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE WIRES AND CABLES

PART 1 GENERAL

1.01 REFERENCED STANDARDS

A. Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI).

B. Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.

C. National Electrical Manufacturers Association (NEMA): ICS 4, Industrial Control and Systems: Terminal Blocks.

D. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA): WC 57/S-73-532, Standard for Control Cables: WC 70/S-95-658, Non-Shielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.

E. National Fire Protection Association NFPA-70, National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL44): Standard for Safety Thermoset Insulated Wires and Cables; (UL83): Standard for Safety Thermoplastic-Insulated Wires and Cables; UL467 Standard for Safety Grounding and Bonding Equipment. UL486A Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors; UL 486C, Standard for Safety Splicing Wire Connections. UL510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

1.02 DEFINITIONS

A. Building Wire: Copper single conductor, cross link polyethylene insulated; type XHHW-2.

B. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

C. Instrumentation Cable (Analog signal cable): Multiple conductor, insulated, twisted Pair/Triad, with individual Pair/Triad shield and outer overall shield and outer sheath. Used for the transmission of low current (e.g., 4-20mA DC) using No. 16 AWG conductors. Common Types, TSP: Twisted shielded pair, TST: Twisted shielded triad.

D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, AWG. With overall shield where specified. Type SIS and MTW approved for use in the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers; otherwise type XHHW-2.

E. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 12 AWG and larger; Rated XHHW-2.

F. Digital signal cable: Used for the transmission of digital signals between computers.

G. PLC's, RTU's, etc. Common Types: Ethernet UTP-unshielded twisted pair.

1.03 SUBMITTALS:

A. Submit cut sheets on all major types of wires and cables including splicing tape, and terminating/splicing lugs, conductor identification systems and connectors and cable sleeves. Submit sample of all instrumentation and control cable. Sample shall be a minimum of 24 inches with exterior sheath clearly marked.

B. Submit sample of all cable identification systems products.

C. Submit conduit schedule identifying conduit tag numbers, locations the conduit connects and the wire count.

PART 2 PRODUCTS

2.01 POWER CONDUCTORS:

A. Branch circuits and feeder conductors for all three phase electric power shall be stranded copper type XHHW-2 cross-link polyethylene (XLP) insulation and derated to 75 degrees Centigrade. No aluminum wiring shall be permitted. Wire shall be in accordance to NEC and minimum No. 12, except that branch "homeruns" over 50 feet in length shall be minimum No. 10 for 120/208V circuits. All branch lighting circuits serving HID and Fluorescent fixtures shall be minimum #10 with each circuit provided with a separate neutral. All wire shall be manufactured in the USA.

B. Motor leads from variable frequency drives to driven motor shall be shielded VFD drive cable for all VFD motors. Provide flexible VFD shielded drive cables, 3 Class-I conductor cable plus 3 trisectional green insulated ground wires. Provide electrostatic shielding of tinned copper braided shield with aluminum-polyester laminated tape shielding system. Cross-linked Polyethelene insulation (RHH/RHW-2 or XHHW-2) system and PVC, type TC cable as manufactured by Southwire, Service Wire or equal. Shielded VFD motor cables require increased conduit sizes over standard wire installations. Contractor to verify conduit sizes.

C. Taps and Splices:
   1. All power wiring taps and splices in No. 8 or smaller wire shall be fastened together by means of terminal strips except within lighting fixtures and wiring devices where conformance to NEC practices will be acceptable (Twist/screw on type connectors). All taps and splices in wire larger than No. 8 require approval by the engineer and shall be made with compression type connectors and taped to provide insulation equal to wire. Tape shall be heavy duty, flame retardant and weather resistant vinyl electrical tape, minimum 7 mil premium grade with an operating temperature of 0 degree F. to 220 degrees F. Provide tape meeting UL 510 and CSA standard C22.2.

2. All taps and splices in manholes or in ground pull boxes, etc. shall be approved by the engineer on a case by case basis; be made with high press long barrel double crimp compression type connectors and covered with Raychem heavy wall cable sleeves (type CTE or WCS) with type "S" sealant coating. Install sleeve kits as per manufacturer's installation instructions.

D. Color Coding:
1. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel except for the wire markings.
2. Unless otherwise approved, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire green, bare or green with yellow strips. Nominal Voltage: 120/208V, Phase A - black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C -yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above. In exiting or expansion projects, comply with existing color coding established within the facility.

2.02 INSTRUMENTATION AND CONTROL CABLE:

A. Multiconductor and Multi pair Process instrumentation cable shall be #16 AWG stranded, twisted pair, 600V, (XLP) cross link polyethylene insulated, aluminum tape pair shielding, cross link polyethylene or chlorinated polyethylene (CPE) overall sheathed and shielded, type TC instrument cable as manufactured by the American Insulated Wire Co., Belden Wire Co. or equal.

B. Multiconductor control cable shall be #14 AWG stranded, 600V, (XLP) cross link polyethylene insulated or polyolefin, with cross link polyethylene or chlorinated polyethylene (CPE or Hypalon) overall sheathed type TC control cable except for control cable into and out of VFD cabinets. Multiconductor control cable into and out of VFD cabinets shall be as indicated above and in addition include an aluminum polyester tape overall shield and drain wire. As a contractor alternate to shielded control cable into and out of VFD cabinets, provide twisted shielded instrument cable as specified above. Contractor to provide increased conduit size as required if instrument cable alternate is used into and out of VFD cabinets.

C. Category 6 Unshielded Twisted Pair (UTP), UL listed, and third party verified to comply with TIA/EIA 568 C Category 6 requirements. Suitable for high speed network applications including gigabit Ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket. Cable shall withstand a bend radius of 1 inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking. Manufacturer and Product: Belden; 7852A. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.

2.03 CONNECTIONS:

A. All conductor connections shall be on terminal strips including all spare conductors. Provide terminal strips in all cabinets, motor control centers, etc.

B. All connections of stranded wire to screw terminals shall be by insulated spade lugs, crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks. The stranded wire ferrule is to be crimped to all stranded wire using a crimping tool specifically approved for crimping the size and type of ferrule.

C. All conductors shall be marked with mylar wrap type "Brady" labels. Identification labels shall be permanent type and be machine printed. All terminal block terminations shall be labeled. The inside portion of the terminal cabinet doors shall display a protected terminal cabinet drawing with all connections shown and described as to color code, number assigned to connection function of conductor and destination.

D. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.

E. Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.

F. Cabinets: All cabinets shall be labeled with an engraved plastic laminate label riveted to the door.

G. No splices shall be made within a conduit run or in manholes.

H. All plant control system field wiring shall be labeled per the instrumentation and control contractor loop drawings from the field device, through the intermediate cabinets, to the PLC cabinet. The labeling system shall be consistent throughout the loop and follow the standard tag designation: PLC#-Rack#-Slot#-Point# (example PLC1-R2-S3-P4).

I. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24-inch separation for parallel run of power conduit and instrumentation or control conduit. This separation can be reduced to 8 inches if metallic grounded separation is provided.

2.04 MISCELLANEOUS ACCESSORIES

A. Tape:
   1. General Purpose, Flame Retardant: 7 mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
   2. Flame Retardant, Cold and Weather Resistant: 8.5 mil, vinyl plastic, Scotch Brand 88.
   3. Arc and Fireproofing: 30 mil, elastomer. Manufacturers and Products: 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tape binder.

PART 3 EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors and aluminum conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 SPARE CONDUCTORS

A. All runs of Multi pair Process instrumentation cable and multi conductor Control cable shall have a minimum of 2 spare conductors per conduit.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. The terms “connect”, “ground” and “bond” are used interchangeably in this specification and have the same meaning

B. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

C. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, perimeter counterpoise ground, lightning protection system grounding electrodes.

1.02 RELATED WORK

A. Section 26 05 02, Basic Electrical Materials and Methods: General electrical requirements.

B. Section 26 05 19, Low Voltage Wires and Cables.

C. Section 26 41 00, Lightning Protection Systems.

1.03 SUBMITTALS

A. Submit in accordance with Section 26 05 02, Basic Electrical Materials and Methods.

B. Shop Drawings:
   1. Sufficient information, clearly presented, shall be included to determine compliance with Drawings and Specifications.
   2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Project Engineer:
   1. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.04 APPLICABLE PUBLICATIONS

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

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE).

C. Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

D. National Fire Protection Association (NFPA).

E. National Electrical Code (NEC) 2008.

F. Underwriters Laboratories, Inc. (UL):
   1. Thermoset-Insulated Wires and Cables.
   2. Thermoplastic-Insulated Wires and Cables.
   3. Grounding and Bonding Equipment.
   4. Wire Connectors.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 2 AWG and smaller may be solid copper unless noted otherwise noted on the Drawings. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 2 AWG and smaller may be ASTM B1 solid bare copper wire.

C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the Drawings and not less than required by the NEC, whichever is greater.

2.02 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.03 GROUND CONNECTIONS

A. Above Grade:
   1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lock washers.
   2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

PART 3 EXECUTION

3.01 GENERAL

A. Ground in accordance with the NEC, as shown on Drawings, and as hereinafter specified.

B. System Grounding:
   1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
   2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 GROUNDING CONNECTIONS

A. Make grounding connections that are below grade by exothermic weld. Make grounding connections that are above grade but are otherwise normally inaccessible (poured columns, within walls) with exothermic weld.

3.03 SECONDARY EQUIPMENT AND CIRCUITS

A. Transformers:
   1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
   2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

B. Conduit Systems:
   1. Ground all metallic conduit systems. All conduit systems shall contain an equipment grounding conductor (except service entrance with grounded neutral). Ground conductor shall be bonded to metallic conduit systems at the entrance and exit from the conduit.

C. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
   2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
   3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

D. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

E. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.04 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.05 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system.

3.06 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 2 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Below-grade connections shall be visually inspected by the Project Engineer prior to backfilling. Provide ground inspection wells at all ground rod locations.

3.07 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 20 feet in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make above grade accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, drill rock then install rod. Backfill with flowable fill or concrete mix. Obtain the necessary permits if required for drilling.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE

A. The Work under this sections includes conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work. Furnish and install all supports, hangers and inserts required to mount fixtures, conduit, cables, pull boxes and other equipment furnished under this Division 26, Electrical. All supporting devices and hardware exterior of buildings or interior of structures except in air conditioned spaces shall be stainless steel. Aluminum and nonmetallic supports (fiberglass) and hardware will be reviewed by the Engineer on a case-by-case basis.

B. All items shall be supported from the structural portion of the building. Supports and hangers shall be of a type approved by Underwriters' Laboratories. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.

C. The Contractor shall furnish and install all sleeves that may be required for openings through floors, wall etc. Where plans call for conduit to be run exposed, the Contractor shall furnish and install all inserts and clamps for the supporting of conduit. If the Contractor does not properly install all sleeves and inserts required, Contractor to provide cutting and patching to the satisfaction of the Engineer.

1.02 RELATED WORK

A. Applicable provisions of Division 1, General Requirements govern Work under this section.
   1. Section 26 05 33, Conduit Systems.

1.03 SUBMITTALS: PRODUCT DATA

A. Provide data for support channel.

1.04 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 PRODUCTS

2.01 MATERIAL

A. Support Channel: Stainless steel throughout except galvanized steel in conditioned interior areas.

B. Hardware: Stainless steel throughout.

C. Minimum sized threaded rod for supports shall be 3/8 inch.

D. Conduit clamps, straps, supports, etc., shall be stainless steel or malleable iron. One-hole straps shall be heavy duty type.

PART 3 EXECUTION

3.01 INSTALLATION

A. All steel conduits shall be securely fastened in place on maximum of 6 foot intervals; all PVC conduits shall be securely fastened in place on maximum of 3 foot intervals vertically and 2 foot intervals horizontally. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by two-hole malleable straps, clamp-backs, or other approved devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.

B. On concrete or masonry construction, use "Tapcon" type fasteners. For brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head screws shall be used. An electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. Steel members shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from stainless steel, or approved substitution.

C. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only). Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.

D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not drill structural steel members unless approved by the Engineer.

E. Fabricate supports from stainless steel or galvanized steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall.

F. Furnish and install all supports as required to fasten all electrical components required for the project, including freestanding supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

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SECTION 26 05 33

CONDUIT SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Description of System: This section includes requirements for raceways, fittings, boxes, enclosures, and cabinets for electrical, instrumentation and control system wiring.

B. Heavy wall PVC (Schedule 80) shall be used for all raceways directly buried without concrete encasement protection. Conduits in concrete encasement use Schedule 40-PVC. Above ground in areas subject to chemical degradation (chemical storage, chemical feeder rooms, chlorine rooms, odor control and scrubber area, etc) use Schedule 80-PVC. Use aluminum conduit for exposed above grade interior area. Electrical Metallic Tubing shall be used within air conditioned spaces and in electrical rooms for power and for instrumentation and control conduits. Use rigid aluminum conduit above grade on exterior of buildings and in above grade interior wet locations. Where PVC conduit penetrates a floor from underground or in a slab; PVC coated rigid aluminum conduit shall be used at penetration for all conduits.

C. Minimum conduit size for all systems shall be 3/4 inch. All conduits shall be U.L. listed and labeled. Conduit sizes shown on the drawings are to aid the contractor in bidding only; the Contractor is responsible for conduit sizes as required by NEC fill tables but do not provide smaller conduits than indicated. The Contractor is responsible to coordinate the required conduit sizes and conductor quantities for all control and instrumentation system conduit and wiring with the controls subcontractor prior to installation.

D. Provide stainless steel or non-metallic conduit supports and Type 316 stainless steel hardware in all areas except air conditioned spaces.

1.02 SUBMITTALS

A. Product Data:
   1. Product data shall be submitted on:

B. Conduit, raceways, wireways.

C. Conduit fittings, boxes, enclosures and cabinets.

D. Surface metal raceway.

E. Conduit Schedule identifying conduit tag numbers, locations the conduit connects and the wire count.

PART 2 PRODUCTS

A. ELECTRIC METALLIC TUBING
   1. Electric metallic tubing (thin wall) shall meet Federal EMT Specifications WW-C-563 ANSI C80.3 and UL 797 with chromated and lacquered protective layer.

B. FLEXIBLE CONDUIT
   1. Flexible, Nonmetallic, Liquid-Tight Conduit: Type B.
      a. Material: PVC core with fused flexible PVC jacket. UL 1660 listed for:
   2. Dry Conditions: 80 degrees C insulated conductors.
   3. Wet Conditions: 60 degrees C insulated conductors.
      a. Manufacturers and Products:
   4. Carlon; Carflex or X Flex.
   5. T & B; Xtraflex LTC or EFC.
   6. Flexible Steel Conduit: Continuous length, spirally wound steel strip, zinc-coated, each convolution interlocked with following convolution. Federal Specification WW-C-566. Liquid-tight Flexible Steel Conduit: Plastic (PVC) jacketed flexible steel conduit with copper bonding conductor (UL 1660). Flexible conduit fittings: UL 514B.

C. PVC CONDUIT
   1. PVC conduit shall be composed of High Impact Virgin homopolymer, PVC (polyvinyl chloride C-200 Compound), and shall conform to industry standards, and be UL 651 listed in accordance with Article 347 of National Electrical Code for underground, concrete encasement and or direct sunlight exposed use and NEMA standard TC-2. Materials must have tensile strength of 55 psi, at 70oF, flexural strength of 11,000 psi, compression strength of 8600 psi. Manufacturer shall have five years' extruding PVC experience. Consistent with requirements provide PVC conduit products by one of the following manufacturers:
      a. Carlon.
      b. Cantex.
      c. J.M. Plastics.
      d. Queen City Plastics.
         1) Rigid Aluminum Conduit
   2. Provide Rigid Aluminum Conduit of 6063 alloy in temper designation T-1. The fittings are of the same alloy. Provide threaded Rigid Aluminum Conduit to Underwriters Laboratories U.L. 6A, “Standard for Electrical Rigid Metal Conduit and manufactured to ANSI C80.5.
   3. Provide threaded aluminum conduit fittings, of 6063 alloy, cast copper free aluminum with integral insulated throat as manufactured by Allied, OZ Gedney, T&B, Crouse-Hinds, Killark or Appleton.
   4. Provide supplementary corrosion protection for aluminum conduit imbedded in concrete or in contact with soil. Where aluminum conduits are in contact with or penetrate concrete, coast conduit with asphaltic or bitumastic type coating.

D. CONDUIT FITTINGS
   1. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   2. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
   3. Fittings for EMT: Steel compression type.

4. Fittings, surface boxes and conduit bodies for Rigid Aluminum Conduit shall be heavy cast aluminum with external raised hubs and mounting lugs; Appleton, Crouse Hinds or approved substitution. Cover plates cast aluminum. Zinc die cast not acceptable.
5. Conduit locknuts shall be aluminum throughout except steel is acceptable within air conditioned spaces.
6. Conduit expansion fittings shall be malleable iron, and shall be hot dipped galvanized inside and outside. These fittings shall have a four-inch expansion chamber to allow approximately two-inch movement parallel to conduit run in either direction from normal. They shall have factory-installed packing and internal tinned copper braid packing to serve as an emergency bonding jumper. Unless the fitting used is listed by Underwriters' Laboratories for use "without external bonding jumpers", an external copper bonding jumper shall be installed with each expansion fitting with one end clamped on each conduit entering fitting.
7. Flexible, Nonmetallic, Liquid-Tight Conduit shall meet requirements of UL 514B with High strength plastic body, complete with lock nut, O-ring seal, threaded ferrule, sealing ring. Threaded ferrule designed to ensure high mechanical pullout strength and watertight seal. Manufacturer, Carlon; Type LN or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. All raceways shall be run in neat and workmanlike manner and shall be properly supported in accordance with latest edition of NEC with approved conduit clamps, hanger rods and structural fasteners except for PVC conduit installed in exterior locations. PVC conduit installed in exterior locations shall be supported at two foot intervals. Supporting conduit and boxes with wire is not approved. All raceways except those from surface-mounted switches, outlet boxes or panels shall be run concealed from view. Exposed raceways shall be supported with clamp fasteners with toggle bolt on hollow walls, and with lead expansion shields on masonry. Rigid steel box connections shall be made with double locknuts and bushings. Where PVC penetrates a floor from underground or in slab, a black mastic coated steel conduit elbow shall be used on all conduits. All individual bare copper ground conductors (i.e. service, transformer, or lightning protection grounds) shall be installed in PVC conduit, not metal conduit. This does not apply to bare copper ground conductors run with feeders (as specified in this section). Conduits shall be run parallel to building walls wherever possible, exposed or concealed, and shall be grouped in workmanlike fashion. Crisscrossing of conduits shall be minimized.

B. All raceways runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.

C. All raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.

D. All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.

E. All raceways shall be run from outlet to outlet exactly as shown on the Drawings, unless permission is granted to alter arrangement shown. If permission is granted arrangement shall be marked on field set of drawings as previously specified.

F. All underground raceways (with exception of raceways installed under floor slab) shall be installed in accordance with Section 300-5 of the NEC except that the minimum cover for any conduit shall be two feet. Included under this section shall be the responsibility for verifying finished lines in areas where raceways will be installed underground before the grading is complete.

G. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.

H. Spare conduit stubs shall be capped and location and use marked with concrete marker set flush with finish grade or terminated in a manhole. Marker shall be 6-inch round by 6 inches deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

I. All conduit stubbed above floor shall be separated with plastic interlocking spacers manufactured specifically for this purpose, or shall be strapped to Kindorf channel supported by conduit driven into ground or tied to steel.

J. Raceways which do not have conductors furnished under this Division 26, Electrical of the Specifications shall be left with an approved nylon pull cord in raceway.

K. Rigid Aluminum Conduit, electrical metallic tubing, flexible steel conduit and PVC conduit shall be manufactured within the United States.

L. All connections to motors or other vibrating equipment (except dry type transformers) or at other locations where required shall be made with not less than 12 inches no more than 20 inches of flexible liquid-tight steel conduit, using special type of connectors with strain relief fittings at both terminations of conduit. Flex connectors shall have insulated throat and shall be T & B 3100 Series or approved substitution. Use angle connectors wherever necessary to relieve angle strain on flex conduit. Connections to dry type transformers shall be made with flexible conduit. Typical length of flex conduit shall be limited to 20 inches unless specifically approved by the engineer.

M. PVC joints shall be solvent welded. Threads will not be permitted on PVC conduit and fittings, except for rigid steel to PVC couplings. Installation of PVC conduit shall be in accordance with manufacturer's recommendations. PVC conduit shall not be used to support fixture or equipment. Field bends shall be made with approved hotbox. Heating with flame and hand held heat guns are prohibited.

N. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete structure; on one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints; in each conduit run which mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit run above ground which is more than fifty feet long and interval between expansion fittings in such a runs shall not be greater than 100 feet for steel conduit and 50 feet for PVC conduit.

O. Electric metallic tubing (thin wall) where installed inside air conditioned buildings above grade shall be joined with steel fittings and steel compression connectors.

P. Conduit installations on roofs shall be kept to a bare minimum. Where required, conduit shall be rigid aluminum conduit, including couplings. Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Supports to be fastened to roof using roofing adhesive as approved by roofing contractor.

Q. Underground cable identification: bury a continuous, pre-printed, bright colored metalized plastic (electronically traceable) ribbon cable marker with each underground conduit (or group of conduits), regardless of whether conduits are in ductbanks. Locate directly over conduits, 6-inch to 8 inches below finished grade. Delete this requirement under building slabs.

R. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24-inch separation for parallel runs of power conduit to instrumentation or control conduit with either conduit being PVC or aluminum. This separation can be reduced to 8 inches if metallic grounded separation is provided (steel conduit).

S. Duct seal all conduit entrances. Foam seal is not acceptable.

T. All conduit runs shall have (1) spare conduits installed in the run sized to match the largest conduit in the run.

END OF SECTION

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SECTION 26 05 43

UNDERGROUND DUCTS AND DUCTBANKS

PART 1 GENERAL

1.01 GENERAL

A. Provide underground duct banks for power and lighting feeders; instrumentation and control systems as shown or as specified herein; from point of service switchgear or equipment to the point of distribution or equipment served.

1.02 SUBMITTALS

A. Submit Shop Drawings or cut sheets on:
   1. Conduit.
   2. Fittings.
   3. Conduit Separators.
   4. PVC solvent.
   5. Precast concrete manholes.
   6. Composite handholes.
   7. Cable lubricants.

1.03 DESCRIPTION OF ASSEMBLY

A. Underground ductbanks shall be multiple individual conduits encased in reinforced concrete as indicated on the Drawings. Conduits within building or structural foundations and protected by a concrete slab above them do not require encasement (except provide encasement or flowable fill under electrical and pump room slabs). The conduit shall be of plastic (PVC Schedule 40 for concrete encasement and Schedule 80 without concrete encasement), unless indicated or specified otherwise. The conduit used shall not be smaller than 4 inches in diameter, inside, unless otherwise noted. The concrete encasement surrounding the duct bank shall be rectangular in cross section, having a minimum concrete thickness of three inches around all conduits. All concrete encased duct banks shall be steel reinforced as detailed. Power distribution conduits shall be separated by a minimum dimension of four inches and not less than 7.5-inch center to center. Power conduits shall be separated from low voltage instrumentation & control conduits by a minimum dimension of 24 inches.

B. The concrete work shall conform to Section on "Concrete". The top of the concrete envelope shall be not less than 24 inches below grade unless otherwise indicated. Concrete shall be installed in a continuous pour to eliminate joints in the duct run. The ductbank sides shall be formed in place using suitable concrete formwork or corrugated metal forms. Open trench pours will not be allowed.

C. Plastic conduit, fittings and joints shall not have been stored in the sun or weather, in any excessively heated space, or unevenly supported during storage. Use and installation shall be in accordance with the National Electrical Code requirements for the installation of non-metallic rigid conduit. Plastic conduit shall be protected against the direct rays of the sun prior to installation. Conduit shall be PVC schedule 40 manufactured by Carlon, Queen City Plastics, or approved substitution. Conduit shall be U.L. listed and conform to NEMA Standards for schedule 40 PVC conduit.

D. Trenches for ductbanks shall be completely dry before setting conduits or pouring concrete. Provide well pointing as required if necessary to keep trench dry.

E. Wires and cables in manhole/handhole shall be placed on cable racks. Manhole/handhole shall be cleaned of all loose materials, dirt and debris immediately after completion of new work and shall be in a clean condition when Project is completed. Cable racks shall be stainless steel or nonmetallic with stainless steel hardware, cable racks shall be complete with insulators. Racks shall be Underground Devices or approved substitution.

F. Back filling of trenches shall be in layers not more than 8 inches deep, and shall be thoroughly tamped. The first layer shall be earth or sand, free from particles that would be retained on a 1/4 inch sieve. The succeeding layers shall be excavated material having stones no larger than would pass through a 4-inch ring. The back fill shall be level with adjacent surface, except that in sodded or paved areas, a space equal to the thickness of the sod or paving shall be left.

G. The surface disturbed during the installation of duct shall be restored to its original elevation and condition if not refinished in connection with Site Work.

H. All unused conduit openings shall be plugged or capped with a suitable device designed for the purpose; caulking compound shall not be used for plugging conduit openings.

I. One No. 2 bare solid tinned copper counterpoise shall be run above all duct banks and shall be run into all manholes/handholes and grounded to 5/8 inch by 20 foot driven ground rods. Counterpoise shall run into buildings and be grounded at each structures service ground.

J. All conduits entering a building or structure shall be sealed with duct seal.

PART 2 PRODUCTS

2.01 DUCT BANK STRUCTURES

A. Precast Concrete Construction: Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and pullboxes.

1. General: Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4,000 psi. Structures may be precast to the design and details indicated precast monolithicly and placed as a unit, or structures may be assembled sections, design and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
2. Construction: Structure top, bottom and wall shall be of a uniform thickness of not less than 4 inches. Quantity, size, and location of ductbank entrance windows shall be as required, and cast completely open by the precaster. Size of windows shall exceed the nominal ductbank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 6 inches deep.
3. Joints: Provide tongue-and-groove or shiplap joints on mating edges of precast components. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type-B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

B. Precast Concrete manholes and pullboxes (handholes): ASTM C478. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes and pullboxes. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Metal Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

C. Metal Frames and Covers: Shall be made of Aluminum. Covers shall have engineered lift assistance. Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Covers shall have raised letters of identification as indicated on the drawings. Covers shall have an approved antislip surface. Covers shall be rated AASHTO H20.

D. Pulling-In Irons: Shall be steel bars bent cast in the walls and floors. In the floor they shall be centered under the cover and in the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the manhole or pullbox. Pulling-in irons shall project into the box approximately 4 inches. Iron shall be hot-dipped galvanized after fabrication.

E. Cable Racks: Rack arms and insulators, shall be sufficient to accommodate the cables. Racks in manhole and pullbox shall be spaced not more than 2 feet apart, and each box wall shall be provided with a minimum of two racks. The wall bracket shall be stainless steel or fiberglass. Slots for mounting cable rack arms shall be spaced at 8-inch intervals. The cable rack arms shall be of stainless steel or fiberglass and shall be of removable type. Insulators shall be dry-process glazed porcelain. All metal fasteners and hardware portion of racks shall be stainless steel.

F. Grounding in manholes and pullboxes: Provide No. 6 AWG bare copper grounding pigtails on walls of each manhole and pullbox. The pigtails shall be exothermically welded to the reinforcing bars and shall extend at least 8 inches into box. Two pigtails shall be provided in each box.

G. Pull Wire: Plastic rope having a minimum tensile strength of 200 pounds in each empty duct. Leave a minimum of 24 inches of slack at each end of the pull wires.

H. Composite Handholes: Only where composite handholes are indicated on the drawings, use handholes, covers and boxes of polymer concrete as manufactured by Quazite Corporation. The material shall consist of aggregate bound together with a polyester resin and reinforced with continuous woven glass strands. The covers and boxes shall be designed to be installed flush to grade with cover fitting flush to the box and shall be capable of withstanding normal shipping and installation process without chipping, cracking or structural damage. All boxes shall be manufactured with the use of male/female molds to ensure a consistent wall thickness and structural strength and shall be stackable or extra depth. The boxes and covers shall have dimensions as indicated and shall be concrete gray in color. The cover logo shall be recessed into the cover and shall read INSTRUMENTATION or ELECTRIC as indicated. The composite covers shall be designed for a static vertical load of 8,000 pounds and shall be tested, in the box, to a static load of 12,000 pounds (1.5 safety factor). The test load shall be distributed over a 10 inch by 10 inch by 1 inch thick distribution plate located at the center of the cover. The maximum deflection at a load of 8,000 pounds shall not exceed 0.50 inches. The covers shall be skid resistant and have a minimum coefficient of friction of 0.50 on the top surface for the life of the cover. Coatings will not be provided. The permanent deflection of any surface shall not exceed 10 percent of the maximum allowable test load deflection. The lockdown mechanism shall be capable of withstanding a minimum torque of 30 foot-pounds. All inserts and fasteners shall be of stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION: CONFORM TO NFPA 70 AND ANSI C2.

A. The top of the conduit shall be not less than 24 inches below grade, for low voltage conduits and 48 inches for high voltage ducts. Run conduit in straight lines except where a change of direction is necessary. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2-1/2 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve.

B. Precast manhole and pullbox Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4-inch to 1-inch size, extending 12 inches beyond the manhole or pullbox on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

C. Buried Warning and Identification Tape: Metallic core or metallic-faced, acid-and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3-inch-minimum width, color coded as specified below for the intended utility and warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes
Yellow or red: Electric power
Orange: Instrumentation and Control

D. Conduit Placement: Duct lines shall have a continuous slope downward toward manholes/handholes and away from buildings with a pitch of not less than 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Manufactured bends may be made up or one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

E. Termination and Cleaning of Conduit: Terminate conduits in end-bells where duct lines enter manholes and pullboxes. Separators shall be of precast concrete, high impact polystyrene, steel, or a combination of these. Stagger conduit joints by rows and layers to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt with suitable conduit plugs. As each section of a duct line is completed, draw a non-flexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush having the same diameter of the duct through the duct, until duct is clear of particles of earth, sand, and gravel; then immediately install end plugs.

F. Conduit Protection at Concrete Penetrations: Conduits which penetrate concrete (slabs, pavement, and walls) shall be galvanized rigid steel; protected by a PVC sheath at the penetration; PVC sheath shall be 40-mils thick conforming to NEMA RN 1, and shall extend from at least 2 inches below the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches above concrete).

G. Cable Pulling: Pull Cables down grade with the feed-in point at the manhole or pullbox or point of the highest elevation. Use flexible cable feeds to convey cables through box opening and into duct runs. Accumulate cable slack at each box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.

H. Cable Lubricants: Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

I. Cable Pulling Tensions: Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

J. Installation of Cables in manholes and pullboxes and Handholes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space opening for future cables, except as otherwise indicated for existing installations.

K. Fireproofing of Cables in Manholes: All wire and cables in manholes shall be fireproofed. Strips of fireproofing tape approximately 1/16-inch thick by 3 inches wide shall be wrapped tightly around each cable spirally in one-half lapped wrapping, or in two butt-jointed wrappings with the second wrapping covering the joints in the first. The tape shall be applied with the coated side toward the cable, and shall extend one inch into the ducts. To prevent unraveling, the fireproofing (Arc-proofing) tape shall be random wrapped with tape conforming to type FGT of specification MIL-I-15126. The fireproofing (arc proofing) tape shall consist of a flexible, conformable fabric having one side coated with a flame-retardant, flexible, polymeric coating and/or a chlorinated elastomer. The tape shall not be less than 0.050 inch thick, and shall weigh not less than 2.5 pounds per square yard. The tape shall be non-corrosive to cable sheath, shall be self-extinguishing, and shall not support combustion. The tape shall not deteriorate when subjected to oil, water, gases, saltwater, sewage and fungus. The tape shall have a tensile strength of not less than 40 pounds per inch width, and when tested under USA Standard L14.184 cut strip method. Provide certification the product retains 65 percent of its original tensile strength for the following tests for 168 hours for each requirement;
   1. Immersion in distilled water,
   2. Immersion in 3 percent salt water,
   3. Exposure to ultra-violet light (30-watt germicidal lamp),
   4. Exposure to sunlight (Type S-1 sun lamp), and exposure to concentrated sewage.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 GENERAL

A. Provide materials and installation for the identification of electrical equipment, components, cables and wiring and safety signs.

B. Related Work Specified in Other Sections Includes:
   1. Sections 26 05 02, Basic Electrical Materials and Methods; 26 08 00, Acceptance Testing Performance Verifications; 26 05 19, Low Voltage Wires and Cables; and Section 26 29 13, Control Panels.

1.02 REFERENCES:

A. Codes and standards incorporated within this section are:
   1. ANSIC2/NFPA70E National Electrical Safety Code (NESC).
   2. ANSI Z535.1 Safety Color Code.
   3. ANSI Z535.2 Environmental and Facility Safety Signs.
   4. ANSI Z535.3 Criteria for Safety Symbols.
   5. OSHA Occupational Safety and Health Act: specification 1910.145, Standards for Accident Prevention, Signs and Tags.

1.03 SUBMITTALS: FURNISH ALL PRODUCT SUBMITTALS USED.

A. Product Data and Information: Furnish manufacturer's catalog data for safety signs, nameplates, labels and markers.

B. Furnish manufacturer's instructions indicating application conditions and limitations of use; and storage, handling, protection, examination and installation of product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
   1. W. H. Brady Company.
   2. Seton.
   3. Thomas & Betts A.
   4. Approved equal.

2.02 MATERIALS

A. General: Provide identification materials listed and classified by UL or tested by an acceptable Electrical Testing Company certifying the equivalence of the materials to UL listing requirements and OSHA approved.

B. Laminated Plastic Nameplates: Provide engraved three layer laminated plastic nameplates with black letters on white background with lettering etched through the outer covering and fastened with corrosion resistant pan head brass or stainless steel machine nuts and bolts. Do not use mounting cement for fastening nameplates.
   1. Provide nameplates with 1-inch high lettering for main breakers, automatic transfer switches, panelboards, transformers, VFD's, control panels and disconnect switches.
   2. Provide nameplates for each motor identifying service or function and lettering of an appropriate size to suit each motor. Submersible motor nameplates to be affixed to equipment disconnect.
   3. Provide approved directories of circuits with typewritten designations of each branch circuit in each panelboard.
   4. Provide smaller lettering for a neat, legible nameplate where the amount of lettering causes excessively large nameplates.

2.03 WIRE MARKERS: IDENTIFY WIRE BUNDLES AND EACH INDIVIDUAL WIRE

A. Wire bundles: Provide a permanent waterproof brass or rigid fiber identifying tag attached with nylon self locking "Ty-Raps".

B. Wire identification markers: Provide a printed white, heat-shrink, seamless tubing type with black bold lettering for wires size No. 10 AWG and smaller. Provide a printed self-laminating white, vinyl type with black bold lettering for wires No. 8 AWG and larger.

C. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

E. Write-On Tags: Polyester tag, 0.015-inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable: Marker for Tags: Permanent, waterproof, black-ink marker recommended by tag manufacturer.

F. Manufacturers and Products:
   1. Sleeve: Raychem; Type D SCE or ZH SCE. Brady, Type 3PS.
   2. Heat Bond Marker: Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive. Self-laminating protective shield over text. Machine printed black text. Manufacturer 3M Co.; Type SCS HB.
   3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
   4. Tie-On Cable Marker Tags: Chemical-resistant white tag. Size: 1/2 inch by 2 inches. Manufacturer and Product: Raychem; Type CM SCE.

2.04 SAFETY SIGNS

A. Provide safety signs in accordance with OSHA standards meeting the requirements of ANSI C2, ANSI Z535.1, ANSI Z535.2 and ANSI Z535.3. Comply with NFPA 70 and 29 CFR 1910.145.

B. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils with red and black letters and graphics on a white background.

C. Size: Provide 7-inch by 10-inch signs or smaller if larger size cannot be applied.

D. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.

E. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

F. All receptacles and switches shall be identified on the inside of the cover plate by circuit number and panelboard.

G. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application and with 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

H. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing, and with colors, legend, and size required for application and with 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

2.05 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch. Identification plates shall be furnished for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, pilot lights, disconnect switches, manual starting switches, magnetic starters, and all miscellaneous controls, switches and enclosures.

B. Process control devices and pilot lights shall have identification plates. Identification plates shall be furnished for all line-voltage enclosed-circuit breakers; the plates shall identify the equipment served, voltage, phase(s), and power source. Circuits 480-volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

C. Identification plates shall be three-layer white-black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16 inch thick with engraved lettering 1/8 inch high. Identification plates larger than 1-1/2 inches high shall be 1/8 inch thick with engraved lettering not less than 3/16 inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

D. Provide nameplates of minimum letter height as follows: Panelboards, switchboards, safety switches and motor control centers: 1/4-inch, identify panel name; 1/8-inch, identify voltage, phase, number of wires, and source.

E. Safety color coding for identification of warning signs shall conform to NEMA Z 535. Red identification plates reading CAUTION: 480/277 VOLTS shall be provided in switch and outlet boxes containing 277-or 480-volt circuits. An identification plate marked DANGER: 480 VOLTS shall be provided on the outside of 480-volt enclosures. Identification plate shall use white lettering on a red laminated plastic.

F. Any equipment with externally powered wiring shall be marked with a laminated plastic name plate having 3/16-inch-high white letters on a red background as follows: DANGER – EXTERNAL VOLTAGE SOURCE.

G. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying equipment in building, and the area served by each.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install nameplates on the front of equipment, parallel to the equipment lines and secured with corrosion resistant pan head nuts and bolts. Labels to be consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual designations. Warning Labels for Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

B. Install laminated nameplates identifying, each electrical equipment enclosure and Individual equipment and devices. The following items shall be equipped with nameplates: All motors; motor starters, motor-control centers, pushbutton stations, control panels, time switches, disconnect switches panelboards, circuit breakers, contactors, recorders, transmitters, instruments or relays in separate enclosures, thermostats, photocells, power receptacles, switches controlling equipment or receptacles, switches controlling lighting fixtures where the fixtures are not located within the same space as the controlling switch, termination cabinets, manholes and pull boxes, instrumentation and control terminal cabinets, pull boxes manholes and cabinets. Special electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks.

C. Electrical contractor is responsible for nameplates on electrical equipment supplied by other divisions and installed and wired by electrical including all instrumentation and controls equipment. A portion of existing equipment affected by this contract shall also receive nameplates as determined by the engineer.

D. Surface Preparation: Degrease and clean surfaces to receive nameplates, labels and marking paint.

E. Nameplates shall adequately describe the function of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277/480V, 3-phase, 4-wire". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine. Equipment Requiring Workspace Clearance shall be labeled According to NFPA 70 applied to door or cover of equipment.

F. Label all disconnects with nameplates as well as the location from which they are fed.

G. Rework or reuse of existing equipment will require new identification tags for some existing equipment.

H. Wire Markers: Identify each individual wire with identification tags as follows:
   1. Wire identification markers: Provide wire identification markers on each wire at all termination points.

I. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings

J. On control circuits terminated in motor control centers, switchgears, control panels and alike: The field device and terminal number of the opposite end connection.

K. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.
   1. Provide oversize wire markers so that after heat shrinking the wire marker can be rotated on the wire. Rotate wire markers so that wire identification number is visible.
   2. All wires whether spare or used shall be tagged.
   3. Mark wire at both ends.

L. Raceway Tags:
   1. Provide raceway tags to identify origin and destination of conduit. Install tags at each terminus and at midpoint of run. Provide tags at minimum intervals of every 50 feet of above grade raceway except where concealed in walls. Provide two color hard plastic engraved tags and UV resistant cable ties for attachment.
   2. Tag numbers to match that submitted on approved conduit schedule.

M. Safety Signs: Provide safety signs as follows or as shown:
   1. Wording: "DANGER -ELECTRICAL EQUIPMENT, AUTHORIZED PERSONNEL ONLY" Location: On the outside door of all electrical equipment rooms or areas. On the outside door of all electrical equipment cabinets.
   2. Wording: "DANGER -POWERED FROM MORE THAN ONE SOURCE" Location: Outside all equipment that operates from more than one power source; ATS, PLCs, Main Tie Main switchgear/MCCs, etc.
   3. Wording: "NOTICE -KEEP DOOR CLOSED" Location: On all doors with another safety sign installed.

4. Wording: "CAUTION -CONTROLS & INTERLOCKS POWERED FROM MULTIPLE SOURCES". Location: On all control panel doors, MCCs I&C terminal cabinets, etc.

N. Create and submit conduit schedule. Schedule to identify conduit tag numbers, the locations the conduit connects and the wire count.

END OF SECTION

SECTION 26 05 70

WIRING DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work of this section shall consist of furnishing all labor, materials, and equipment necessary for installation of wiring devices and plates.

1.02 REFERENCES

A. The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this Contract.
   1. NEC (NFPA 70) National Electrical Code.
   2. NETA International Electrical Testing Association - Acceptance Testing specifications.
   3. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum).
   4. Local Building Codes and Standards.
   5. UL 1449 3rd edition Standard for Surge Protection Devices.
   6. UL 498 Standard for Safety Attachment Plugs and Receptacles.

1.03 SUBMITTALS

A. Shop Drawings: Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials

B. Documentation showing that proposed materials comply with the requirements of NEC and U.L.

1.04 TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 05 11, Special Electrical Requirements.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

C. Test GFCI receptacle for correct tripping operation with tester.

PART 2 PRODUCTS

2.01 SNAP SWITCHES

A. Unless otherwise specified, each snap switch (flush tumbler-toggle) shall be of the Specification grade, heavy-duty type for mounting in a single-gang spacing, fully rated 20 amperes, minimum, at 120-277V ac, conforming to minimum requirements of the latest revision of the UL.

B. Switches shall operate in any position and shall be fully enclosed cup type with entire body molded phenolic or melamine. Fiber, paper of similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated on the drawings. Silver or silver alloy contacts. Brass contact arm.

C. Switches for hazardous locations shall be factory sealed, rated at 20 amperes, 120-277V ac, capable of controlling 100 percent tungsten filament, fluorescent and HID lamp loads.

2.02 RECEPTACLES

A. Industrial or Hospital Grade: receptacles shall be in accordance with NEMA Publications and UL Listings. Receptacles shall be rated for 125V ac, 20 amperes, shall be polarized 3 wire type for use with 3 wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Receptacles shall also be fire-resistant, with nylon top (face) and bodies and bases with metal plaster ears (integral with the supporting member).

B. Provide single or duplex receptacles as shown or noted on drawings, and ivory color unless otherwise noted, with triple wipe or equivalent brass alloy power contacts for each prong. Approved manufacturers are Hubbell, Cooper, Pass & Seymour, or Leviton or approved equal.

C. All receptacles shall be grounding type with a green-colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper in accordance with NEC, Article 250. Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.

D. GFCI: Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated and as required by the NEC. GFCI's shall be duplex, Industrial or Hospital grade, tripping at 5 mA. Ratings shall be 125V, 20 amperes, NEMA WD-1, Configuration 5-20R, capable of interrupting 5,000 amperes without damage.

E. Provide GFCI receptacles where shown and as required. Feed-through type GFCI's serving standard receptacles will not be permitted.

F. Pedestal type boxes receptacles shall be cast iron 3/4 inch N.P.T. tapped flanged inlet; double gang, meeting UL Standard 514.

G. Special purpose receptacles shall have ratings and number of poles as indicated or required for anticipated purpose. Matching plug with cord-grip features shall be provided with each special-purpose receptacle.

H. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. The receptacles shall be rated for 20 amps at 125V ac.

I. SPD Receptacles: Transient voltage surge suppressing receptacles provide with a filtering capacitor for 7 to 1 average noise reduction and Two way protection for line equipment. Response time less than 1 nanosecond for un-mounted Metal Oxide Varistor (MOV); Overcurrent protection; Thermal protection; Varistor with voltage capabilities of 150V RMS.

J. Outdoor mounted Receptacles shall be Corrosion-Resistant and shall in addition to meeting the requirements of general-purpose receptacle have Nickel coated metal parts. Manufacturer; Hubbell Bryant; 20A rated HBL53CM62 Series or equal.

2.03 SWITCH, MOTOR RATED

A. Two-pole or three-pole, manual motor starting/disconnect switch without overload protection. UL 508 listed. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts. Minimum General Purpose Rating: 30 amperes, 600V ac. Manufacturer: Cooper Arrow Hart; Hubbell Bryant: HBL78 Series; Leviton.

2.04 PLUG CAPS & CORDS

A. Provide and install a matching plug cap and properly sized cord for equipment items noted on the Drawings.

2.05 DEVICE PLATES

A. Provide device plates for each switch, receptacle, signal and telephone outlet, and special purpose outlet. Do not use sectional gang plates for multi-gang boxes.

B. All Plates shall be of stainless steel except provided cast covers for cast boxes.

C. Coverplates for exterior GFCI receptacles shall be cast.

PART 3 EXECUTION

3.01 GENERAL

A. Perform work in accordance with the National Electrical Code.

3.02 CONNECTION

A. Rigidly attach wiring devices in accordance with National Electrical Code. Coordinate installation avoiding interference with other equipment.

3.03 GROUNDING

A. Ground all devices, including switches and receptacles, in accordance with NEC, ART 250.

B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through grounding jumper connections to outlet box and grounding system.

END OF SECTION

SECTION 26 08 00

ACCEPTANCE TESTING AND PERFORMANCE VERIFICATION

PART 1 GENERAL

1.01 GENERAL SCOPE

A. The Contractor shall engage the services of a recognized corporately and financially independent testing firm for the purpose of performing inspections and tests on all new electrical equipment supplied in this contract and on existing modified equipment as herein specified. All tests shall be documented.

B. It is the intent of these Specifications that the testing firm work in direct communication with the engineer of record with frequent testing data updates as the work progresses. Submit draft test reports of work in progress at a minimum 48 hours after test is completed and PRIOR to energizing of any equipment for testing or start-up.

C. The testing firm shall provide all material, equipment, labor and technical supervision to perform such tests and inspections. Testing shall be supervised by qualified professional engineering staff.

D. It is the purpose of these tests to assure that all tested electrical equipment, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications. Tests shall be performed with and in cooperation with certification tests performed by switchgear and generator manufacturer. The testing contractor shall be an integral part in assuring the coordinated testing and startup of the power system. The tests and inspections shall determine suitability for energization.

E. An itemized description of existing equipment to be inspected and tested is as follows:
   a. Provide testing of existing feeders that are relocated, extended or disturbed in any way.
   b. Provide testing of existing breakers that are re-fed, relocated, re-cabled or disturbed in any way.

F. The above electrical testing shall be used in the development of the final testing report encompassing all new and existing electrical equipment; submitted with the operation and maintenance manuals prior to substantial completion of the project. The testing report shall be submitted on 8.5-inch by 11-inch paper bound with all field test data in appendix form plus an electronic copy in Adobe PDF format. All tested breakers shall be fitted with a sticker indicating the testing firm, date and technician performing the test.

1.02 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and test shall be in accordance with the following codes and standards except as provided otherwise herein:
   1. National Electrical Manufacturer's Association – NEMA.
   2. American Society for Testing and Materials – ASTM.
   3. Institute of Electrical and Electronic Engineers – IEEE.
   4. International Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1991.
   5. American National Standards Institute - ANSI C2: National Electrical Safety Code.
   6. State and local codes and ordinances.
   7. Insulated Cable Engineers Association – ICEA.
   8. Association of Edison Illuminating Companies – AEIC.
   9. Occupational Safety and Health Administration – OSHA.
   10. National Fire Protection Association – NFPA.
      a. ANSI/NFPA 70: National Electrical Code.
      b. ANSI/NFPA 70B: Electrical Equipment Maintenance.
      c. NFPA70E: Standard for Electrical Safety in the Workplace.
      d. ANSI/NFPA 780: Lightning Protection Code.
      e. ANSI/NFPA 101: Life Safety Code.

B. All inspections and test shall utilize the following references:
   1. Project design Specifications.
   2. Project design Drawings.
   3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.03 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, supplier, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the International Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the International Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing or be a electrical professional engineer in the state of Florida.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services. The testing firm shall provide in house electrical studies and reports as specified. The testing firm shall have a Florida registered professional electrical engineer on staff.

F. The testing firm shall submit proof of the above qualifications when requested. Pre-qualified testing firms for this Project are:
   1. Emerson Electrical Reliability Services, Inc.
   2. Industrial Electrical Testing, Inc.
   3. Circuit Breaker Sales & Service.

G. Other firms will be considered by the engineer on submittal of qualifications on or before 20 days prior to Bid.

1.04 DIVISION OF RESPONSIBILITY

A. The Contractor shall perform routine insulation-resistance, continuity, and rotation test for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The Contractor shall supply a suitable and stable source of electrical power to each test Site.

C. The Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling. However the testing firm shall visit the Site a minimum of once a week to perform coordination duties required and make reports to the engineer of the installation progress.

D. The testing firm shall notify the engineer prior to commencement of any testing.

E. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer.

F. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

G. Safety and Precautions:
   1. Safety practices shall include, but are not limited to, the following requirements:
      a. Occupational Safety and Health Act.
      b. Accident Prevention Manual for Industrial Operations, National Safety council.
      c. Applicable state and local safety operating procedures.
      d. Owner's safety practices.
      e. National Fire Protection Association - NFPA 70E-2009.
      f. American National Standards for Personnel Protection.
   2. All test shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.
   3. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

1.05 SUITABILITY OF TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition.

B. Digital multimeters used shall be RMS sensing when the variable be measured contains harmonics or dc offset or any deviation from a pure sine wave. Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of 2 percent of the scale used.

PART 2 INSPECTION AND TEST PROCEDURES

2.01 CABLES - LOW VOLTAGE - 600V MAXIMUM (ALL CABLES EXCEPT 20 AND 30AMP LIGHTING AND RECEPTACLE CIRCUITS).

A. Visual and Mechanical Inspection:
   1. Inspect cables for physical damage and proper connection.
   2. Test cable mechanical connections to manufacturer's recommended values or NETA Standards using a calibrated torque wrench.
   3. Inspect compression-applied connectors for correct cable match and indentation.
   4. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.
   5. Compare cable data with drawings and specifications.
   6. Inspect for correct identification and arrangements.
   7. Inspect cable jacket insulation and condition

B. Electrical Tests:
   1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1,000-volts dc for 1 minute.
   2. Perform continuity test to insure proper cable connection.
   3. Test Values; Evaluate results by comparison with cables of same length and type. Minimum acceptable value shall be no less than 50 megohms for new feeders; 5megohms for existing reused, renovated, rerouted or extended feeders.

2.02 CIRCUIT BREAKERS (ALL BREAKERS EXCEPT 20AMP LIGHTING AND RECEPTACLE BREAKERS; TEST ALL GFCI BREAKERS)

A. Circuit Breakers - Low Voltage insulated case/molded case:
   1. Visual and Mechanical Inspection:
      a. Check circuit breaker for proper mounting and compare nameplate data to drawings and specifications.
      b. Operate circuit breaker to ensure smooth operation.
      c. Inspect physical and mechanical condition.
      d. Inspect anchorage and alignment
      e. Check tightness of connections using calibrated torque wrench. Refer to manufacturer's instructions or NETA standards for proper torque levels.
      f. Verify the unit is clean.
      g. Perform mechanical operator and contact alignment tests on both the breaker and its operating mechanism in accordance with manufacturer’s published data.
   2. Electrical Tests:
      a. Perform a contact-resistance test.

b. Perform an insulation-resistance test at 1,000-volts dc for 1 minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase.
c. Determine long-time minimum pickup current by primary current injection where practical.
d. Perform long-time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time.
e. Determine short-time pickup and delay by primary current injection, if applicable.
f. Determine ground-fault pickup and time delay by primary current injection, if applicable.
g. Determine instantaneous pickup current by primary injection using run-up or pulse method.

3. Test Values:
a. Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
b. Insulation resistance shall not be less than 100 megohms.
c. Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
d. All trip times shall fall within NETA Standards. Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.
e. Instantaneous pickup values shall be within NETA standards.

2.03 METERING AND INSTRUMENTATION

A. Visual and Mechanical Inspection:
1. Examine all devices for broken parts, shipping damage and tightness of connections.
2. Verify that meter types, scales and connections are in accordance with Drawings and Specifications.
3. Verify tightness of electrical connections.
4. Verify operation of display and indicating devices.
5. Verify unit is grounded and connected in accordance with manufacturer’s instructions.

B. Electrical Tests:
1. Determine accuracy of meters at 25/50/75/100 percent of full scale.
2. Calibrate watt-hour meters to one-half percent (0.5%).
3. Verify all instrument multipliers.
4. Verify calibration of all instrumentation is accurate to the operator interface terminals.

2.04 GROUNDING SYSTEMS: (PROVIDE FOR NEW AND UPGRADED GROUNDING SYSTEMS)

A. Visual and Mechanical Inspection:
1. Inspect ground systems for compliance with Drawings and Specifications and NFPA 70 National Electrical Code - Article 250.

2. Inspect physical and mechanical condition.
3. Verify tightness of accessible bolted electrical connections.
4. Inspect anchorage.

B. Electrical Tests:
1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System." Instrumentation utilized shall be as Approved by NETA Standards and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten. In large ground grid systems where adequate pole distance is not practical provide Tagg Slope technique or the intersecting curves method (Ref. Nos. 40 and 41 in IEEE Std. 81.) of calculating system resistance.
2. Equipment Grounds: Utilize two-point method of IEEE Standard 81. Measure between equipment ground being tested and known low-impedance grounding electrode of system:
   a. Lightning protection ground system test values within the ground system should be 5 ohms or less tested with a clamp on ground test instrument. Down conductor tests at grade level should be 2 ohms or less. Investigate high resistance connections and correct readings above these limits.
   b. The main ground electrode system impedance-to-ground should be no greater than one (1) ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground

2.05 GROUND-FAULT SYSTEMS

A. Visual and Mechanical Inspection:
1. Inspect for physical damage and compliance with Drawings and Specifications.
2. Inspect neutral main bonding connection to assure:
   a. Zero-sequence sensing system is grounded.
   b. Ground-strap sensing systems are grounded through sensing device.
   c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.
   d. Grounded conductor (neutral) is solidly grounded.
3. Inspect control power transformer to ensure adequate capacity for system.
4. Manually operate monitor panels (if present) for: Trip test; No trip test; Non-automatic reset.
5. Record proper operation and test sequence.
6. Set pick-up and time-delay settings in accordance with the settings provided by the manufacturer.

B. Electrical Tests:
1. Measure system neutral insulation resistance to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.
2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.

3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.
4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.
5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.
6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameter:
1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferable one (1) megohm or greater.
2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.
3. Relay pickup value shall be within 10 percent of setting and in no case greater than 1,200A.

2.06 MOTORS (1 HP AND GREATER)

A. Visual and Mechanical Inspection:
1. Inspect for physical damage.
2. Inspect for proper anchorage, mounting, grounding, connection and lubrication.
3. When applicable, perform special tests as air gap spacing and pedestal alignment.

B. Electrical Tests - Induction Motors:
1. Perform insulation resistance tests in accordance with ANSI/IEEE Standard 43.
2. Motors 200 hp and Less - Test duration shall be for one minute with resistances tabulated at 30 and 60 seconds and calculate the dielectric absorption ratio. Motors larger than 200 hp perform tests for ten minutes and calculate polarization index. Minimum acceptable polarization index for Class B or F insulated motors shall be 2.0.
3. Perform insulation resistance test on pedestal per manufacturer instructions.
4. Perform insulation resistance test on surge protection device in accordance with this Specification.
5. Check that the motor space heater circuit is in proper operating conduction.
6. Check all protective devices in accordance with other sections of these Specifications.
7. Perform a rotation test to ensure proper shaft direction if the motor has been disconnected.
8. Measure running current and evaluate relative to load conditions and nameplate full load amperes. Verify proper overload relays.

2.07 MOTOR STARTERS (ALL MOTORS)

A. Visual and Mechanical Inspection:
1. Inspect for physical damage, proper anchorage, and grounding.
2. Compare equipment nameplate data with drawings and specifications.

3. Inspect anchorage, alignment, and grounding
4. Inspect contactors.
5. Verify mechanical operation.
6. Verify tightness of accessible bolted electrical connections.
7. Motor-running protection
    a. Compare overload heater rating with motor full-load current rating to verify proper sizing.
    b. If motor-running protection is provided by fuses, verify proper rating considering motor characteristics and power-factor correction capacitors if applicable. Check tightness of bolted connections using calibrated torque wrench.

B. Electrical Tests:
1. Insulation tests:
    a. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one (1) minute. Test voltage shall be in accordance with NETA Standards.
    b. Measure insulation resistance of each starter section phase-to-phase and phase-to-ground with the starter contacts closed and the protective device open. Test voltage shall be in accordance with NETA Standards.
    c. Measure insulation resistance of each control circuit with respect to ground.
2. Perform a contact resistance test
3. Test motor overload units by injecting current through overload unit and monitoring trip time at three hundred percent (300%) of motor full-load current.
4. Three phase power unbalance: Run motor at full load steady state conditions and take current readings on all three leads. Roll the motor leads maintaining the proper rotation and take motor current readings on all three possible hook-ups. Choose the least unbalance hookup for each motor. The maximum acceptable unbalance is 10 percent at full load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If on the three possible hook ups, the leg of "greatest unbalance" (furthest from the average) stays on the same power lead then most of the unbalance is being caused by the power source. However, if the leg of greatest unbalance moves on each of the hookups with a particular motor lead, the primary source of unbalance is on the motor side of the starter. Check for damaged cable, leaking splices, poor connections, or faulty motor winding.

2.08 VARIABLE FREQUENCY DRIVES

A. Visual and Mechanical Inspection:
1. Inspect physical and mechanical condition.
2. Inspect anchorage, alignment, and grounding.
3. Prior to cleaning the unit, perform as-found tests.
4. Clean the unit.
5. Ensure vent path openings are free from debris and that heat transfer surfaces are not contaminated by oil, dust, or dirt.
6. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.
7. Motor running protection

a. Compare drive overcurrent set points with motor full-load current rating to verify correct settings.
b. If drive is used to operate multiple motors, compare individual overload element ratings with motor full-load current ratings.
c. Apply minimum and maximum speed set points. Confirm set points are within limitations of the load coupled to the motor.

8. Inspect bolted electrical connections for high resistance using one or more of the following methods:
   a. Use of a low-resistance ohmmeter.
   b. Verify tightness of accessible bolted electrical connections by calibrated torque wrench method.
   c. Perform a thermographic survey.
9. Verify correct fuse sizing in accordance with manufacturer's published data.
10. Perform as-left tests.

B. Electrical Tests:
1. Perform resistance measurements through bolted connections with low-resistance ohmmeter.
2. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
3. Test input circuit breaker by primary injection.
4. Test for the following parameters in accordance with relay calibration procedures or as recommended by the manufacturer:
   a. Input phase loss protection
   b. Input overvoltage protection
   c. Output phase rotation
   d. Overtemperature protection
   e. DC overvoltage protection
   f. Overfrequency protection
   g. Drive overload protection
   h. Fault alarm outputs
5. Perform continuity tests on bonding conductors.
6. Perform operational tests by initiating control devices.
   a. Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.
   b. Verify operation of drive from remote start/stop and speed control signals.

C. Test Values
1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA Maintenance Testing Specifications for Electrical Power Equipment and Systems Table 100.12.
3. Results of the thermographic survey shall be in accordance with NETA Maintenance Testing Specifications for Electrical Power Equipment and Systems Section 9.
4. Overload test trip times at 300 percent of overload element rating should be in accordance with manufacturer's published time-current curve.

5. Input circuit breaker test results shall be in accordance with NETA Maintenance Testing Specifications for Electrical Power Equipment and Systems Section 7.6.
6. Relay calibration test results shall be in accordance with NETA Maintenance Testing Specifications for Electrical Power Equipment and Systems Section 7.9.
7. Continuity of bonding conductors shall be in accordance with Section 7.13.
8. Control devices should perform in accordance with system requirements.

2.09 PANELBOARDS

A. Visual and Mechanical Inspection:
1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, grounding, and required area clearances.
4. Verify the unit is clean.
5. Verify circuit breaker sizes and types.
6. Verify tightness of accessible bolted electrical connections.
7. Inspect insulators for evidence of physical damage or contaminated surfaces.
8. Exercise all active components.

B. Electrical Tests:
1. Perform insulation-resistance tests on each bus section, phase to phase, phase to ground, and line-to-load for one minute in accordance with NETA ATS Table 100.1.
2. Perform point-to-point ground test

2.10 THERMOGRAPHIC SURVEY (PROVIDE FOR ALL NEW OR MODIFIED SWITCHGEAR, BUS DUCTS, TRANSFORMERS, POINTS OF POWER CONNECTION EQUAL TO OR GREATER THAN 30AMPS, MCC'S AND DISTRIBUTION CENTERS)

A. Visual and Mechanical:
1. Remove all necessary covers prior to scanning.
2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned:
1. All new and existing equipment with ratings of 30 amps or more.

C. Provide report indicating the following:
1. Problem area (location of "hot spot").
2. Temperature rise between "hot spot" and normal or reference area.
3. Cause of heat rise.
4. Phase unbalance, if present.
5. Areas scanned.

D. Test Parameters:
1. Scanning distribution system with ability to detect 1^{o}C between subject area and reference at 30^{o}C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.
4. Provide photographs and/or the thermogram of the deficient area as seem on the imaging system.

2.11 LOW VOLTAGE SURGE SUPPRESSORS

A. Visual and Mechanical Inspection:
   1. Verify suppressors are installed with minimum length leads to the protected equipment. Verify connections to bus.
   2. Verify ground connections to ground bus.

B. Electrical Tests:
   1. Test clamping voltage and verify meets specified ratings; test in accordance with ANSI C62.33 section 4.4 and 4.7.

2.12 LOW VOLTAGE AIR SWITCHES (DISCONNECT SWITCHES, MANUAL AND AUTOMATIC TRANSFER SWITCHES)

A. Visual and Mechanical Inspection:
   1. Compare equipment nameplate data with drawings and specs.
   2. Inspection for mechanical and physical damage. Cleaning of interior, insulators, arc chutes.
   3. Testing of mechanical operator. Cleaning and lubrication of contacts and mechanism, as applicable.
   4. Verification of contact alignment and wipe. Verify phase barrier insulation.
   5. Inspect anchorage, alignment, grounding, and required clearances.
   6. Documentation of fuse and types are in accordance with drawings, short circuit studies and coordination study.
   7. Verification of tightness of accessible bolted electrical connections by calibrated torque-wrench method.
   8. Verification of presence of expulsion-limiting devices on all holders having expulsion-type elements.
   9. Verification of interlocking systems for proper operation and sequencing.
   10. Verify proper lubrication on current carrying and moving sliding parts.

B. Electrical Tests:
   1. Contact resistance testing across each switch blade and fuse holder.
   2. Measurement of fuse resistance.
   3. Insulation resistance testing on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole for one minute.
   4. ac or dc overpotential testing phase-to-phase and phase-to-ground.
   5. Verification of proper space heater operation.

END OF SECTION

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SECTION 26_24_16

PANELBOARDS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall provide panelboards complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.02 REFERENCES

A. The latest edition of the following codes or standards shall apply:
   1. NEC (NFPA 70) National Electrical Code.
   2. NEMA 250 Enclosure for Electrical Equipment (1,000 Volts Maximum).
   3. UL 50 - Standard for Safety for Enclosures for Electrical Equipment.
   4. UL 67 – Panelboards.

1.03 SUBMITTALS

A. General:
   1. Submittals shall be in accordance Section 26_05_02, Basic Materials and Methods.
      a. Breaker layout drawings with dimensions and nameplate designations.
      b. Drawings of conduit entry/exit locations.
      c. Assembly ratings including: Short circuit rating, Voltage; Continuous current.
      d. Cable terminal sizes.
      e. Descriptive bulletins.
      f. Product sheets.

PART 2 PRODUCTS

2.01 GENERAL

A. Panelboard shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 - Safety Enclosures for Electrical Equipment and UL 67 - Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3-wire operation as indicated.

B. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

C. Panelboards rated 240V ac or less shall have short circuit ratings not less than 10,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

D. Panelboards rated 480V ac shall have short circuit ratings not less than 42,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

E. Panelboards shall be labeled with a UL short circuit rating. Panels shall be fully rated, series ratings are not acceptable.

F. Provide panelboards by Square-D or approved equal.

2.02 CONSTRUCTION:

A. All lighting and power distribution panels shall have copper bus bars density rated for maximum of 1000amps/sq-in. Enclosures for panelboards shall be galvanized and painted steel except enclosures for panelboards located in corrosive, damp or wet locations shall be stainless steel and NEMA-4X

B. Breakers shall be one, two, or three pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position. Double and triple pole breakers shall be of the common trip, single handle type.

C. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.

D. All circuit breakers shall be interchangeable and bolt on type capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. Plug-in circuit breakers are not acceptable.

E. Panelboards shall be UL listed.

F. Size of wiring gutters and gauge of steel shall be in accordance with NEMA Standards Publication No. PBI 57 and UL Standards No. 67. Cabinets shall be minimum 20" wide for all panels.

PART 3 EXECUTION

3.01 GENERAL

A. Surface mount panelboards on wall, as indicated on project drawings, at an elevation convenient for operation and as required in the latest NEC.

B. Install typewritten or computer generated circuit directory in panelboards. The directory shall coordinated with the identification of equipment as shown on the contract drawings and clearly indicating the serving load.

END OF SECTION

SECTION 26 24 20

ELECTRIC MOTORS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes materials, installation and testing of induction motors and applies to motors which are provided as part of equipment specified in other sections. Contractor shall furnish motors in conformance to this section and with the individual Specification sections of the driven equipment for a complete and operable system. It shall be the Contractor’s responsibility to bring to the attention of the engineer any conflict between this section and the driven equipment section for engineer's resolution prior to purchase; in general most stringent best quality governs.

B. Motors which are an integral part of standard manufactured driven equipment (submersible pumps, motor valve operators) may be exempt from this Specification where necessary and required by the manufacturer of the equipment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26_24_19, Motor Control Centers.

B. Section 26_29_23, Variable-Frequency Drives.

C. Section 26_08_00, Acceptance Testing and Performance Verification.

1.03 SUBMITTALS

A. Submit Shop Drawings in accordance with the General Conditions.

B. Show complete nameplate data, horsepower, current, voltage, phase, and frequency ratings, NEMA design, Frame Size, starting code letter or locked rotor KVA, efficiency and power factor, winding insulation class and treatment, rated ambient temperature, service factor, mounting arrangements, size and location of conduit entry, location and size of grounding lug, and coatings.

C. Submit guaranteed full load efficiency.

1.04 FACTORY TESTS

A. Tests shall comply with NEMA Standard MG1-12.51 and MG 1-23.46.

B. For high efficiency motors, provide certified test results of percent efficiency and power factor data at full, 75 and 50 percent load.

C. Test thermally protected motors in accordance with NEMA Standard MG 1 winding temperature and trip current tests.

1.05 CONTROLLER COORDINATION

A. Where motor controllers are furnished, provide reviewed shop drawings to the controller manufacturer for coordination and sizing of the controller.

1.06 QUALITY ASSURANCE

A. NEMA Compliance: Unless otherwise indicated, comply with NEMA standard MG 1.

B. U.L. Listing: Motors for applications in hazardous locations shall bear the U.L. label listing its use in accordance with NEC.

C. ANSI/IEEE 112; Test Procedures for polyphase induction motors.

PART 2 PRODUCTS

2.01 GENERAL MOTOR DESIGN REQUIREMENTS

A. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.

B. Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1

HP	1200 RPM	1800 PM	3600 RPM
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8

C. Unless otherwise specified or specifically required by the manufacturer of the equipment to be driven, alternating current motors shall be single speed, non reversing, squirrel cage induction motors, NEMA design B. Motors 15 horsepower and larger shall be NEMA starting code F or G. Motors smaller than 15 horsepower may be manufacturers' standard starting characteristics. Stator windings shall be copper.

D. The connected load (maximum horsepower required) of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any operating condition.

E. Connection box shall be cast metal with gaskets between the box and housing and between the box and cover. Provide a grounding terminal in the connection box.

F. Open dripproof and weather-protected motors shall have a service factor of 1.15. Inverter Duty (VFD) rated motors shall have a service factor of 1.15 for sine wave power and 1.0 for inverter power. Totally enclosed fan cooled motors shall have a service factor of 1.15.

G. Unless otherwise noted, motors shall be rated for continuous duty at an ambient temperature of 40 degrees C and at an altitude of 3,300 feet. High ambient Motors shall be rated for continuous duty at an ambient temperature of 65 degrees C.

H. Non-submersible Motors shall have 120-volt heating elements.

I. Open dripproof and weather-protected motors 7.5 HP and larger shall have stainless steel screens over openings.

J. Motors installed in hazardous areas shall be Totally enclosed, explosion proof, suitable for use in Class 1, Division I, Group D hazardous locations, with UL label.

K. Provide motors with a guaranteed maximum noise level of 90dBA, measured at three feet from the motor surface per IEEE 85, when running at no-load connected to sine wave power.

L. Unless otherwise noted, motors shall be premium efficiency type. The efficiency shall be determined by IEEE 112 method B using sine wave power for motors up to 300 horsepower and method F for motors above 300 horsepower. Efficiency shall be listed on the nameplate in accordance with NEMA MG 1 12.53.

M. As a minimum, all motors shall have manufacturer's standard tropical protection. Motors in wet locations shall be moisture sealed. Motors with form-wound coils shall have vacuum-pressure impregnated windings.

N. Motors designated to be Totally Enclosed Fan Cooled (TEFC) shall be rated for IEEE-841-2001 standards or Coro-duty where listed in pump sections of specifications. TEFC motors shall be premium efficient, all cast iron including conduit box and fan cover guard, with stainless steel nameplate and plated hardware, with internal bearing caps and an inpro/seal on the drive end. Motor finishes shall be rated for 250 hour salt spray. TEFC motors shall have a one year warranty or the manufacturer's standard warranty, whichever is greater..

O. In addition to nameplate information required by NEMA Standard MG 1-10.37 through 39, show on the nameplate the bearing numbers for both bearings, efficiency, power factor at full load and the maximum recommended kVAR of power capacitors to result in a 90 percent power factor. Provide all motors with stainless steel nameplates.

P. Equip all motors with thermal protection in accordance with NEMA Standard MG 1. Control leads shall be color-coded, brought out to the motor conduit box or a separate terminal box for connection.
   1. Provide three series connected, thermal switches, one in each winding. Provide normally closed and normally open switches as shown on the electrical elementary drawings. Where not shown provide normally closed switches.

2.02 BEARINGS

A. Bearings for standard duty motors shall be rated for a minimum of 24,000 hours (B-10 rating); Heavy duty specified motors bearings shall be rated for a minimum of 40,000 hours (B-10 rating). Where unspecified provide bearings with B-10 ratings as follows: Less than 50hp provide 24,000hr B-10 rating; 50hp to 200hp provide B-10 rating of 40,000hr; greater than 200hp provide B-10 rating of 100,000hr.

B. Bearings shall be ball or roller anti-friction type. Fractional horsepower through 2 horsepower motors shall be furnished with lifetime lubricated bearings. Horizontal motors larger than 2 horsepower shall be furnished with relubricatable ball bearings.

C. Vertical Motors
   1. Vertical motors shall be designed for vertical operation and shall have thrust bearings with a rated B-10 life of 40,000 hours as defined by Anti-Friction Bearing Manufacturers Association (AFBMA).
   2. Thrust bearings for motors 75 horsepower and larger shall be oil lubricated. Guide bearings may be anti-friction, grease lubricated or oil lubricated.
   3. Equip grease lubricated bearings with fittings in each bearing housing. Fittings shall be accessible without removal of any covers or guards. Provide drains to prevent over-lubrication.

D. Equip motors with a non-reversing ratchet as required or as indicated.

E. Bearing Protection
   1. Provide bearing protection from shaft currents for all motors 20hp or greater and driven by variable frequency drives. The device shall divert shaft currents to ground or insulate the shaft so currents will not flow through bearings. The device shall be maintenance free. Provide current diverter seal equal to Inpro-Seal type CDR.

2.03 INSULATION AND TEMPERATURE RISE

A. Unless otherwise noted, provide Class F insulation limited to Class B temperature rise at unity service factor.

B. All motors indicated to be heavy duty motors in the individual equipment specifications of the contract documents shall be provided with minimum Class "H" insulation system limited to Class "B" temperature rise at unity service factor.

2.04 VOLTAGE

A. Generally provide alternating current motors 1/2 horsepower and smaller at 115 volts single phase 60 Hz, and motors 3/4 horsepower and larger at 460 volts three phase 60 Hz. Contractor shall coordinate exact requirements.

2.05 COATING

A. Do not coat cast aluminum frame motors.

B. Motors housed within equipment enclosures, such as exhaust fans, air handling units, and air conditioners, may have factory's standard prime and finish coats.

C. Coat cast-iron frame motors. Apply prime coat at the factory which shall be compatible with field applied finish coats.

D. Field apply finish coat(s) specified in the applicable equipment section.

2.06 INVERTER DUTY RATED MOTORS

A. Inverter duty rated motors (variable frequency drive (VFD) controlled motors) shall have a nameplate that states "SUITABLE FOR VFD APPLICATION". VFD motors shall not have a critical vibration frequency within the operating range of the VFD. Provide VFD rated motors with special balance option. Provide balance to .0005in for high thrust and 3600rpm motors; .0010in for all other motors.

B. Except where noted, the motor features defined by this specification shall be in addition to any mechanical and electrical feature defined in the fixed speed motor section.

C. Motor insulation shall be an "Inverter Grade" system designed to meet the voltage spike limits defined by NEMA MG1, Part 31, 1993. The insulation system must include the use of High Dielectric magnet wire which exceeds the dielectric

withstand levels provided by double film or heavy film magnet wire. Complete insulation of the slot, cell and phase groups is required. The system shall be rated for class F rise or better. The winding insulation system shall be equal to Phelps Dodge Thermaleze Quantum Shield. The system shall exhibit an insulation pulse endurance life expectancy of 150 percent at 60 Hz when compared to typical heavy film insulation systems. The system shall exhibit an insulation pulse endurance life expectancy from fast rise time IGBT inverters of 100 percent at a 2.0K Hz carrier frequency.

D. Motors shall be capable of operating at 1.0 service factor on Inverter Power. Nameplate Sinewave service factor shall be 1.15 or greater.

E. Motor temperature rise shall not exceed class F insulation limits, with 115C allowable winding hot spot temperature, when operated on Inverter Power across its nameplate speed and torque envelope. Sinewave temperature rise shall be class B or better.

F. The 2, 4, 6, 8 pole motors shall be capable of operating a Variable Torque centrifugal pump load from base speed down to 10 percent of base speed. Motor shall be nameplated for 6-60 Hertz operation. Hazardous location motors may be nameplated 10-60 Hertz.

G. Stator core designs shall be of high rigidity with reinforced end turn construction to minimize mechanical fatigue of the winding, and to reduce resonant noise. Single dip and bake cycles are not acceptable.

H. Winding thermal protection, utilizing normally closed contacts (or normally open where shown on the electrical drawings) shall be sized to match the maximum safe operating temperature of the insulation system. Hazardous location motors shall have winding thermal protection sized as required to meet U.L. or as auxiliary devices where not required by U.L.

I. Maximized copper content shall be utilized to achieve high motor efficiency and thermal transfer. Table 1 lists the minimum NEMA nominal efficiency levels that must be nameplated on the motor. Low loss electrical steel shall be utilized in the stator and rotor core assemblies.

J. Nameplate data for adjustable speed operation shall be stamped on a stainless steel data plate and permanently attached to the motor frame. The minimum amount of adjustable speed data shall include:
   1. Application Type - Variable Torque and/or Constant hp.
   2. Maximum approved continuous hp.
   3. Approved speed range.
   4. Typical motor volts per hertz.
   5. S.F. on inverter power.

PART 3 EXECUTION

3.01 STORAGE

A. Protect motors from exposure of elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

B. Unless protected by manufacturer's packing, upon delivery, carefully wrap each motor in three layers of 8-mil minimum polyethylene. Secure the wrap with adhesive tape to minimize the entrance of moisture. For base mounted motors, wrap the entire assembly.

3.02 FIELD OPERATING TESTS

A. Run each motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

B. Record current in each phase of each motor 1 horsepower and larger and include in the maintenance manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

END OF SECTION

SECTION 26 28 11

CIRCUIT BREAKERS AND FUSIBLE SWITCHES – LOW VOLTAGE

PART 1 GENERAL (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide Square-D or approve equal circuit breakers to match equipment provided. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions.

2.02 POWER CIRCUIT BREAKERS

A. Provide power circuit devices, type low-voltage power circuit breakers, Square D type MasterPact NW or approved equal. Frame ratings shall be 800, 1600, 2000, 3200, 4000 amperes. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

B. Breakers shall be manually operated (MO) or electrically operated (EO) as indicated on the drawings.

C. Electrically operated breakers shall be complete with close/open pushbuttons control switch, plus red and green indicating lights to indicate breaker contact position 120 Vac motor operators; the charging time of the motor shall not exceed 6 seconds. Source voltage shall be taken from a control power transformer internal to the switchgear assembly.

D. All circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000amperes or higher where shown on the drawings. To ensure a selective system, all circuit breakers shall have 30-cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.

E. All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standards. The circuit breakers shall carry a UL label.

F. Provide units Arc Flash Reduction Maintenance Remote accessory as specified in Paragraph 2.03. The Arc Flash Reduction Maintenance Remote shall allow the operator to enable a maintenance mode with a preset accelerated instantaneous override trip to reduce arc flash energy.

G. To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker. The power circuit breaker shall have a closing time of not more than 3 cycles. The primary contacts shall have an easily accessible wear indicator to indicate conta ct erosion.

H. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

I. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a “Positive On” feature. The breaker flag will read “Closed” if the contacts are welded and the breaker is attempted to be tripped or opened.

J. The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit.

K. A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

L. Each power circuit breaker shall offer sixty (60) front mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue or spade terminals or bare wire.

M. include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall secure the breaker in the connected, test or disconnected position by preventing levering

2.03 TRIP UNITS

A. Each low-voltage power circuit breaker and insulated case circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating

plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall Square D Micrologic P with MODBUS communication module.

B. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.

C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

E. Trip unit shall have selectable thermal memory for enhanced circuit protection.

F. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after a preset time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

G. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

H. The trip unit shall be equipped to permit communication via Modbus to the switchgear Allen Bradley compactlogix PLC system provided in the equipment for remote monitoring and control. All monitored parameters shall be transmitted.

I. The trip unit shall include a power/relay module, which shall supply control power to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available. An internal relay shall be programmable to provide contacts for remote ground alarm indication.

J. The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the power relay module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

K. The display for the trip units shall be a 24-character LED display.

L. Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.

M. The unit shall be capable of monitoring the following data:
   1. Instantaneous value of phase, neutral and ground current
   2. Instantaneous value of line-to-line voltage
   3. Minimum and maximum current values
   4. Watts, vars, VA, watthours, varhours, and VA hours, Peak demand, Present demand,Energy consumption.
   5. Crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.

N. An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.

O. The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.

P. Programming may be done via a keypad at the faceplate of the unit or via the communication network.

Q. System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments. The short-time pickup adjustment shall be dependant on the long delay setting.
   1. Programmable long-time setting
   2. Programmable long-time delay with selectable I2t or I4t curve shaping
   3. Programmable short-time setting
   4. Programmable short-time delay with selectable flat or I2t curve shaping, and zone selective interlocking
   5. Programmable instantaneous setting
   6. Programmable ground fault setting trip or ground fault setting alarm
   7. Programmable ground fault delay with selectable flat or I2t curve shaping and zone selective interlocking

R. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

S. The trip unit shall have the following advanced features integral to the trip unit:
   1. Adjustable undervoltage release
   2. Adjustable overvoltage release
   3. Reverse load and fault current
   4. Reverse sequence voltage alarm

5. Underfrequency
6. Overfrequency
7. Voltage phase unbalance and phase loss during current detection

T. The main breakers fitted with trip units shall be provided with an Arcflash Reduction Maintenance System Technology capability. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a remote control which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode

2.04 INSULATED CASE CIRCUIT BREAKERS

A. Protective devices shall be switchboard class insulated case low-voltage power circuit breakers. Frame ratings shall be 800, 1600, 2000 amperes. All breakers shall be UL listed for application in their intended enclosures for 100 percent of their continuous ampere rating.

B. Breakers shall be manually operated (MO) or electrically operated (EO) as indicated on the Drawings.

C. Electrically operated breakers shall be complete with close/open pushbuttons control switch, plus red and green indicating lights to indicate breaker contact position 120V ac motor operators; the charging time of the motor shall not exceed 6 seconds. Source voltage shall be taken from a control power transformer internal to the switchgear assembly.

D. All insulated case circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000 amperes or greater where shown. To ensure a selective system, all circuit breakers shall have 30-cycle short-time withstand ratings equal to 18 times their frame ratings. Insulated case circuit breakers without an instantaneous trip element adjustment shall be equipped with a fixed internal instantaneous override set at that level.

E. All insulated case circuit breakers shall be constructed and tested in accordance with UL 1066. The circuit breakers shall carry a UL label.

F. Provide units Arc Flash Reduction Maintenance Remote accessory as specified in Paragraph 2.05. The Arc Flash Reduction Maintenance Remote shall allow the operator to enable a maintenance mode with a preset accelerated instantaneous override trip to reduce arc flash energy.

G. To facilitate lifting, the insulated case circuit breaker shall have integral handles on the side of the breaker. The insulated case circuit breaker shall have a closing time of not more than 3 cycles. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

H. The insulated case circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

I. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a “Positive On” feature. The breaker flag will read “Closed” if the contacts are welded and the breaker is attempted to be tripped or opened.

J. The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit.

K. A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

L. Each insulated case circuit breaker shall offer sixty (60) front mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue or spade terminals or bare wire.

2.05 TRIP UNITS

A. Each low-voltage power circuit breaker and insulated case circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.

B. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.

C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be

continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

E. Trip unit shall have selectable thermal memory for enhanced circuit protection. Protective device coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:
   1. All circuit breakers shall have adjustments for long delay pickup and time.
   2. All circuit breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.
   3. All circuit breakers shall have an adjustable instantaneous pickup.
   4. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings or ground alarm only.

F. The trip unit shall have provisions for a single test kit to test each of the trip functions.

G. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after a preset time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

H. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

I. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be plus or minus 2 percent of full scale.

J. All switchboard main circuit breaker trip units shall be provided with an Arcflash Reduction Maintenance System Technology capability. Delete this requirement when the switchboard is feed through main switchgear that has provision for arc flash maintenance mode on the switchboard feeder breaker. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a 5 position switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.

2.06 MOLDED CASE CIRCUIT BREAKERS – 800 A AND BELOW

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Eaton or approved equal.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the Drawings.

D. Circuit breakers 400 ampere frame and below shall be have thermal-magnetic trip units and inverse time-current characteristics.

E. Circuit breakers 800 ampere through 1,200 ampere frame shall have microprocessor-based rms sensing trip units.

2.07 QUICK-MAKE/QUICK-BREAK FUSIBLE SWITCHES

A. Protective devices shall be quick-make/quick-break fusible switches. Fusible switches 30 amperes through 600 amperes frames shall be furnished with rejection Class “R” or “J” type fuse clips unless otherwise scheduled. Fusible switches 800 amperes through 1200 amperes shall be furnished with Class L fuse clips. Switches shall incorporate safety cover interlocks to prevent opening the cover with the switch in the ON position or prevent placing the switch in the ON position with the cover open. Provide defeater for authorized personnel. Handles shall have provisions for padlocking and shall clearly indicate the ON or OFF position. Front cover doors shall be padlockable in the closed position.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26 29 13

CONTROL PANELS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, equipment, and materials for control panels as indicated on the Drawings and specified herein. The panel supplier shall be a UL listed panel shop and all panels shall be UL-508 certified and labeled.

B. Control panel equipment shall be coordinated to provide all the specified control as indicate in the elementary diagrams or specified herein.

C. The Contractor shall be responsible for coordinating and interfacing with equipment and instrumentation supplied under other sections of the Contract Documents that are an integral part of the plant control systems. This interfacing shall be incorporated in the detailed systems drawings and data sections to be submitted by the Contractor prior to rough-in work.

1.02 SUBMITTALS

A. The Contractor shall submit to the Engineer for approval complete shop drawings, wiring diagrams, data, and operation and maintenance manuals of all equipment to be furnished under this section.

B. Coordination and Shop Drawings: Prepare and submit coordination drawings for installation of products and materials fabricated. Coordination and shop drawings shall be prepared using a computer aided drafting system compatible with Autodesk Autocad version 2012 or greater. Coordination and shop drawings shall be submitted on hard copy and electronic CD-Rom (dwg) format.

1. Submit component interconnect drawings showing the interconnecting wiring between each component including equipment supplied under other sections requiring interfacing with the control system. Diagrams shall show all component and panel terminal board identification numbers, and external wire and cable numbers. Note, this diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, pull boxes, etc.). Diagrams' devise designations, and symbols shall be in accordance with NEMA ICS 1-101.
2. Panel Wiring Diagrams: Elementary diagrams shall be similar to those diagrams shown in the Drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, fans, heaters, etc.
3. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, tag numbers and PLC I/O identification (address) numbers. Wiring diagrams shall show all circuits individually; no common diagrams shall be allowed.

4. Submit arrangement and construction drawings for consoles, control panels, and for other special enclosed assemblies for field installation. Include dimensions, identification of all components, preparation and finish data, nameplates, enough other details to define the style and overall appearance of the assembly and a finish treatment. Drawings shall show the location of all front panel mounted devices to scale, and shall include a panel legend and a bill of materials. The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends and annunciator inscriptions. The bill of materials shall list all devices mounted within the panel that are not listed in the panel legend, and shall include the tag number, description, manufacturer and complete model number for each service.
5. Submit installation, mounting, and anchoring details for all components.

C. Operation, Maintenance and Repair Manuals:
1. Submit operation and maintenance manuals.

1.03 CODES AND STANDARDS

A. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards.
1. Instrumentation: Instrument Society of America (ISA).
2. National Electrical Code (NEC) 2005,
3. Wiring: ISA S5.3 and S5.4, latest issue.
4. Control Panels and equipment: NEMA, UL and ANSI.
5. Control Logic: Joint Industrial Council (JIC).
6. UL508A and UL508A-SB.

PART 2 PRODUCTS

2.01 GENERAL

A. Control panels shall be UL508A/SB compliant. Control panels shall be marked with a short circuit current rating (SCCR). The SCCR shall be equal to or more than the short circuit current available at the panel line terminals and in no case be less than 10,000A SCCR. The panel designer shall verify the available short circuit required.

B. The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X dead-front enclosure constructed of not less than 304 stainless steel and shall be equipped with a 3-point latch with all hardware and exterior components construction of 300 series stainless steel (except control panels in air conditioned spaces and electrical room may be NEMA 1 painted steel). The enclosure shall be equipped with an inner dead front door and shall incorporate a removable, aluminum or stainless steel back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. All hardware shall be stainless steel. Provide safety hardware to hold the door in an open position. Provide a folding shelf on the door for convenient temporary support of a laptop computer.

C. Components: All motor branch circuit breakers; motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

D. A circuit breaker shall be provided on each control panel as a means of disconnecting power to the control panel. The circuit breaker operating handle shall be installed on the right side of the cabinet not in the door. The door shall be interlocked from opening when the circuit breaker is in the on position. The circuit breaker operating handle shall have an interlock defeat mechanism for qualified personnel to gain access to the panel without shutting off power.

E. Control transformers shall be installed where shown to provide 120V ac and 24V ac for control circuits. Transformers shall be fused on the primary and secondary circuits. The transformer secondary shall be grounded on one leg.

F. All control panel wiring shall be identified at both ends with type written heat shrinkable wire markers with the numbering system shown on the control submittal drawings.
   1. Control wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable may be #16 AWG), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
   2. Wire shall be guided within control and terminal cabinets by cable supports (duct). Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.
   3. All conductors shall be neatly led to terminations. All connections of stranded wire to screw type terminal blocks shall be by insulated spade lugs, crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks.

G. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process. Nameplates shall be laminated plastic, engraved white letters with a black background.

H. Corrosion Inhibitor Emitter: Provide an industrial corrosion inhibitor emitter on all exterior mounted control panels that will protect internal components of the control panel from corrosion one year. Provide one spare emitter for each control panel.

I. Terminal strips shall be provided for all signals as indicated on the drawings plus all spare conductors as specified. Terminal strips shall be switch type with integral fuses equal to Allen Bradley 1492-H6. Wiring from the control panel to the terminal strips shall be factory installed. All spare conductors shall be terminated and identified. All terminals over 200V phase to phase shall be covered with approved plastic shields.

J. Relays:
   1. Control circuit switching shall be accomplished with relays. These relays, for interfacing and control applications, shall be the compact general purpose plug-in type having low coil inrush and holding current characteristics. A neon status-indicating light shall be provided with each relay. Contact arrangements shall be as noted or shown, and shall be rated for not less than 10 amperes at 120V ac or 28V dc. Coil voltage shall be as noted or shown. Non-latching relays shall have a single coil. Latching relays shall have two coils, unlatching being accomplished by energizing one coil, and latching being accomplished by energizing the other coil. Relays shall have plain plastic dust covers, test buttons, and mounting sockets with screw terminals and holddown springs. Relays shall be UL recognized. Relays shall be Potter and Brumfield, Struthers-Dunn, or equal.
   2. Time delay functions shall be accomplished with time delay relays. Units shall be adjustable time delay relays with the number of contacts and contact arrangements as shown. A neon status-indicating light shall be provided with each relay. Contacts shall be rated for 10 amperes at 120V ac. Integral knob with calibrated scale shall be provided for adjustment of time delay. Initial setting shall be as shown with time delay range approximately three times the initial setting. Time delay rangeability shall be at least 10:1. Operating voltage shall be 120V ac, plus 10 percent, -15 percent at 60-Hz. Operating temperature shall be -20 degrees F to 165 degrees F. Repeat timing accuracy shall be plus or minus 10 percent over the operating range. Units shall be Amerace Corp., Control Products Division, Agastat Series 7000, Cutler-Hammer Series D87, or equal.
   3. All relays shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and the terminals are readily accessible.

K. Front Panel Operating Controls and Instruments:
   1. All operating controls and instruments shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.
   2. Indicator lamps shall be LED full voltage push to test type and mounted in NEMA 4X (800H) modules, as manufactured by Allen Bradley or SKPI as manufactured by Square D. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Units shall be heavy-duty, oiltight, push to test industrial type with screwed on prismatic glass lenses in colors as shown, and shall have factory engraved legend plates. LED's shall be high illumination type (5ma at 130V ac).

3. Selector switches shall be heavy-duty, oiltight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size, black field, legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as shown. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. Units with up to four selection positions shall be Allen Bradley 800H, Square D Type K, Cutler-Hammer Type T, or equal. Units with up to 12 selection positions shall be Rundel-Idec Standard Cam Switch, Electroswitch 31, or equal.

L. Process Meters

1. Provide digital programmable process meters with a loop powered display designed for a 4-20MA current loop. Provide minimum 0.5" high, 4-1/2 digit LED display to indicate amplitude of current in the current loop. In general, a loop current of 4ma corresponds to a display indication of 0 percent and a loop current of 20ma corresponds to a display indication of 100 percent. The meter shall be provided with programmable internal scaling adjustment. Provide units with NEMA-4X faceplate rating constructed of silicone coated Lexan and gasketed for NEMA 4 requirements; circuit boards coated for moisture resistance. Provide panel meters for each analog process variables; Pressure, level and flow as indicated equal to Yokogawa UM-33 or approved equal.

PART 3 EXECUTION

3.01 MOUNTING OF EQUIPMENT AND ACCESSORIES

A. Install and mount equipment in accordance with the Contract Documents, and installation detailed shop drawings. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock and vibration; and freedom from interference with other equipment, piping, and electrical work.

B. Mount local equipment in cabinets or existing panels as specified. Mount associated terminals on a common panel or rack; all terminals over 200V phase to phase shall be covered with plastic shields.

C. Provide services of panel manufacturer to test the completed system after installation to assure that all components are operating with the specified range and all interlocks are functioning properly. Panel manufacturer shall certify functional operation and calibration in written startup report. Perform field tests on all completed control assemblies to demonstrate conformance to specifications and functional compatibility.

END OF SECTION

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SECTION 26 29 23

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 FURNISHING OF EQUIPMENT

A. Unless specifically noted otherwise, variable frequency motor drives for all equipment requiring them shall be furnished under this section. The drive manufacturer shall furnish all required controls as specified herein and as functionally required by the instrumentation and controls section.

B. The manufacturer shall be Square D Altivar 660 or Ativar 320 Process Drive series. No equal.

C. Provide Altivar 660 drives with necessary modifications to provide a two second power loss ride through.

D. The manufacturer of 1 phase drives for chemical pumping systems shall be Square D. Provide Altivar 12 series for 1/4HP, 120V, 1 phase drives.

E. Provide all drives with conventional analog and digital control interface for control and Ethernet/IP network communications for monitoring to the plant control system. Ethernet communications not required for 1/4HP, 120V single phase chemical pump drives.

F. Provide equipment purchased from the manufacturer's representative authorized to represent the manufacturer in the projects territory, Lee County Florida.

G. The manufacturer shall factory fabricate the drive cabinets to match the plan lineup and available space indicated.

1.02 DESCRIPTION OF SYSTEM

A. Factory-assembled, metal-enclosed VFD motor control units for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed and tested in place. Where shown on Drawings, furnish and install VFD units in freestanding NEMA 1 gasketed, ventilated and filtered motor control cabinets as herein specified. The motor control shall be supplied from a 3-phase, 3-wire 60 cycle power system as shown. A U.L. label shall be provided on each section indicating compliance with UL Standards. The adjustable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ETL, UL, ANSI, and NEMA.

B. VFD Motor Control Units shall include all protective devices and equipment as listed on Drawings or as included in these Specifications, with necessary interconnections, instrumentation, and control wiring.

C. The VFD manufacturer shall be responsible for providing a system for the specific installation intended, including considerations of conductor distances from the drive to the motor. Each VFD drive shall include an output dv/dt filter system within the VFD cabinet to limit voltage peak and voltage rise time at the motor terminals. The filters must limit the voltage rise time and voltage peak at the motor terminals to those required by NEMA MG1-1993, Section IV, Part 30 with voltage peak less than 1,000 volts and rise time greater than 2 microseconds.

1.03 QUALITY ASSURANCE

A. Reference Standards:
   1. American National Standard Institute (ANSI):
      a. ANSI Y32.2-1975, Graphic Symbols for Electrical and Electronic Diagrams.
      b. ANSI Z55.1-1967 (R1973) Gray finishes for Industrial Apparatus and Equipment.
   2. National Electrical Manufacturers Association (NEMA):
      a. NEMA ICS-1, 2, 3, 4, 5, 6, controls and systems.
   3. National Fire Protection Association (NFPA):
      a. NFPA 70-2017, National Electric Code (NEC).
      b. NFPA-70E-2018 Standard for Electrical Safety in the Workplace.
   4. Underwriters' Laboratories, Incorporated (UL):
      a. UL Electrical Construction Materials List, motor controllers motor-control centers (NJAV), (HJOT) and (NLDX).

1.04 SUBMITTALS

A. Product Data:
   1. Layouts showing concrete pad dimensions, conduit entrance and available space, bus duct connections, electrical ratings, nameplate nomenclature, and single-line diagrams in accordance with ANSI Y32.2 indicating connections and controls with numbered terminals.
   2. Frame sizes and Interrupting Capacity of unit.
   3. Horsepower rating and rated voltage of unit.
   4. Manufacturer's written recommendation for storage and protection, installation instructions and field test requirements.
   5. Manufacturer's instructions for tightening bus connections, performing cleaning, and operating and maintaining motor control unit.
   6. Submit written verification that overall dimensions are within the maximum dimensions indicated on plans.
   7. Submit manufacturer’s recommended spare parts list.

B. Shop Drawings:

1. Complete master wiring diagrams, elementary schematics and control schematics shall be submitted for approval before proceeding with manufacture. Suitable outline drawings shall be furnished as part of this submittal. Standard or typical pre-printed sheets or Drawings simply marked to indicate applicability to this Contract will not be acceptable. Shop Drawings shall be job specific.
2. A complete Drawing indicating each point of interface with the process control system and the type of signal provided or accepted at each point.
3. A complete drive programmer's manual.
4. A Drawing showing the layout of the VFD local control panel indicating every device mounted on the door with complete identification.
5. Provide Shop Drawings on 11-inch by 17-inch paper and drawn with a computer aided design (CAD) package. The computer aided design package shall be Autocad or converted to Autocad format. Submittals shall include hard copy and CD-ROM media electronic copies (dwg format).

1.05 WARRANTY

A. The equipment manufacturer shall provide a one year warranty or the manufacturer's standard warranty, whichever is greater, from initial startup and demonstration of the complete automatic controlled drive pump system to the engineer. The equipment manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship. In the event the equipment fails to perform as specified, the equipment manufacturer shall promptly repair or replace the defective equipment without any costs to the Owner (including labor, transportation, handling and shipment costs). Warranty shall not cover damage to the equipment caused by external sources and operator errors; however the units shall be protected from power line surges and electrical fault conditions and therefore the warranty shall apply to power line transient surge, ground faults, line to line faults, EMI and RFI interference and other external electrical disturbance caused damage.

B. The VFD manufacturer shall maintain as part of a national network, engineering service facilities within 150 miles of the Project to provide startup service, emergency service calls, repair work, and service contracts.

1.06 SPARE PARTS:

A. Provide spare parts as follows: One complete set of VFD inverter fans and VFD enclosure fans.

B. Provide a list of manufacturer's recommended spare parts. The owner may purchase additional spare parts separate from or as an added cost to the project.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide 75hp and above VFD's as manufactured by Square D Altivar 660 Process Drive series with clean power drive. Provide 20hp and below VFD's as manufactured by Square D Altivar 320 Process Drive series with clean power drive. Provide clean power controller utilizing a front end MTE Matrix broadband filter with harmonic cancellation techniques. The VFD shall contain a built in cut-out circuit to automatically take the filter offline on low power loads. Provide Ethernet communications capability. Provide hard wired control where shown on the drawings.

B. Provide VFDs for 1/4HP Chemical pumps as manufactured by Square D model Altivar 12 standard drive. Provide optional remote control module for control panel deadfront mounting. Power loss ride through provisions are not required of the 1/4hp drives.

C. The VFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a three step operation. Adjustable Current Source VFDs are not acceptable. IGBT type Transistors shall be used in the inverter section. GTOs and SCRs are not acceptable. The VFDs shall be current regulated. VFDs permitting instantaneous over current trips other than for output short circuit are not acceptable.

D. All VFDs shall utilize a vector torque control strategy to regulate motor flux to optimize motor torque without the need for encoders. VFDs requiring voltage, dwell and current adjustments to achieve improved torque control are not acceptable.

E. The manufacturer shall supply variable frequency drives compatible with the pump motors for operation of these motors at motor full load amps. The drives shall vary the output frequency from minimum to maximum pump speed typically 6-60hz.

F. The drive shall be of sufficient capacity and provide a quality of output waveform so as to achieve full rated and continuous output of the pump motor. All drives shall be factory built-up units complete with all necessary and specified components, as hereinafter defined, which shall be supplied by the drive manufacturer as a unit. Each built-up drive shall be tested by the drive manufacturer prior to shipment from the factory and a certificate of the test provided.

2.02 ENVIRONMENTAL CONDITIONS

A. The drive shall accept plant power nominal AC voltage of 480V ac +10 percent -10 percent, 3 phase, 60 Hertz $\pm$ 3 percent.

B. The operating ambient condition shall have a temperature range of 0 to 40 degrees Celsius with a relative humidity of up to 95 percent (non-condensing).

2.03 CONSTRUCTION TECHNIQUES

A. The drive shall be of modular design to provide for ease and speed of maintenance including removal of modules, with one maintenance technician.

B. All components shall be mounted in a NEMA type 1 gasketed, ventilated and filtered enclosure properly sized to dissipate the heat generated by the power electronics. The enclosure shall be painted with corrosion resistant coatings with finish paint of manufacturer’s standard color. Either top or bottom entry of cables shall be permitted.

C. The DC bus shall be filtered by series inductor & capacitors to provide ripple free dc.

D. Circuit breakers: The operating mechanism shall be designed so that the door can be padlocked in the "Off" position. Protection for the VFD's power circuit shall be provided by use of circuit breakers and type "J" input fuses.

E. A relay shall be provided that energizes and provides 120V power to a motor space heater when the drive is not running.

F. The drive shall meet any one of the following standards; CSA, ETL, UL.

G. All VFD's must be tested/run under load until rated operating temperatures is achieved.

H. Provide VFDs with shock hazard shielding methods for all exposed terminals, bus bars and termination points. The low voltage terminals, buss bars, lugs etc. shall be physically guarded, insulated and/or isolated to insure safety to maintenance personnel and for reduced arc flash hazard.

I. Provide VFDs with approved ventilation air filter frame mounting and hardware assemblies.

J. The VFD shall be furnished with a diagnostic indicator to show low bus/line and high bus/line voltage conditions, timed current overload and inverter output fault. Drive ready and Drive run status indication shall be standard.

2.04 ACCESSORIES

A. The unit shall include an incoming, UL listed, circuit breaker. A three position switch (hand-off-auto) mounted on the controller door provides manual selection of local or auto control. The "Hand” position allows manual local keypad run/stop and speed control of the VFD; the speed control shall be via a keypad mounted on the door calibrated from 0-100 percent speed. The door of the VFD cabinet shall contain but not be limited to the following devices:
   1. Circuit breaker operating handle - mechanically interlocked with the door.
   2. Key Pad and alpha numeric displays providing programming and manual control of the drive.

3. VFD fault indicating light.
4. Hand off auto switch.
5. Power On indicating light.
6. VFD Run indicating light.
7. Motor High Temperature indicating light.
8. Process parameter control indicating light (Ex: Low Level shutdown).

B. The Altivar 320 unit shall include a dial and escape button mounted on the unit drive to navigate the menus and set drive speed control calibrated from 0-100% speed. The unit shall contain but not be limited to the following devices:
1. Integrated Alpha numeric displays providing programming and manual control of the drive.
2. VFD fault indicating light.
3. VFD Run indicating light.

C. Provide a UPS with manual bypass to hold the 120V ac control relays active during a momentary power outage. Size UPS for a minimum of 60 second run time.

D. Provide 24V dc logic module and 24V dc power supply within the drive to hold the drive logic active during power interruptions.

E. Regardless of VFD manufacturer provide Square D power and energy monitor model PM820 with optional Ethernet module on the supply side of the drive as indicated on the drawings. Connect via Ethernet/IP back to PLC cabinet. Power monitor is not required for 120V drives or plant drives less then 20HP. Power monitor required on all wellfield drives.

2.05 OPERATING CHARACTERISTICS

A. The variable frequency drive shall convert 3 phase, 60 Hertz input power to an adjustable frequency and voltage (from 6 Hertz to 60 Hertz with a frequency stability of +/- 1 percent of setting) for controlling the speed of AC induction motors. The converter will be of the voltage source design using current controlled PWM techniques. The input power factor of the drive shall be a minimum of .95 at all speeds and loads.

B. The output voltage shall vary proportionally with the output frequency to maintain a constant volts/Hertz value up to nominal frequency. Above nominal frequency, the output voltage shall remain constant.

C. The modulating control scheme shall closely approximate actual sine wave current throughout the speed range of the drive. The regulator shall be fully digital with microprocessor control of frequency, voltage, and current. The frequency resolution of the drive shall be .01 Hertz. All drive adjustments and custom programming shall be capable of being stored in a non-volatile memory (EEPROM).

D. Current limit: A current limit circuit shall be provided to limit motor current to a preset adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 115 percent.

E. The power unit's logic common shall be at ground potential.

F. Short circuit and ground fault protection. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. The VFD must be capable of withstanding without damage to the VFD, short circuits at 480V plus 10 percent (528V). Opening of the VFD's input and/or output line switches during drive operation shall not result in damage to the drive.

G. The VFD shall be capable of providing 110 percent motor name plate service factor current for one minute. The VFD shall include an instantaneous overcurrent trip. The VFD shall not restart after electronic overcurrent trip until manually reset. Except for overcurrent, the drive will first attempt to restart on the inverter up to a maximum of three times on "Auto-Restart" before faulting out and waiting for operator reset.

H. Power loss ride-through. The VFD shall be capable of continued operation during an intermittent loss of power for 2.0 second (120 cycles). The essential drive and pump relay logic integrated within the drive shall be powered through the 24VDC VFD power source during the power interruption for the 2 second duration. The VFD drive will resume normal operation within 0.5sec if power is reapplied during the 2 second ride through duration.

I. Auto restart after power outage. The VFD shall be capable of starting into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the preset method of starting.

J. Transient and surge voltage protection. Transient and surge voltage protection shall be provided through use of Metal Oxide Varistors (MOV's) and phase-to-ground filter capacitors.

K. Auto restart after fault. The VFD shall automatically attempt to restart after a malfunction or an interruption of power. If the drive reaches the limit of restarts without successfully restarting and running for 90 seconds, the restart circuit shall lockout and drop out the fault relay. Two Form C contacts shall be provided.

L. Motor overload protection. Provide electronic motor overload and single phase protection integral to the inverter.

M. Frequency jump points: Provide three selectable frequency jump points in 1.0hz increments, to be used to avoid critical resonance frequencies of the mechanical system.

N. Application programming dedicated to pumps.
   1. The VFD shall provide Pump Control & Monitoring Functions for Centrifugal pump characteristics and configurations.

a. Pump monitoring function in order to define data relevant for pump (acceleration, low speed, high speed, etc.)
b. Application Units function in order to define units used in applications.
c. Pump Cyclic Start Protection in order to protect the pump against too many restarts in a dedicated time period.
d. Multi-pump functions.

2. The VFD shall provide Pump Protection Functions
   a. Anti-Jam function in order to remove automatically clogging substances from the pump impellers.
   b. Pipe Cleaning function in order to start pump regularly to avoid sedimentation in pump impeller
   c. Cavitation Pump Protection
   d. Inlet protection in order to avoid system dry running.
3. The VFD shall provide Application control functions
   a. Stop and Go function in order to reduce consumption of VFD in case of pump inoperation.
   b. Pipe Fill function in order to manage a smooth control during pipe filling and to lessen the effects of water hammer.
   c. Sleep wake-up function in order to manage periods of the application when process demand is low and when it is not needed.
   d. Low demand function in order to define periods of the application when process demand is low in order to save energy.
4. The VFD shall provide Pump curve input to help optimize pump performance.
   a. Input and storage of the pump characteristics including 5 points of the pump curve.
   b. A best efficiency point (BEP) function in order to run in optimum conditions and detect deviation from this point.

2.06 CONTROLS

A. Provide an operator panel with keypad and 2-line 20-character alphanumeric display. The display provides indication of any selected drive functions; speed, load, motor volts, motor amps, diagnostic information, programming functions, etc. The keypad provides a means of programming and manually controlling the drive. Programming only keypads are not acceptable. The key pad shall be used to input the following setup adjustments:
   1. Minimum speed, 1 to 85 percent.
   2. Maximum speed, 50 to 100 percent.
   3. Linear accel, 2-25 seconds.
   4. Maximum output voltage, adjustable.
   5. Volts/Hertz, adjustable.
   6. Local setpoint reference.
   7. Current Limit Setpoint.
   8. Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.
   9. Multiple attempt restarts.

B. Remote Controls: The VFD drives shall be hardwired to the plant control system as detailed on the single line drawing. The VFD drives shall have a dedicated Ethernet

connection to the plant control system with all parameters within the drive accessible to the control system. As a minimum provide the following inputs and outputs for remote operator control from the plant computer system.

1. Drive Digital inputs:
    a. Start/Stop.
    b. Drive Reset.
2. Drive Digital outputs:
    a. VFD in remote and Ready.
    b. Drive running.
    c. VFD internal fault.
    d. VFD external fault
3. Analog inputs/outputs:
    a. Motor speed feedback output.
    b. Remote speed setpoint input.

C. Internal Control Wiring: Each control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine area to receive motor-control units to assure adequate clearance for motor control unit installation. Check that concrete pads are level and free of irregularities for motor control centers.

B. All workmanship utilized in the manufacture and installation of this system shall be of the highest quality and performed in a manner which is consistent with all accepted practices for industrial controls.

C. The supplier shall construct and verify proper operation of the assembled system under simulated conditions with motors of similar characteristics; before shipment to the site.

3.02 INSTALLATION

A. Install motor control units in accordance with manufacturer's written instructions, and NEC.

B. The installing contractor shall guarantee that installation of the system is in accordance with the manufacturer's instructions.

C. Provide rubber insulation mats on floor in front of motor control center for entire length equipment. Mats to be minimum 3 feet wide or equal to isle width. Provide OSHA approved insulating mats meeting OSHA regulation 1910.137 with 30,000 volt insulating strength (Matworks or equal, 800 336-4604).

3.03 STARTUP SUPERVISION AND TRAINING

A. The system supplier shall provide a factory trained and authorized service technician to inspect all final connections and check the system prior to startup of the pump drive system. The service technician shall coordinate with the systems integrator for complete functional check-out of the system. The factory authorized person shall provide written certification that the installation meets or exceeds all factory recommendations for proper operation.

B. Copies of the Operating and Maintenance manuals shall be prepared specifically for this installation and shall include all required specification sheets, Drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

C. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for training to instruct representatives of the Owner and the Engineer in proper operation and maintenance. Training subjects shall include, operator training, system repair, maintenance and detailed software training. Training shall be conducted after system startup, testing, and control tuning procedures are complete, and before final completion. If there are difficulties in operation of the equipment due to the installation or fabrication, additional instruction days shall be provided as deemed necessary by the engineer and at no cost to the Owner.

END OF SECTION

SECTION 26 36 13

SAFETY SWITCHES AND DISCONNECTS

PART 1 GENERAL (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL

A. All single throw disconnect switches and double throw manual transfer switches shall be heavy-duty horsepower rated type. Safety switches shall be rated for the available fault current where installed. Provide enclosed molded case switch type disconnects where required to meet high available fault current areas (above 10kaic). Switches shall be fusible only where required to meet equipment nameplate requirements.

B. Switches shall be 240-volt rated on systems up to and including 120/208V and 600V rated on higher voltage systems. All switches for motors shall be horsepower rated. All switches shall be NEMA 4X stainless steel enclosure except switches mounted in air-conditioned spaces. As an alternate to NEMA 4X stainless steel enclosure provide NEMA 4X switches with aluminum enclosure as manufactured by Bryant. As an alternate to NEMA 4X stainless steel enclosures provide polyglass enclosures for 30 amp (10 hp) switches in the chemical areas equal to Hubbell Circuit-Lock.

C. Provide and install lugs on disconnect switch as required to accept conductors called for on Drawings.

D. Provide Switches with an externally operated handle; quick make quick break mechanism; the handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be lockable in the "off" position with a padlock. Switches shall have arch suppressors, pin hinges and be horsepower rated at 600-volts.

E. All disconnect switches shall be furnished from the manufacturer with (2) normally open and (2) normally closed interlock contacts. Motor space heater shall be wired through one set of contacts. The other contact shall be wired through the local off/remote motor switch at the disconnect location.

F. Double throw non-fused safety switches may be used for manual power transfer where shown on the Drawings and in areas up to 10,000A available short circuit current. In areas above 10k amps use double throw molded case manual transfer switches rated for the available fault currents.

2.02 SUBMITTALS

A. Submit product data on all major types of disconnects.

PART 3 EXECUTION

3.01 INSTALLATION

A. All three phase motors shall be provided with field mounted disconnects if they are not mounted within site of the three phase feeder breaker or control device they are wired from.

B. With the safety switch in the open position, both the motor heater and power circuits shall be open as well.

C. Provide all motor disconnects with an auxillary Off/Remote maintained hand switch to disable the control power circuit.

END OF SECTION

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. Description of Systems:
   1. A Lightning Protection System shall be placed on the structures by LPI Certified Master Installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. Intent of the lightning protection systems shall be to protect the structures against damage by lightning. All equipment to that result shall be included whether or not specifically called for herein. Installers shall be Underwriters Laboratories certified as Master Label installers or of equal qualifications as approved by Engineer.
   2. Provide complete and upgraded lightning protection systems as noted on the drawings. Provide bonding and grounding systems and interconnection to the site lightning protection and grounding systems as shown on the drawings and as specified. All systems shall be in conformance to NFPA-780, UL-96, UL96-A and as shown on the contract drawings.
   3. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be U.L. labeled.
   4. All installations shall be performed to meet Underwriters Laboratories Master Label standards. Provide Lightning Protection Institute (LPI) Master Certification for all protected structures to the extent the structures are eligible under the standards of UL 96A. If the structure is not eligible under the standards of UL 96A, provide a Letter of Findings for the installation at completion of work.

1.02 SUBMITTALS

A. Shop Drawings and Product Data:
   1. Shop Drawings: Shop drawings shall be submitted before work is started. Drawings shall include full layout of cabling and points, and connections. The drawing shall show the type, size and location of all equipment, grounds and cable routing. The drawing shall show all grounds and air terminals that are shown on the contract drawings. See additional requirements for shop drawings in section 26 05 02.
   2. Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation. Provide a sample of the air terminal to be used with the shop drawing submittal.

1.03 SYSTEM DESIGN

A. The system shall be an effective, aesthetically acceptable streamer-delaying lightning protection system to the standards of Underwriters Laboratories UL 96 &

UL 96A. The purpose of the system shall be to reduce the likelihood of a direct strike to the protected structure by delaying the formation of streamers from that structure. Secondarily the system shall be designed in such a manner that it affords protection to the structure upon which it is installed in the event a direct lightning strike to the structure does occur.

B. The system components shall not require mounting in a specific configuration or impose any other mounting limitations which may interfere with utility use of structure space or otherwise preclude or limit the intended use of the structure.

C. All components shall be attached to the structure in such a manner as to reduce the possibility of corrosion between dissimilar metals. If installed on a metallic or otherwise electrically conductive structure, the system shall be electrically bonded to the structure upon which it is installed through mounting clamps and brackets, with additional bonding to grounded objects and to the structure, as required or as indicated on the drawings.

D. The system shall be composed of components that meet the requirements of Underwriters Laboratories UL 96. Aluminum and Stainless Steel components shall be employed on structures and portions of structures subject to corrosive elements, where the use of copper components could be rendered ineffective, due to the surrounding environment. No dissimilar metals shall be allowed to be in contact. In areas where chemical conditions may deteriorate the specified materials faster than the life expectancy of the material, the LP installer shall bring these conditions to the attention of the engineer prior to installation.

E. Air Terminals shall be mounted on all outside corners of each structure, around the perimeter of each structure at intervals not to exceed twenty (20) feet, and on the interior of each structure in such a manner that no two Air Terminals are separated by a distance of more than fifty (50) feet. In the event this is not practical, such as on a large open tank, Air Terminal spacing around the perimeter shall be decreased to not more than fifteen (15) feet, with a total number around the perimeter not less than the total of the normally required perimeter Air Terminals, plus the additional number of Air Terminals if Air Terminals had been installed on the interior at intervals not greater than fifty (50) feet.

F. Each Air Terminal shall be provided with two (2) contiguous paths to ground. On structures with handrails, exposed structural members, or other conductors, provide a bond to structural conductors from the lightning protection system. Handrails shall not be used as a main lightning protection conductor. Provide a continuous lightning protection conductor parallel with handrails and bond from it to each handrail section and a minimum of 10’ on center. In the case of a structure or a portion of the structure where the structure itself is electrically conductive, such as a light pole, tower, etc, that structure or portion of the structure itself may be employed as part of the lightning protection system, provided it meets the minimum requirements of UL 96 or UL 96A, and down conductors are specifically not required on such structures.

PART 2 PRODUCTS AND INSTALLATION

2.01 AIR TERMINALS

A. Air Terminals shall be of the streamer delaying type. Each air terminal shall have a minimum of five hundred dissipater electrode wires, none of which exceed ten thousands of an inch diameter. All air terminals shall complying with the weight and construction requirements for Class II lightning protection systems. Electrode material shall be high quality 316 series stainless steel and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface. Terminals shall project a minimum of 18" above top of object to which attached and have a minimum 3/16” ball shaped tip. Air terminal point must be 3/16 or greater to meet current UL standards.

B. Streamer-delaying Air Terminals shall be manufactured by Altec Global or equal.

2.02 CONDUCTORS

A. Roof conductors shall consist of rope lay aluminum conductor complying with the weight and construction requirements for Class II lightning protection systems. Aluminum Conductor: TLP #A508 Braided, No. 4/0 Size, 214 pounds per 1000’, 30 strand of 5/8” diameter wire, 192,000 circular mils. Conductors shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be bare stranded copper and transition to tinned copper at 18” minimum above grade. Down conductors shall be installed in PVC conduit and hidden within the structure. Approved bi-metal transitions from aluminum conductors for bonding of aluminum roof structures (exhaust fans, etc.) to copper down conductor sections shall be provided. Radius of bends shall not be less than 8 inches.

1. Provide tinned copper grounding system. Transition to bare copper down conductors 18” AFG or AFF.

C. Counterpoise loop ground conductors shall be tinned copper and be a minimum size equal to the main roof conductor size (115,000cm) or 2/0.

2.03 FASTENER

A. A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

B. All fasteners shall be of a heavy-duty double bolted type typically used for Class II lightning protection systems. Conductor to conductor connections shall be through heavy-duty pressure type bolted fasteners. Splice and bimetal connections shall be through four bolt pressure type heavy-duty connectors. Crimp fasteners shall not be used.

C. Dissimilar metals shall not be allowed to be in contact. Aluminum fittings shall be mounted on aluminum where necessary, and bonded to the main system using bi-metal connectors. Lead coating shall not be acceptable as a bi-metal transition.

D. All mechanical termination points and lugs shall have an anti-corrosive coating applied. In areas subject to chemical corrosion (odor control, degasifiers, chem. Rooms, etc.) apply Glyptal 1201 red enamel coating after termination is made. In other less corrosive areas apply Permatex battery protector sealer (SA-9) or Glyptal 1201 or equal.

E. Lugs for copper cable shall be high copper alloy terminals or stainless steel equal to Burndy type QDA Qiklug. Lugs of aluminum alloy are not acceptable.

2.04 GROUND CONNECTIONS

A. Ground rods shall be installed in the quantities as indicated on the drawings and as required by NFPA-780. Ground rods shall be placed a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each two-path system shall be connected to water piping system with approved water pipe type strap connector. All ground rods shall be 5/8" X 20' minimum copperweld type. All connections made below grade shall be exothermically welded (cadweld) connection and placed in a ground rod inspection well as detailed.

B. Soil type in the area is primarily sand with rock layer below. The rock layers on site will require drilling of ground rod holes. All ground rods shall be installed vertically. After drilling and installation of rod, back fill with sand and hydro compact around rod to provide low resistance to ground.

2.05 GROUND ROD & GROUND SYSTEM TESTING

A. The contractor shall utilize a clamp on ground loop tester during construction to check the system for high resistance connections. The resistance at any point below the air terminal shall be less than 5 ohms. The resistance at grade level on the down conductors should be less than 2 ohms. The contractor shall investigate and correct high resistance readings within the system. Demonstrate to the engineer’s satisfaction with witness testing, provision of a low resistance installation meeting this specification.

B. Provide three point fall of potential ground testing on a minimum of one ground rod on each facility prior to connection to the counterpoise system. As an alternate provide ground rod selective method testing with appropriate ground testers. The complete ground system shall be three point fall of potential tested after completion of work. The system shall be tested at a minimum of three points spaced around the site using the “Tagg Slope” technique. Total grid system grounds should be less than one ohm.

2.06 INSTALLATION

A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. Surface mount down conductors to existing structures in a neat and workmanlike manner. Seal conduit ends utilizing No.155 transitional fitting. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical ground and other ground systems in the area.

2.07 COORDINATION

A. The installer shall coordinate the lightning protection work to insure a correct, neat, and unobtrusive installation. In normally accessible areas, catwalks, equipment platforms, etc., provide installation without trip hazard. Provide embedded conduit sleeves across access ways for ground conductors. In retrofit projects provide flat copper strap to ground or bond across access ways.

B. Any electrical service grounding system and metallic water service piping to the structure shall be electrically bonded to the lightning protection system.

C. The contractor shall coordinate his work in such a manner as to not interfere with the normal operation of the structure upon which the installation is performed.

2.08 MATERIAL MANUFACTURERS

A. Equipment shall be as manufactured by Altec Global Lightning Protection or equal.

END OF SECTION

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SECTION 26 43 00

SURGE PROTECTIVE DEVICES (SPDS)

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

A. Division 26, Electrical.

1.03 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 4th Edition).

1.04 SUBMITTALS

A. The following information shall be submitted to the Engineer:
   1. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
   2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:
   1. Descriptive bulletins.
   2. Product sheets.

C. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed and shall incorporate all changes made during the manufacturing process

1.05 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

1.07 MANUFACTURERS

A. Eaton / Cutler-Hammer products.

B. Square-D products.

C. General Electric products.

D. EDCO.

E. APT.

F. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

1.08 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	450kA	225 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	250 kA	125 kA
A	Branch Locations (Panelboards, MCCs, Busway)	250kA	125 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

PART 2 PRODUCTS

2.01 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements
1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115 percent of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design:
   1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
   2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
   3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
   4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
   5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
      a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
         1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
         2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
         3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
c. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection:
   a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
7. Safety Requirements:
   a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free.
   b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit.
   c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.02 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
   1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
   2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
   3. The panelboard shall be capable of re-energizing upon removal of the SPD.
   4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the

conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly):
1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements:
1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway.
3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer.
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.03 ENCLOSURES

A. All enclosed equipment mounted for indoor application shall be NEMA 1 general purpose enclosures. Provide NEMA 4X enclosures for all outdoor applications.
1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4X – Constructed of stainless steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, splashing water, and hose directed water).

2.04 POWER SUPPRESSORS FOR ELECTRONIC EQUIPMENT

A. Each item of electronic equipment provided under this contract and connected by line cord or direct wired to the building electrical system shall be provided with a three-stage single or multi-phase hybrid suppressor. Fusing shall be provided which removes the protective elements from the circuit upon failure. Visual indication or loss of output power shall be used to notify the user of device failure.

B. Suppressors shall be rated for a minimum of 125 percent of their continuous electrical load. Suppressors for cord connected equipment shall be equipped with standard NEMA cordsets one of which includes a molded grounding receptacle and the other, a molded grounding plug. Suppressor shall be installed in series with the power cord for the protected equipment. Where several items of equipment are grouped within the same cluster of equipment, one suppressor may be used in conjunction with properly sized grounding plugstrip to serve the equipment.

C. Suppressors for direct wired equipment shall be identical in internal design to the unit described for cord connected applications, however, protected screw terminals suitable for termination of solid copper wire shall be used for wiring terminations. One suppressor may be used to support several equipment cabinets provided all cabinets are located within the same equipment cluster and the maximum connected load shall not exceed eighty percent of the rated suppressor capacity.

D. Suppressors shall be constructed with a phenolic non-flammable exterior housing with provisions for mounting to the interior of equipment racks, cabinets, or to the exterior of free-standing equipment. Suppressors shall be constructed as three-stage devices. The first stage shall include a high-energy varistor clamp between line and neutral and from neutral to ground. The second stage shall consist of series air-core inductor installed in the line conductor(s) to properly coordinate the action of the first and third stages. The third, fast acting, hard clamping stage shall consist of a network of silicon avalanche bipolar surge suppression diodes between the neutral and line conductor(s).

E. Minimum suppressor performance characteristics shall be as follows:
   1. Maximum single impulse line-to-neutral current withstand: 15,000 Amperes (8 x 20 us waveform)
   2. Maximum single impulse neutral-to-ground current withstand: 10,000 Amperes (8 x 20 us waveform).
   3. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 1200 occurrences.
   4. Pulse lifetime rating for 200 Ampere (8 x 20 us waveform): 10,000 occurrences.
   5. Worst case response time: Five Nanoseconds.
   6. Worst case (Maximum Single Impulse Current Conditions) clamping voltage: 400 percent of nominal phase-to-ground RMS voltage.
   7. Initial breakdown voltage: 200 percent of nominal phase-to-ground RMS voltage.

2.05 SUPPRESSORS FOR CONDUCTOR PAIR PROTECTION

A. Suppression devices for conductor pair protection shall be provided in multi-circuit pluggable packages suitable for the circuitry to be protected. Units for protection of data circuits which utilize standard connector configurations shall be equipped with connectors which install in series with the data cable to the protected equipment. Units intended for use with multiple wiring pairs shall be equipped with an accessory terminal blocks or strips suitable for the type of wiring being used. Single pair units shall be configured as encapsulated units with wire leads or screw-terminal wiring terminations. Suppressors installed outside of terminal or equipment cabinets (except at designated terminal boards) shall be provided with a housing to afford physical protection for the surge suppression modules.

B. Suppression for each pair shall consist of a three-element gas tube first stage, an isolating element in series with each conductor of the pair, and a silicon avalanche second stage. Second stage clamping shall be provided across the pair for differential mode protection and from each side of the pair to ground for common mode protection. Resistive limiting elements may be used on low current circuits where the effect of voltage drop across the series resistance has no effect on circuit operation. Inductive series elements shall be used on higher current circuits to effectively pass direct or low frequency alternating currents while limiting passage of fast risetime surge waveforms. Silicon avalanche devices shall be designed for surge suppressor applications and shall be polarized or bipolar as appropriate for each circuit.

C. Minimum performance criteria (each circuit) shall be as follows:
   1. Maximum single impulse conductor-to-ground or conductor to conductor current withstand: 10,000 Amperes (8 x 20 us waveform).
   2. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 10 occurrences.
   3. Pulse lifetime rating for 100 Ampere (10 x 1000 us waveform): 1,000 occurrences.
   4. Worst case response time: Five Nanoseconds.
   5. Worst case (Maximum Single Impulse Current) clamping voltage: 200 percent of normal operating voltage amplitude and polarized or bipolar as appropriate for each circuit type.
   6. Initial breakdown voltage: 150 percent of normal operating voltage peak amplitude plus or minus five percent.
   7. Capacitance: Capacitance for DC or low frequency lines shall not exceed 2000 picofarads measured line to line or line to ground at the rated diode breakdown voltage. Suppressors intended for use on high frequency or high baud rate circuits shall be designed for use on such lines. Capacitance of such units shall be equated to equivalent cable feet based on the type of cabling used for the particular circuit. The sum of equivalent cable feet for suppressors and actual cable footage shall not exceed manufacturers recommended maximum values for the system on which these devices are installed.

8. Circuit compensation: Any additional circuit compensation (gain or equalization) required to compensate for the insertion of surge suppression devices shall be provided as part of this Contract.

PART 3 EXECUTION

3.01 BONDING AND GROUNDING CONDUCTORS AND MATERIALS

A. Conductors utilized for surge suppressor bonding shall be a minimum of #6 AWG solid insulated copper unless otherwise specified.

B. Ground bus or strip material shall be copper, a minimum of 26-gauge in thickness and three inches wide unless otherwise specified. Bus materials may be secured to surfaces with an appropriate mastic material or mechanical fasteners. Bus connections shall be bolted or brazed and reinforced as necessary on thin bus material to provide a permanent and secure connection.

C. Unless otherwise specified, all surge suppression grounding electrodes shall be 5/8-inch diameter copperweld rods, twenty feet in length.

D. Connectors, splices, and other fittings used to interconnect grounding conductors, bond to equipment or ground bars, shall comply with requirements of the National Electric Code and be approved by Underwriters Laboratories for the purpose.

E. Connectors and fittings for grounding and bonding conductors shall be of the compression or set-screw type in above grade locations. Connections below grade shall be exothermically welded or brazed.

F. Bonding connections between electrically dissimilar metals shall be made using exothermic welds or using bi-metal connectors designed to prevent galvanic corrosion.

3.02 SEGREGATION OF WIRING

A. All system wiring shall be classified into protected and non-protected categories. Wiring on the exposed side of suppression devices shall be considered unprotected. Surge suppressor grounding and bonding conductors shall also fall into this category.

B. All wiring between surge suppressors and protected equipment shall be considered protected. Isolated circuitry exempted from surge suppression requirements in part one of this section shall also be considered protected.

C. A minimum of three inches of separation shall be provided between parallel runs of protected and unprotected wiring in control panels, terminal cabinets, terminal boards and other locations. In no case shall protected and unprotected wiring be bundled together or routed through the same conduit. Where bundles of protected and unprotected wiring cross, such crossings shall be made at right angles.

3.03 INSTALLATION OF SUPPRESSORS

A. Suppressors shall be installed as close as practical to the equipment to be protected consistent with available space. Where space permits and no code restrictions apply, suppressors may be installed within the same cabinet as the protected equipment. Suppressors installed in this manner shall utilize the equipment chassis as a medium for bonding of their ground terminals. Bonding jumpers not exceeding two inches in length shall be installed between the chassis and suppressor ground terminals. Bolted connections with star washers shall be used to insure electrical and mechanical integrity of connections to the equipment chassis.

B. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be consistent with recommended industry practices for the system on which these devices are installed.

C. Bonding between ground terminals for power and signal line suppressors serving a particular item or cluster of equipment shall be kept as short as possible. Where practical, suppressors shall be installed in a common location for the cluster with their ground terminals bonded closely together. For installations requiring separation between the various suppressor grounds and equipment chassis within an equipment cluster, the following table shall be used to determine bonding conductor requirements (distances are measured between most distant suppressor or chassis grounds):

BONDING DISTANCE	MATERIAL
0 - 10 feet	#6 AWG Bare Copper (Solid)
10- 25 feet	1-1/2" Copper Strip 26ga. Min.
25- 50 feet	3" Copper Strip 26ga. Min.
Over 50 feet	6" Copper Strip 26ga. Min.

Care shall be exercised to avoid connection of incidental grounds to the bonding bus system.

D. Where terminal cabinets are used to house surge suppressors, painted steel backboards shall be used to serve as a low impedance ground plane for bonding surge suppressor leads together. Terminal boards used for the same purpose shall be laminated with a single sheet of 14 ga. galvanized steel to serve as a ground plane for suppressors. Suppressors with ground terminals not inherently bonded to the ground plane through their mounting shall be bonded to this plane using a two-inch maximum length of #12AWG copper wire and suitable lug. Ground planes and backboards shall be drilled to accept self tapping screws, any paint in the area of the bond shall be removed and star washers shall be used.

E. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG bare copper conductors and approved connections unless otherwise noted.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 26 50 00

LIGHTING FIXTURES

PART 1 PART 1 GENERAL

1.01 DESCRIPTION

A. Description of System:
   1. Light fixtures furnished under this Division shall be furnished complete with lamps and all necessary trim and mounting hardware, and installed as shown on the Drawings.
   2. Light fixtures shall be neatly and firmly mounted, using standard supports for outlets and fixtures. See special mounting requirements as detailed on the Drawings.
   3. Lamps shall be included in the system guarantee for a period of ninety (90) days after final acceptance of the building.

1.02 CODES

A. The Work of this section shall comply with the current editions of the following codes:
   1. National Electrical Code (NEC), NFPA 70.
   2. Florida Building Code (FBC).

1.03 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the Work of this section:
   1. UL Underwriters Laboratories.
   2. CBM Certified Ballast Manufacturer's Association.

1.04 SUBMITTALS

A. Shop Drawings and manufacturers data shall be submitted for the following items:
   1. Luminaire data shall show full-size cross sections. Indicate finished dimensions, metal thickness, U.L. Label, finish, lens/louver thickness and materials.
   2. Show mounting details, including hung ceiling construction.
   3. Indicate type of ballast and manufacturers and ballast quantity and location. Include information as to power factor, input watts and ballast factor.
   4. Indicate lamps to be utilized and quantity.
   5. Include a complete listing of all luminaries on a single sheet. This listing shall contain the luminaire type, manufacturer’s catalog number, applied voltage, lamps, ballast type and luminaire quantities.
   6. The Engineer reserves the right to require submittal of a complete sample fixture for any fixture type.

7. For exterior post/pole mounted light fixtures, clearly indicate hand hole and lightning protection ground lug mounted to post/pole at hand hole inside post/pole.
8. Signed and sealed shop drawings and calculations shall be submitted for all exterior pole mounted fixtures. The seal must be of a registered professional engineer certifying that the foundation and pole/fixture assembly meets or exceeds the wind load criteria of the most current Florida Building Code. The foundation details shown on the plans are for bidding purposes only; the contractor shall provide the foundation and pole assembly necessary for compliance as submitted at no additional cost to Owner.
9. Product data shall be submitted showing manufacturer's written recommendations for storage and protection, and installation instructions.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Luminaires
   1. Acceptable manufacturers are listed in the lighting fixture schedule shown on the Drawings.
   2. The designations indicated on the lighting fixture schedule are a design series reference (not necessarily a complete catalog number) and do not necessarily represent the number, size, voltage, wattage, type of lamp, ballast, finish trim, ceiling type, mounting hardware of special requirements as specified hereinafter on as required by the particular installation(s) and code. Contractor shall verify these requirements and order fixtures as required to give proper installation per the contract documents and per codes.

B. Ballasts:
   1. It is preferred that all ballasts shall be of the same manufacturer. Every effort shall be made to eliminate ballasts from multiple manufacturers. Ballasts within luminaires of a given type must however be of the same manufacturer. Multiple manufacturers will not be permitted.
   2. Approved Manufacturers:
      a. Motorola.
      b. Advance Transformer Co.
      c. Magnetek.
      d. General Electric.

C. Lamps:
   1. All lamps shall be of the same manufacturer. Multiple manufacturers are not permitted.
   2. Approved Manufacturers:
      a. General Electric.
      b. Philips.
      c. Osram Sylvania.

2.02 MATERIALS

A. All lighting fixtures mounted outdoors subject to dampness and insects shall have gasketing material between lens door and frame to completely seal interior of fixture. Knockouts and holes in fixtures housing shall be closed and sealed. All fixtures shall be complete with lamps, shielding brackets, concrete bases, anchor bolts, and all necessary fittings and accessories for a complete installation.

B. Plastic Lenses and diffusers:
   1. Virgin acrylic unless otherwise noted. Install and leave with no finger prints or dirt marks on the lens or diffuser. Lenses shall be provided on all recessed metal halide luminaires.
   2. Minimum unpenetrated thickness for Parabolic or conical element diffuser: 0.085 inch.
   3. Minimum nominal thickness: 0.125 inch.

C. Parabolic Luminaire Care: Parabolic luminaires to be installed with mylar cover over louvers. Cover shall be U.L. listed for temporary lighting. Upon completion of work, remove mylar cover with white gloves and blow clean reflectors.

D. Finish: Porcelain or baked enamel finish matte white on interiors with minimum tested reflectance of 90 percent matte white finish or as specified in visible exterior. Thoroughly clean base metal and painted after fabrication.

E. Sockets: Incandescent lamp sockets - porcelain housings over copper screw shells, with medium base sockets rated at 660 watts and 250 volts. Insulating joint in pull chains. Fluorescent lampholder - white, rotor lock, heat-resistant plastic rated 660 watts and 600 volts. Fluorescent industrial sockets - heavy-duty, multi-socket, metal-clad, spring-loaded. Provide heavy-duty sockets for H.I.D. luminaires where mounted less than 8'-0" AFF.

F. Luminaire Wiring: Minimum individual luminaire wiring - number 18 gauge with insulation at rated operating temperature of 105 degrees Centigrade or higher. Terminate wiring for recessed luminaires, except fluorescent units, in an external splice box.

G. Ballasts:
   1. Ballasts for F32T8 lamps shall be:
      a. High frequency solid state electronic.
      b. Electronic Program start
      c. 50 F minimum starting temperature unless otherwise noted
      d. Minimum 1.15 ballast factor
      e. Maximum total harmonic distortion (THD) less than 10%
      f. High power factor, minimum 95 %
      g. Sound rated A
   2. High-power factor (over 90 percent). Certified Ballast Manufacturers' Certification, ballast case temperature not to exceed 90 degrees Centigrade during normal operation in 30 degrees Centigrade ambient temperature.

Ballast voltage: 120 or 277 volts, as required by circuiting. Ballast shall be provided with the best sound rating available.

3. Built-in self-resetting thermal actuated device will remove ballast from line when excessive ballast temperature is reached. U.L. Class P, CBM certified 100 percent output.
4. The conductors between ballasts and lampholders shall have an approved insulation for 1,000 volts. This includes conductors to and from remote ballasts.
5. High-intensity discharge ballasts shall be constant wattage autotransformer type with built-in thermal protection, minimum power factor of 80 percent. 12" min. leads.
6. Provide ballasts with voltage characteristics to match that of all related circuitry indicated on the Drawings. No extra compensation will be allowed for failure to properly coordinate ballast voltage with circuitry.
7. Ballasts for control of lamps in one housing or fixture unit may control lamps of an adjoining unit, except as otherwise noted.
8. Guarantee ballast for one full year and one year prorated as per standard manufacturer's warranty against defects for a period of 2 years. Guarantee to include replacing defective ballast with new ballast.
9. Provide dimming ballasts as shown on the drawing for fixtures controlled by individual dimming or dimming systems.
10. LED drivers for interior luminaires shall employ an auto resetting thermal management system to turn off the LED array when normal operating temperatures are exceeded. Exterior drivers shall employ a step reduction circuit to reduce lumen output in order to maintain proper operating temperatures, but will not allow an “off” condition for thermal management.

H. Lamps:
   1. Provide a complete set of new lamps in each fixture.
   2. Unless noted otherwise lamps must conform to the following:
      a. Fluorescent: T-8, 41k color. Minimum of 80 CRI and 3100 lumens.
      b. Incandescent: "A" lamps to be inside frosted rated at 130 volts.
      c. Compact Fluorescent: triple Twin tube, 4-pin
      d. HID: Metal Halide, clear, universal base, open rated.
      e. LED: Minimum of 50,000 hrs life at no less than 70 percent initial lumen rating. 40k color. Minimum of 80 CRI. Color variation shall not exceed a 3 step MacAdam ellipse.

I. Luminaires installed recessed in a metal pan ceiling shall have a flange type trim to overlap abutment of adjacent pans.

J. Where utilized as raceways, luminaires shall be suitable for use as raceways. Provide feed through splice boxes where necessary.

K. Where ceiling mounted fixtures are called for in the Light Fixture Schedule and on the drawings, this contractor shall provide fixture trims and supports as required to match type of ceiling system which will be furnished. No ceiling fixtures shall be ordered until the Ceiling System Installer has given written approval of the method

and location of fixture hanging and fixture type. Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Clips identified for use with the type of ceiling frame member(s) and fixture(s) shall also be permitted. Where fixtures are supported by the suspended ceiling system; the ceiling system shall have a minimum (2) opposite corners tied to structure at each fixture location; this contractor shall be responsible for doing this work or for having the ceiling contractor perform it. All supports shall meet current FBC standards.

L. All exterior post/pole mounted light fixtures shall have a hand hole at the base, lightning protection in hand hole and ground conductor connected to ground rod at base. Hand hole shall provide easy access to light fixture fusing and lightning protection ground lug. Lightning protection ground lug shall be provided inside post/pole, electrically in contact with pole, for connection to ground rod. Provide and install ground wire from ground lug to ground rod, concealing ground wire through post/pole base. Anchor bolts to be galvanized.

M. All interior and exterior light fixtures shall not have any labels exposed to normal viewing angles. This includes manufacturer labels and U.L. labels. All labels shall be concealed within the body of the fixture and/or luminaire. No manufacturers name or logo shall appear on the exterior of any light fixtures unless approved in writing by Engineer.

N. All light fixtures shall adhere to U.L. Test Standard #1571 and Section #410-65C of the National Electric Code. All manufacturers shall provide the required thermal protection as required.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install luminaires in mechanical and unfinished areas after ductwork and piping installation. Adjust fixture locations to provide the best lighting for equipment access and service locations. Locate fixtures 8 feet 6 inches above floor, or at suitable locations within space on walls but not lower than 7'-0" AFF.

B. The Contractor shall protect luminaires from damage during installation of same and up to time of final acceptance. Any broken luminaires, glassware, plastics, lamps, etc., must be replaced by the Contractor with new parts, without any additional expense to the Owner.

C. The contractor shall verify prior to ordering fixtures that each fixture scheduled has correct type trim and support arrangement for the proposed ceiling construction.

D. Install all fixtures in accordance with manufacturer’s written instructions and the NEC.

E. Pendant mounted units shall comply with the following:

1. Each stem shall have a brass or steel swivel or other self-aligning device of type approved by the Engineer. The entire luminaire mounting (hickey, aligner, swivel, stem, etc.) shall be submitted to and approved by the Engineer before installation.
2. An insulated malleable iron bushing shall be placed at luminaire end of stem through which wire passes.
3. A pendant support using an approved sliding clevis bracket which firmly grips an indentation in rigid sides of the wiring channel will be acceptable.
4. Connections between outlet boxes and luminaires shall be by means of approved flexible raceways. The application of raceways directly between luminaires is unacceptable.

F. Where luminaires are mounted upon surface-mounted outlet boxes in surface mounted conduit runs, this Contractor shall furnish and install a luminaire canopy sufficiently deep to permit exposed conduits to pass through. Canopy shall have proper openings cut by luminaire manufacturer through which conduits may pass. Submit sample of canopy for approval before installation.

G. Ceiling surface mounted fluorescent fixtures installed in exposed ceiling areas are to be suspended from ceiling structure with all-thread rods and 1-1/2-inch by 1-1/2-inch Kindorf channels, full length of fixture/row. Mount outlet box at structure with flexible connection to fixture.

H. Ducseal shall be installed to seal all conduits entering exterior light fixtures from underground.

I. Install exit light as indicated on the drawings but not higher than 10'0" AFF. Size and color of lettering shall comply with local codes.

J. Outdoor lighting shall be aimed in periods of darkness in front of the owner/engineer.

3.02 COORDINATION WITH AMBIENT CONDITIONS

A. The Contractor is responsible for coordinating the characteristics and the U.L. labeling of the luminaires and their components with the ambient conditions which will exist when the luminaires are installed. No extra compensation will be permitted for failure to coordinate the luminaires with their ambient conditions. These areas of coordination include but are not limited to the following:
1. Wet location labels.
2. Damp location labels.
3. Low temperature ballasts.
4. Dimming ballasts.
5. Very low heat rise ballasts.
6. Explosion proof.
7. Plenums and air handling spaces.
8. Fire rated ceilings.
9. Low density ceilings.

10. Insulated ceilings.

3.03 CLEAN-UP

A. Luminaires:
   1. Clean free from dust and dirt. Wash lens and glassware using cleaner such as “Windex” and dry with absorbent paper. Clean plastic per manufacturer’s recommendations; do not wipe. Lenses which are kept in original containers until immediately prior to final inspection may not require cleaning. Clean “Alzak” aluminum surfaces (reflectors, fixture cones and the like) per mfr’s recommendations being careful to remove finger prints and smudges.
   2. It is the contractor’s responsibility to remove any U.L. labels or manufacturer’s labels from areas of fixture exposed to view and relocate label to non-obtrusive area on fixture.

END OF SECTION

Division 31

SECTION 31 23 16
EXCAVATION - EARTH AND ROCK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for performing opencut excavations to the widths and depths necessary for constructing structures, pipelines and conduits including excavation of any material necessary for any purpose pertinent to the construction of the Work.

B. Related Work Specified in Other Sections Includes:

1. Section 31 40 00 - Shoring, Sheeting and Bracing

2. Section 31 23 23 - Backfilling

1.02 DEFINITIONS

A. Earth: "Earth" includes all materials which, in the opinion of the Engineer, do not require blasting, barring, wedging or special impact tools for their removal from their original beds, and removal of which can be completed using standard excavating equipment. Specifically excluded are all ledge and bedrock and boulders or pieces of masonry larger than one cubic yard in volume.

B. Rock: "Rock" includes all materials which, in the opinion of the Engineer, require blasting, barring, wedging and/or special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock for removal from their original beds and which have compressive strengths in their natural undisturbed state in excess of 300 psi. Boulders or masonry larger than one cubic yard in volume are classed as rock excavation.

1.03 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 01.

B. Dewatering Excavation Plan: Develop an excavation dewatering plan that considers site ground and groundwater conditions, the type and arrangement of the equipment to be used and the proper method of groundwater disposal. Prepare the dewatering plan before beginning excavations below groundwater. Maintain one copy of the dewatering plan at the project site to be available for inspection while all dewatering operations are underway.

1.04 SITE CONDITIONS

A. Actual Conditions: Make any geotechnical investigations deemed necessary to determine actual site conditions.

B. Underground Utilities: Locate and identify all existing underground utilities prior to the commencement of Work.

C. Quality and Quantity: Make any other investigations and determinations necessary to determine the quality and quantities of earth and rock and the methods to be used to excavate these materials.

PART 2 – PART 2 PRODUCTS (NOT USED)

PART 3 – PART 3 EXECUTION

3.01 GENERAL

A. Clearing: Clear opencut excavation sites of obstructions preparatory to excavation. Clearing includes removal and disposal of vegetation, trees, stumps, roots and bushes, except those specified to be protected during trench excavation.

B. Banks: Shore or slope banks to the angle of repose to prevent slides or cave-ins in.

C. Safety: Whenever an excavation site or trench is left unattended by the Contractor or when an area is not within 100 feet of observation by the Contractor, the excavation site or trench shall be filled and/or, at the Owner's discretion, protected by other means to prevent accidental or unauthorized entry. Such protection shall include barricades and other protection devices requested by the Engineer or Owner, including temporary fencing, snow fencing, or temporary "structure" tape. Such safety items shall not relieve the Contractor of any site safety requirements or liabilities established by Federal, State and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the general public.

D. Hazardous Materials: If encountered, take care of hazardous materials not specifically shown or noted in accordance with Section 01 57 00.

E. During excavation and any site work, storm water pollution prevention measures shall be taken to ensure that water quality criteria are not violated in the receiving water body and all state and local regulatory requirements are met.

3.02 STRUCTURE EXCAVATION

A. Excavation Size: Provide excavations of sufficient size and only of sufficient size to permit the Work to be economically and properly constructed in the manner and of the size specified.

B. Excavation Shape: Shape and dimension the bottom of the excavation in earth or rock to the shape and dimensions of the underside of the structure or drainage blanket wherever the nature of the excavated material permits.

C. Compaction: Before placing foundation slabs, footings or backfill, proof roll the bottom of the excavations to detect soft spots.

1. For accessible areas, proof roll with a ten wheel tandem axle dump truck loaded to at least 15 tons or similarly loaded construction equipment.

2. For small areas, proof roll with a smooth-faced steel roller filled with water or sand, or compact with a mechanical tamper.

3. Make one complete coverage, with overlap, of the area.

4. Over excavate soft zones and replace with compacted select fill in accordance with Part 3.09 of this section.

3.03 TRENCH EXCAVATION

A. Preparation: Properly brace and protect trees, shrubs, poles and other structures which are to be preserved. Unless shown or specified otherwise, preserve all trees and large shrubs. Hold damage to the root structure to a minimum. Small shrubs may be preserved or replaced with equivalent specimens.

B. Adequate Space: Keep the width of trenches to a minimum, however provide adequate space for workers to place, joint and backfill the pipe properly.

1. The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 8-inches for unsheeted trench or 12 inches for sheeted trench.

2. The maximum width of trench, measured at the top of the pipe, shall not exceed the outside pipe diameter plus 2 feet, unless otherwise shown on the drawing details or approved by the Engineer. Trench walls shall be maintained vertical from the bottom of the trench to a line measured one foot above the top of the pipe. From one foot above the top of the pipe to the surface the trench walls shall conform with OSHA Regulations.

3. In sheeted trenches, measure the clear width of the trench at the level of the top of the pipe to the inside of the sheeting.

4. Should the maximum trench widths specified above be exceeded without written approval, provide concrete cradle or encasement for the pipe as directed. No separate payment will be made for such concrete cradle or encasement.

C. Depth:

1. Excavate trenches to a minimum depth of 8 inches below the bottom of the pipe or the bottom of encasement for electrical ducts, unless otherwise shown, specified or directed, so that bedding material can be placed in the bottom of the trench and shaped to provide a continuous, firm bearing for duct encasement, pipe barrels and bells.

2. Standard trench grade shall be defined as the bottom surface of the utility to be constructed or placed within the trench. Trench grade for utilities in rock or other non-cushioning material shall be defined as additional undercuts backfilled with #57 stone compacted in 6-inch lifts, below the standard 8-inches minimum trench undercut. Excavation below trench grade that is not ordered in writing by the Engineer shall be backfilled to trench grade and compacted.

D. Unstable or Unsuitable Materials: If unstable or unsuitable material is exposed at the level of the bottom of the trench excavation, excavate the material in accordance with the subsection headed "Authorized Additional Excavation".

1. Material shall be removed for the full width of the trench and to the depth required to reach suitable foundation material.

2. When in the judgment of the Engineer the unstable or unsuitable material extends to an excessive depth, the Engineer may advise, in writing, the need for stabilization of the trench bottom with additional select fill material, crushed stone, washed shell, gravel mat or the need to provide firm support for the pipe or electrical duct by other suitable methods.

3. Crushed stone, washed shell and gravel shall be as specified in Section 31 23 23.

4. Payment for such trench stabilization will be made under the appropriate Contract Items or where no such items exist, as a change in the Work.

E. Length of Excavation: Keep the open excavated trench preceding the pipe or electrical duct laying operation and the unfilled trench, with pipe or duct in place, to a minimum length which causes the least disturbance. Provide ladders for a means of exit from the trench as required by applicable safety and health regulations.

F. Excavated Material: Excavated material to be used for backfill shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall be responsible for obtaining the

sites to be used and shall maintain his operations to provide for natural drainage and not present an unsightly appearance.

G. Water: Allow no water to rise in the trench excavation until sufficient backfill has been placed to prevent pipe or duct flotation.

3.04 FINISHED EXCAVATION

A. Finish: Provide a reasonably smooth finished surface for all excavations, which is uniformly compacted and free from irregular surface changes.

B. Finish Methods: Provide a degree of finish which is ordinarily obtainable from blade-grade operations, except as otherwise specified in Section 31 23 23.

3.05 PROTECTION

A. Traffic and Erosion: Protect newly graded areas from traffic and from erosion.

B. Repair: Repair any settlement or washing away that may occur from any cause, prior to acceptance. Re-establish grades to the required elevations and slopes.

C. It shall be the Contractor's responsibility to acquaint himself with all existing conditions and to locate all structures and utilities along the proposed utility alignment in order to avoid conflicts. Where actual conflicts are unavoidable, work shall be coordinated with the facility owner and performed so as to cause as little interference as possible with the service rendered by the facility disturbed. Facilities or structures damaged in the prosecution of the work shall be repaired and/or replaced immediately, in conformance with current standard practices of the industry, or according to the direction of the owner of such facility, at the Contractor's expense.

D. Other Requirements: Conduct all Work in accordance with the environmental protection requirements specified in Division 01.

3.06 AUTHORIZED ADDITIONAL EXCAVATION

A. Additional Excavation: Carry the excavation to such additional depth and width as authorized in writing, for the following reasons:

1. In case the materials encountered at the elevations shown are not suitable.

2. In case it is found desirable or necessary to go to an additional depth, or to an additional depth and width.

B. Refill Materials: Refill such excavated space with either authorized 2500 psi concrete or compacted select fill material.

C. Compaction: Where necessary, compact fill materials to avoid future settlement. As a minimum, unless otherwise specified or directed, backfill layers shall not exceed 6-

inches in thickness for the full trench width and compaction shall equal 95% of maximum density, or 98% if under paved area of roadway, as determined by using ASTM D 1557. Compaction density tests shall be made at all such backfill areas with spacing not to exceed 100 feet apart and on each 6-inch compacted layer.

3.07 UNAUTHORIZED EXCAVATION

A. Stability: Refill any excavation carried beyond or below the lines and grades shown, except as specified in the subsection headed "Authorized Additional Excavation", with such material and in such manner as may be approved in order to provide for the stability of the various structures.

B. Refill Materials: Refill spaces beneath all manholes, structures, pipelines, or conduits excavated without authority with 2500 psi concrete or compacted select fill material, as approved.

3.08 SEGREGATION STORAGE AND DISPOSAL OF MATERIAL

A. Stockpiling Suitable Materials: Stockpile topsoil suitable for final grading and landscaping and excavated material suitable for backfilling or embankments separately on the site in approved locations.

B. Stockpile Locations: Store excavated and other material a sufficient distance away from the edge of any excavation to prevent its falling or sliding back into the excavation and to prevent collapse of the wall of the excavation. Provide not less than 2 feet clear space between the top of any stockpile and other material and the edge of any excavation.

C. Excess Materials: Contractor shall be responsible to transport and dispose of surplus excavated material and excavated material unsuitable for backfilling or embankments at an off site disposal location secured by the Contractor.

3.09 REMOVAL OF WATER

A. Water Removal: At all times during the excavation period and until completion and acceptance of the Work at final inspection, provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation or other parts of the Work.

B. Dry Excavations: Keep the excavation dry.

C. Water Contact: Allow no water to rise over or come in contact with masonry and concrete until the concrete and mortar have attained a set and, in any event, not sooner than 12 hours after placing the masonry or concrete.

D. Discharge of Water: Dispose of water pumped or drained from the Work in a safe and suitable manner without damage to adjacent property or streets or to other work under construction.

E. Protection: Provide adequate protection for water discharged onto streets. Protect the street surface at the point of discharge.

F. Sanitary Sewers: Discharge no water into sanitary sewers.

G. Storm Sewers: Discharge no water containing settleable solids into storm sewers.

H. Repair: Promptly repair any and all damage caused by dewatering the Work.

END OF SECTION

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SECTION 31 23 23
BACKFILLING

PART 1 – GENERAL

1.01 SUMMARY

A. General Requirements: Backfill all excavation to the original surface of the ground or to such other grades as may be shown or required. For areas to be covered by topsoil, leave or stop backfill (12) inches below the finished grade or as shown. Obtain approval for the time elapsing before backfilling against masonry structures. Remove from all backfill, any compressible, putrescible, or destructible rubbish and refuse and all lumber and braces from the excavated space before backfilling is started. Leave sheeting and bracing in place or remove as the work progresses.

B. Equipment Limitations: Do not permit construction equipment used to backfill to travel against and over cast-in-place concrete structures until the specified concrete strength has been obtained, as verified by concrete test cylinders. In special cases where conditions warrant, the above restriction may be modified providing the concrete has gained sufficient strength, as determined from test cylinders, to satisfy design requirements for the removal of forms and the application of load.

C. Related Work Specified in Other Sections Includes:

    1. Section 31 23 16 - Excavation – Earth and Rock

1.02 REFERENCES

A. Codes and standards referred to in this Section are:

    1. ASTM D 1557 - Standard Test Methods for Moisture-Density Relations of

    2. Soil and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 in Drop

1.03 SUBMITTALS

A. The Contractor shall notify the Engineer of the off-site sources of bedding and backfill materials, and submit to the Engineer the testing results of a representative sample weighing approximately 50 pounds. All fees associated with testing shall be paid for by the Contractor.

PART 2 – PRODUCTS

2.01 BACKFILL MATERIAL - GENERAL

A. General: Backfill with sound materials, free from waste, organic matter, rubbish, boggy or other unsuitable materials.

1. General Materials Requirements: Conform materials used for backfilling to the requirements specified. Follow common fill requirements whenever drainage or select fill is not specified. Determine and obtain the approval of the appropriate test method where more than one compaction test method is specified.

B. Frozen Materials: Do not use frozen material for backfilling.

2.02 DRAINAGE FILL

A. Materials for Drainage Fill: Use clean gravel, crushed stone, or other suitable material conforming to the gradation specified for drainage fill. Clay and fine particles are unacceptable in drainage fill. Provide drainage fill of a grade between the following limits:

U.S. Standard Sieve	Percent Passing by Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	45-65
#4	5-15
#16	0-4

2.03 SELECT FILL

A. Materials for Select Fill: Use clean gravel, crushed stone, washed shell, or other granular or similar material as approved which can be readily and thoroughly compacted to 95 percent of the maximum dry density obtainable by ASTM D 1557.

1. Allowed Materials: Grade select fill between the following limits:

U.S. Standard Sieve	Percent Passing by Weight
2 inch	100
1-1/2 inch	90-100
1 inch	75-95
1/2 inch	45-70
#4	25-50
#10	15-40
#200	5-15

2. Unallowed Materials: Very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet are unacceptable as select fill.

2.04 COMMON FILL

A. Materials for Common Fill: Material from on-site excavation may be used as common fill provided that it can be readily compacted to 90 percent of the maximum dry density obtainable by ASTM D 1557, and does not contain unsuitable material. Select fill may be used as common fill at no change in the Contract Price.

B. Granular Materials On-Site: Granular on-site material, which is fairly well graded between the following limits may be used as granular common fill:

U.S. Standard Sieve	Percent Passing by Weight
3 inch	100
#10	50-100
#60	20-90
#200	0-20

C. Cohesive Materials On-Site: Cohesive site material may be used as common fill.

1. The gradation requirements do not apply to cohesive common fill.

2. Use material having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

D. Material Approval: All material used as common fill is subject to approval. If there is insufficient on-site material, import whatever additional off-site material is required which conforms to the specifications and at no additional cost.

2.05 UTILITY PIPE BEDDING

A. Class A (special utility bedding). Should special bedding be required due to depth of cover, impact loadings or other conditions, Class A bedding shall be installed, as shown in Section 6 of the Lee County Utilities Operations Manual.

B. Class B (minimum utility bedding). The bottom of the trench shall be shaped to provide a firm bedding for the utility pipe. The utility shall be firmly bedded in undisturbed firm soil or hand shaped unyielding material. The bedding shall be shaped so that the pipe will be in continuous contact therewith for its full length and shall provide a minimum bottom segment support for the pipe equal to 0.3 times the outside diameter of the barrel.

PART 3 – EXECUTION

3.01 ELECTRICAL DUCT AND PRECAST MANHOLE BEDDING

A. Bedding Compaction: Bed all electrical ducts and precast manholes in well graded, compacted, select fill conforming to the requirements except as otherwise shown, specified, or required. Extend electrical duct bedding a minimum of 6 inches below the bottom of the duct encasement for the full trench width. Compact bedding thickness no less than 6 inches for precast concrete manhole bases.

B. Concrete Work Mats: Cast cast-in-place manhole bases and other foundations for structures against a 2500 psi concrete work mat in clean and dry excavations, unless otherwise shown, specified or required.

C. Bedding Placement: Place select fill used for bedding beneath electrical ducts and precast manhole bases, in uniform layers not greater than 9 inches in loose thickness. Thoroughly compact in place with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

D. Use of Select Fill: Bed existing underground structures, tunnels, conduits and pipes crossing the excavation with compacted select fill material. Place bedding material under and around each existing underground structure, tunnel, conduit or pipe and extend underneath and on each side to a distance equal to the depth of the trench below the structure, tunnel, conduit or pipe.

3.02 PIPE BEDDING AND INITIAL BACKFILL

A. Hand Placement: Place select fill by hand for initial pipe backfill from top of bedding to 1 foot over top of pipes in uniform layers not greater than 6 inches in loose thickness. Tamp under pipe haunches and thoroughly compact in place the select fill with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

B. Stone Placement: Do not place large stone fragments in the pipe bedding or backfill to 1 foot over the top of pipes, nor nearer than 2 feet at any point from any pipe, conduit or concrete wall.

C. Unallowed Materials: Pipe bedding containing very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet is unacceptable.

3.03 BEDDING PLACEMENT AND BACKFILL FOR PIPE IN SHORT TUNNEL

A. Bed pipelines or electrical ducts placed in short tunnels in select fill or 2500 psi concrete. Completely fill the remainder of the annular space between the outside of the pipe wall and the

tunnel wall with select fill, suitable job-excavated material, or 2500 psi concrete, as approved. Suitably support pipelines or ducts in short tunnels to permit placing of backfill suitably tamped in place.

3.04 TRENCH BACKFILL

A. General: Backfill material shall be clean earth fill composed of sand, clay and sand, sand and stone, crushed stone, or an approved combination thereof. Backfilling shall be accomplished under two specified requirements: First Lift, from trench grade to a point 12 inches above the top of the utility, and, Second Lift, from the top of the First Lift to the ground surface. Where thrust blocks, encasements, or other below-grade concrete work have been installed, backfilling shall not proceed until the concrete has obtained sufficient strength to support the backfill load.

B. First Lift: Fine material shall be carefully placed and tamped around the lower half of the utility. Backfilling shall be carefully continued in compacted and tested layers not exceeding 6 inches in thickness for the full trench width, until the fill is 12 inches above the top of the utility, using the best available material from the excavation, if approved. The material for these first layers of backfill shall be lowered to within 2 feet above the top of pipes before it is allowed to fall, unless the material is placed with approved devices that protect the pipes from impact. The "First Lift" shall be thoroughly compacted and tested before the "Second Lift" is placed. Unless otherwise specified, compaction shall equal 98% of maximum density, as determined by ASTM D 1557. The "First Lift" backfill shall exclude stones, or rock fragments larger than the following:

Pipe Type	(Greatest Dimension-Inches) Fragment Size (Inches)
Steel	2
Concrete	2
Ductile Iron	2
Plastic	1
Fiberglass	1

C. Second Lift: The remainder of the trench, above the "First Lift", shall be backfilled and tested in layers not exceeding 6 inches. The maximum dimension of a stone, rock, or pavement fragment shall be 6 inches. When trenches are cut in pavements or areas to be paved, compaction, as determined by ASTM D 1557, shall be equal to 98% of maximum density, with compaction in other areas not less than 95% of maximum density in unpaved portions of the Rights-of-Way or 90% of maximum density in other areas.

1. As an alternative, or if required under roadways, Flowable Fill may be substituted. If Flowable Fill is to be used, a fabric mesh shall be installed between the “first lift” and the Flowable Fill. Flowable Fill shall be in accordance with Section 4.7.AH of the Lee County Utilities Operations Manual.

D. Compaction Methods: The above specified compaction shall be accomplished using accepted standard methods (powered tampers, vibrators, etc.), with exception that the first two feet of backfilling over the pipe shall be compacted by hand-operated tamping devices. Flooding or puddling with water to consolidate backfill is not acceptable, except where sand is the only material utilized and encountered and the operation has been approved by the Owner.

E. Density Tests: Density tests for determination of the above specified compaction shall be made by an independent testing laboratory and certified by a Florida Registered, Professional Engineer at the expense of the Contractor. Test locations will be determined by the Owner but in any case, shall be spaced not more than 100 feet apart where the trench cut is continuous. If any test results are unsatisfactory, the Contractor shall re-excavate and re-compact the backfill at his expense until the desired compaction is obtained. Additional compaction tests shall be made to each site of an unsatisfactory test, as directed, to determine the extent of re-excavation and re-compaction if necessary.

F. Dropping of Material on Work: Do trench backfilling work in such a way as to prevent dropping material directly on top of any conduit or pipe through any great vertical distance. Do not allow backfilling material from a bucket to fall directly on a structure or pipe and, in all cases, lower the bucket so that the shock of falling earth will not cause damage.

G. Distribution of Large Materials: Break lumps up and distribute any stones, pieces of crushed rock or lumps which cannot be readily broken up, throughout the mass so that all interstices are solidly filled with fine material.

3.05 STRUCTURE BACKFILL

A. Use of Select Fill: Use select fill underneath all structures, and adjacent to structures where pipes, connections, electrical ducts and structural foundations are to be located within this fill. Use select fill beneath all pavements, walkways, and railroad tracks, and extend to the bottom of pavement base course or ballast.

1. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable approved mechanical or pneumatic equipment.

2. Compact backfill to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

B. Use of Common Fill: Use common granular fill adjacent to structures in all areas not specified above, unless otherwise shown or specified. Select fill may be used in place of common granular fill at no additional cost.

1. Extend such backfill from the bottom of the excavation or top of bedding to the bottom of subgrade for lawns or lawn replacement, the top of previously existing ground surface or to such other grades as may be shown or required.

2. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable equipment, as specified above.

3. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

C. Use of Clay: In unpaved areas adjacent to structures for the top 1 foot of fill directly under lawn subgrades use clay backfill placed in 6-inch lifts. Compact clay backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

1. Use clay having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

3.06 COMPACTION EQUIPMENT

A. Equipment and Methods: Carry out all compaction with suitable approved equipment and methods.

1. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use hand held pneumatic tampers elsewhere for compaction of cohesive fill material.

2. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.

3. Do not use heavy compaction equipment over pipelines or other structures, unless the depth of fill is sufficient to adequately distribute the load.

3.07 BORROW

A. Should there be insufficient material from the excavations to meet the requirements for fill material, borrow shall be obtained from pits secured and tested by the Contractor and approved by the Owner. Copies of all test results shall be submitted to Owner.

3.08 FINISH GRADING

A. Final Contours: Perform finish grading in accordance with the completed contour elevations and grades shown and blend into conformation with remaining natural ground surfaces.

1. Leave all finished grading surfaces smooth and firm to drain.

2. Bring finish grades to elevations within plus or minus 0.10 foot of elevations or contours shown.

B. Surface Drainage: Perform grading outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water.

3.09 RESPONSIBILITY FOR AFTERSETTLEMENT

A. After settlement Responsibility: Take responsibility for correcting any depression which may develop in backfilled areas from settlement within one year after the work is fully completed. Provide as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

3.10 INSPECTION AND TESTING OF BACKFILLING

A. Sampling and Testing: Provide sampling, testing, and laboratory methods in accordance with the appropriate ASTM Standard Specification. Subject all backfill to these tests.

B. Compaction density tests shall be made at all such backfill areas with spacing not to exceed 100 feet apart and on each 6-inch compacted layer.

C. Correction of Work: Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating or sprinkling as needed and re-compaction in place prior to placement of a new lift.

END OF SECTION

SECTION 31 40 00
SHORING, SHEETING AND BRACING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Work required for protection of an excavation or structure through shoring, sheeting, and bracing.

B. Related Work Specified in Other Sections Includes:

1. Section 31 23 16 - Excavation - Earth and Rock

2. Section 31 23 23 - Backfilling

1.02 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 01.

B. Contractor's Submittals: All sheeting and bracing shall be the responsibility of the Contractor to retain qualified design services for these systems, and to be completed with strict adherence to OSHA Regulations. Submit complete design calculations and working drawings of proposed shoring, sheeting and bracing which have been prepared, signed and sealed by a Licensed Professional Engineer experienced in Structural Engineering and registered in the State of Florida, before starting excavation for jacking pits and structures. Engineer's review of calculations and working drawings will be limited to confirming that the design was prepared by a licensed professional engineer.

1.03 REFERENCES

A. Design: Comply with all Federal and State laws and regulations applying to the design and construction of shoring, sheeting and bracing.

B. N.B.S. Building Science Series 127 "Recommended Technical Provisions for Construction Practice in Shoring and Sloping Trenches and Excavations.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Do work in accordance with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54), and the Florida Trench Safety Act. The Contractor shall also observe 29 CFR 1910.46 OSHA's regulation for Confined Space Entry.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND MATERIALS

A. Material Recommendations: Use manufacturers and materials for shoring, sheeting and bracing as recommended by the Licensed Professional Engineer who designed the shoring, sheeting, and bracing.

PART 3 – EXECUTION

3.01 SHORING, SHEETING AND BRACING INSTALLATION

A. General: Provide safe working conditions, to prevent shifting of material, to prevent damage to structures or other work, to avoid delay to the work, all in accordance with applicable safety and health regulations. Properly shore, sheet, and brace all excavations which are not cut back to the proper slope and where shown. Meet the general trenching requirements of the applicable safety and health regulations for the minimum shoring, sheeting and bracing for trench excavations.

    1. Contractor's Responsibility: Sole responsibility for the design, methods of installation, and adequacy of the shoring, sheeting and bracing.

B. Arrange shoring, sheeting and bracing so as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength.

C. If Engineer is of the opinion that at any point the shoring, sheeting or bracing are inadequate or unsuited for the purpose, resubmission of design calculations and working drawings for that point may be ordered, taking into consideration the observed field conditions. If the new calculations show the need for additional shoring, sheeting and bracing, it should be installed immediately.

D. Monitoring: Periodically monitor horizontal and vertical deflections of sheeting. Submit these measurements for review.

E. Accurately locate all underground utilities and take the required measures necessary to protect them from damage. All underground utilities shall be kept in service at all times as specified in Division 01.

F. Driven Sheeting: Drive tight sheet piling in that portion of any excavation in paved or surface streets and in State and Owner highways below the intersection of a one-on-one slope line from the nearest face of the excavation to the edge of the existing pavement or surface.

G. Sheeting Depth: In general drive or place sheeting for pipelines to a depth at elevation equal to the top of the pipe as approved.

1. If it is necessary to drive sheeting below that elevation in order to obtain a dry trench or satisfactory working conditions, cut the sheeting off at the top of the pipe and leave in place sheeting below the top of the pipe.

2. Do not cut the sheeting until backfill has been placed and compacted to the top of the pipe.

H. Sheeting Removal: In general, remove sheeting and bracing above the top of the pipe as the excavation is refilled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures. Sheeting shall be removed as backfilling progresses so that the sides are always supported or when removal would not endanger the construction of adjacent structures. When required to eliminate excessive trench width or other damages, shoring or bracing shall be left in place and the top cut off at an elevation 2.5 feet below finished grade, unless otherwise directed.

1. Carefully fill voids left by the withdrawal of the sheeting by jetting, ramming or otherwise.

2. No separate payment will be made for filling of such voids.

I. Permission for Removal: Obtain permission before the removal of any shoring, sheeting or bracing. Retain the responsibility for injury to structures or to other property or persons from failure to leave such shoring, sheeting and bracing in place even though permission for removal has been obtained.

J. Preload internal braces to 50 percent of the design loads.

K. Proof test tie backs to 133 percent of the design loads and lock off tie backs at 75 percent of the design loads.

3.02 SHEETING LEFT IN PLACE FOR PROTECTION

A. Ordered Left in Place: In addition to sheeting specified or shown to be left in place, the Engineer may order, in writing, any or all other shoring, sheeting or bracing to be left in place for the purpose of preventing injury to the structures, pipelines or to other property or to persons.

1. Cutoff sheeting left in place at the elevation shown or ordered, but, in general, at least 2.5 feet below the final ground surface.

2. Drive up tight any bracing remaining in place.

B. Right to Order: Do not construe the right to order shoring, sheeting and bracing left in place as creating any obligation to issue such orders.

END OF SECTION

Division 32

SECTION 32 10 01
PAVEMENT REPAIR AND RESTORATION

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and remove and replace pavements over trenches excavated for installation of pipelines as shown on the drawings and/or specified herein.

1.02 GENERAL

A. All damage, as a result of work under this project, done to existing pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipe lines, conduits, drains, catch basins, or stabilized areas or driveways and including all obstructions not specifically named herein, shall be repaired in a manner satisfactory to the Engineer.

B. Keep the surface of the backfilled area of excavation in a safe condition and level with the remaining pavement until the pavement is restored in the manner specified herein. All surface irregularities that are dangerous or obstructive to traffic are to be removed. The repair shall conform to applicable Owner or State requirements for pavement repair and as described herein.

C. All materials and workmanship shall be first class and nothing herein shall be construed as to relieve the Contractor from this responsibility. The Owner reserves the right to require soil bearing or loading tests or materials tests, should the adequacy of the foundation or the quality of materials used be questionable. Costs of these tests shall be borne by the Owner, if found acceptable; the costs of all failed tests shall be borne by the Contractor.

D. All street and road repair shall be made in accordance with the details indicated on the drawings and in accordance with the applicable requirements of these Specifications and meeting the permit requirements and approval of the governing Department of Transportation agencies.

E. Pavement or roadway surfaces cut or damaged shall be replaced by the Contractor in equal or better condition than the original, including stabilization, base course, surface course, curb and gutter or other appurtenances. The Contractor shall obtain the necessary permits prior to any roadway work. Additionally, the Contractor shall provide advance notice to the appropriate authority, as required, prior to construction operations.

1.03 QUALITY ASSURANCE

A. Applicable provisions of the latest version of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", and Supplemental Specifications hereunder govern the work under this Section. The Florida Department of Transportation will hereafter be referred to as FDOT.

PART 2 – PRODUCTS

2.01 MATERIALS

A. All materials utilized in flexible base pavement and base course shall be as specified in the latest version of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction".

PART 3 – EXECUTION

3.01 CUTTING PAVEMENT

A. Cut and remove pavement as necessary for installing the new pipelines and appurtenances and for making connections to existing pipelines.

B. Before removing pavement, the pavement shall be marked for cuts nearly paralleling pipelines and existing street lines. Asphalt pavement shall be cut along the markings with a jackhammer, rotary saw, or other suitable tool, leaving a uniform and straight edge with minimum disturbance to the remaining adjacent surface.

C. No pavement shall be machine pulled until completely broken and separated along the marked cuts.

D. The pavement adjacent to pipeline trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, remove the damaged pavement and shall replace it at his own expense.

3.02 GENERAL RESTORATION

A. The restoration of existing street paving, driveways, etc., shall be restored, replaced or rebuilt using the same type of construction as was in the original. Be responsible for restoring all such work, including sub-grade and base courses where present. Obtain and pay for such local or other governmental permits as may be necessary for the opening of streets. Meet any requirements other than those herein set forth which may affect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.

B. In all cases, maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract until accepted by the Owner, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.

C. Complete all the final resurfacing or re-paving of streets or roads, over the excavations and relay paving surfaces of roadbed that have failed or been damaged prior to acceptance by the Owner. Backfilling of trenches and the preparation of sub-grades shall conform to the requirements of Section 31 23 23.

D. All re-paving or resurfacing shall be done in accordance with Florida Department of Transportation Specifications, to which the following requirement of trench backfill will be added: Where pipeline construction crossed paved areas such as streets, the top 24 inches of trench below the road bases or concrete slabs shall be backfilled with compacted A-4 or better matter that will provide a bearing value of not less than 75 when tested by the Florida Department of Transportation Soil Bearing Test Methods.

3.03 PRIME AND TACK COATS

A. The work shall consist of the application of bituminous prime and tack coats on the previously prepared base course in accordance with Section 300 of the FDOT Specifications.

3.04 WEARING COURSE

A. The work shall consist of the construction of plant-mixed hot bituminous pavement to the thickness indicated in the drawings conforming to Type III asphaltic concrete in accordance with Section 333 of the FDOT Specifications. The requirements for plant and equipment are specified in Section 320 and the general construction requirements for asphaltic concrete pavement are contained in Section 330 of the FDOT specifications.

3.05 TESTING

A. All field testing shall be performed by an independent laboratory employed by the Owner. All materials shall be tested and certified by the producer. Tests repeated because sub-grade or base does not meet specified compaction shall be at the Contractor's expense.

3.06 MISCELLANEOUS RESTORATION

A. Sidewalks cut or damaged by construction shall be restored in full sections or blocks to a minimum thickness of four inches. Concrete curb or curb gutter shall be restored to the existing height and cross section in full sections or lengths between joints. Concrete shall be as specified on the drawings. Grassed yards, shoulders and parkways shall be

restored to match the existing sections with grass seed or sod of a type matching the existing grass.

3.07 CLEANUP

A. After all repair and restoration or paving has been completed, all excess asphalt, dirt, and other debris shall be removed from the roadways. All existing storm sewers and inlets shall be checked and cleaned of any construction debris.

END OF SECTION

SECTION 32 90 01
LANDSCAPING WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Soil, soil preparation, soil tests, excavation, planting, seeding, sodding, pruning, edging, fertilizing and maintenance.

B. Related Work Specified in Other Sections Includes:

1. Section 31 23 16 - Excavation, Earth and Rock

2. Section 31 23 23 - Backfilling

1.02 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM C 33 - Specification for Concrete Aggregates

1.03 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 01.

B. Soil Tests: Submit soil test results.

C. Maintenance Instruction Manual: Upon completion of the landscaping work and prior to final payment, furnish a landscaping maintenance manual. Include complete and detailed instructions on the recommended maintenance procedure to be followed for maintaining lawns and each species of plant material. Include a schedule of all planted and seeded materials and all pertinent growing and maintenance information and requirements for watering, fertilizing, lime applications, spraying, cultivating, pruning and weed control.

1.04 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)

B. Top Soil: Deliver top soil in a dry state without enough moisture to allow it to be packed or squeezed into a ball.

C. Balled and Bare Root Plants: Immediately after delivery, set all balled plants on the ground with the balls well protected with soil. Water and properly maintain all plants until planting. Plant or heel in bare rooted plants which cannot be planted immediately upon delivery. No materials heeled in for more than a week may be used. Before the roots are covered, open bundler and separate the plants.

D. Grass Seed: Deliver grass seed in standard size bags of the vendor, showing weight, analysis and name of vendor. Store the seed so as not to impair its effectiveness.

E. Sod: Deliver sod to the site in fresh condition and within two days of the time it has been dug.

F. Fertilizer: Deliver fertilizer mixed as specified, in standard size bags, showing weight, analysis and the name of the manufacturer. Store the fertilizer in a weatherproof storage place in a manner that will keep it dry without affecting its effectiveness.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Seeding and Sodding: Sow grass seed between August 15th and October 15th unless sowing between March 15th and June 1st is permitted. Sow seed when the wind velocity is below 5 mph. Place sod between August 15th and October 15th or between March 15th and June 1st, or during the season or seasons which are normal for such work as determined by weather conditions and accepted practice in the locality and as approved.

B. Planting: Unless otherwise directed, plant deciduous material from March 1st to June 1st and from September 1st to December 1st. Plant evergreen material from April 1st to June 1st and from September 1st to November 1st.

1.06 WARRANTY

A. General: Apply the warranty to all seeded, sodded and planted areas. Have the warranty period commence after the final acceptance of all landscaping work exclusive of all replacement plant materials.

B. Plant Material: Warranty plant materials for a period of one year.

C. Seeded Areas: Warranty seeded lawn areas to the time of establishment of an acceptable uniform stand of grass.

D. Sod: Warranty sod to 30 days following the first cutting.

1.07 MAINTENANCE

A. General: Maintain all seeded, sodded and planted areas during the warranty period.

B. Grass Areas: Maintain all seeded and sodded areas to well establish a uniform stand of weed-free grass. Reseed or resod areas failing to develop a uniform stand.

C. Trees, Shrubs and Ground Covers: Cultivate trees, shrubs and ground covers and weed and water when necessary, but not less than twice a month, to prevent plant material from dying. Replace any plant material which is found to be dead or dying during the warranty period to original specifications upon request. Include the full cost of replacing dead or dying plant material in the Contract Amount. No separate payment will be made for replacements. Maintain plant material to be alive, in good growing condition and free of weeds.

D. Replacement: Replace plant material and resod or reseed only during the specified planting seasons and warranty the replacement material for the same period of time as the original material.

PART 2 – PRODUCTS

2.01 SOIL

A. Topsoil: Provide a natural friable top soil of the region, rich in organic matter, without any material toxic to plant growth and of uniform quality, free of large roots, sticks, hard clay, weeds, brush, stones over 1-inch in maximum dimension or other litter or waste products. Provide topsoil containing no decomposed stone, salts or alkali, and not less than 15 parts per million of available nitrates, 3 parts per million of available phosphorus, 15 parts per million of potash, and having a pH of not less than 6.0 nor more than 7.2 at a depth of 8 inches below the surface of the field from which it is removed. Provide topsoil with a mechanical analysis as follows:

Sieve	Percent Passing
1 inch	100
1/4 inch	97-100
No. 100	40-60

B. Planting Soil: Prepare planting soil by mixing 10 parts of topsoil with fertilizer and 1 part of peat moss.

2.02 GRASS SEED AND SOD

A. Grass Seed: Provide a fresh, clean, new crop of grass seed the same as existed prior to construction or as approved by the Engineer and shall be ninety—nine (99) percent minimum purity, either (80) percent minimum germination and one (1) percent maximum week seed, labeled in accordance with U.S. Department of Agriculture Rules and Regulations under Federal Seed Act in effect. Seed which has become wet, mold, or otherwise damaged in transit or storage shall not be acceptable. Tag each sack in accordance with the agricultural seed laws of the United States and the State of Florida. Show on each tag the producer's guarantee as to the year grown, the percentage of purity, the percentage of germination and the tests by which the percentages were determined. Provide seed for this project having a test date within 6 months of the date of sowing.

B. Sod: Provide nursery-grown St. Augustine or Argentine Bahia sod, free of weeds, a minimum of 1-inch thick of dense growth and cut with sharp edges in 18-inch widths and not less than 3 feet long. Sod which has been grown on peat or which has been dug more than two days previous to delivery or which has been allowed to have the roots dry out or on which the grass has turned brown will not be accepted.

2.03 PLANT MATERIALS

A. General: Provide plant materials that are true to species or variety, sound, healthy, vigorous acclimated plants free from defects, disfiguring knots, sun-scaled injuries, abrasions of the bark, plant diseases and insect eggs, borers and all other forms of infestations. Provide material that has normal, well-developed branch systems and vigorous root systems and that is freshly dug, nursery-grown stock grown under the same climatic conditions as the Project location. Provide material grown under climatic conditions similar to those in the locality of the project for at least 2 years and transplanted or root pruned at least in the last 3 years.

B. Plant Size: Dimension a plant as it stands in its natural position. Measure trees under 4 inches in caliper at a point 6 inches above the ground and trees more than 4 inches in caliper at a point 12 inches above ground. Provide the stock of a fair average of the minimum and maximum sizes specified. Do not cut back large shrubs to sizes specified.

C. Balled, Burlapped and Platformed Plants: Dig balled and burlapped, as well as balled and platformed, plants with sufficient roots and a solid ball of earth securely held in place by burlap and stout natural fiber rope. Manufactured balls are not

acceptable. Provide balled and platformed plants with sturdy platforms of a size equal to the diameter of the horizontal midsection of the ball of earth.

D. Bare-Rooted Plants: Dig bare-rooted plants with sufficient root spread and depth to ensure full recovery and development of the plants. Cover roots for these plants with a uniformly thick coating of mud by being puddled immediately after they are dug.

E. Inspection: Submit plants to inspection for approval at the place of growth, for conformity to specification requirements as to quality, size and variety. In addition to the place of growth inspection, submit plants to inspection for approval upon delivery at the project site or during the progress of the work, for size and condition of balls or roots, diseases, insects, and latent defects or injuries. Remove rejected plants immediately from the site. Do not substitute plants for those specified unless approved.

2.04 COMMERCIAL FERTILIZER

A. Provide all commercial mixture fertilizer uniform in composition, free flowing, conforming to state and federal laws and suitable for application with equipment designed for that purpose. Provide fertilizer with organic, inorganic or combined elements with the following composition by weight:

1.	Nitrogen	12 percent
2.	Phosphorus pentoxide	8 percent
3.	Potash	8 percent

2.05 ACCESSORIES

1. Tree Wrap: Provide new, clean, plain, 8-ounce weight burlap material 6 inches wide for wrapping tree trunks.

2. Weed Barrier Fabric: Provide Pro-5 fabric as manufactured by the DeWitt Co., or equal.

3. Gravel: Provide smooth river bed gravel of solid or mixed color range to be as selected and meeting the requirements of ASTM C 33 and graded according to Size No. 467, Table II.

4. Mulch: Provide ground corn cobs, wood chips, tree barks, buckwheat hulls or other approved materials for mulch.

5. Edging: Provide commercial hot-rolled steel edging plate, 4 inches wide and 1/8-inch thick. Fabricate edging in sections with loops pressed from or welded to the face of sections at 30-inch centers to receive 16-inch long tapered steel stakes. Provide edging finished with the manufacturer's standard paint.

2.06 TESTS

A. Sample: Submit a 10-ounce sample of the proposed topsoil to a testing laboratory in sealed containers to prevent contamination.

B. Analysis: Analyze the topsoil sample to determine the amount of lime necessary and the appropriate fertilizer mix and quantity required for planting, seeding and sodding.

PART 3 – EXECUTION

3.01 GRADES

A. General: Existing and final contours shown depict finished grades after completion of landscaping work.

B. Lawn Grades: Grade lawns to meet walks, curbs and adjoining surfaces after uniform settlement of surfaces. Correct water pockets or ridges which appear after surface settlement takes place on or before the end of the guarantee period.

3.02 EXCAVATION FOR PLANTING

A. General: Obtain approval for all plant locations before excavation. Remove from the site all material that is surplus and unsuitable for backfill.

B. Ground Cover and Grass Areas: Excavate for ground cover and grass areas to the required depths for grass to receive 6 inches of topsoil and for groundcover to receive 6 inches of planting soil.

C. Plant Pits: Excavate plant pits with vertical sides and a circular outline.

1. Dig tree and evergreen pits at least twice the diameter of the ball, and deep enough to permit an 8-inch layer of compacted planting soil beneath the ball.

2. Dig shrub pits a minimum of twice the diameter of the ball and deep enough to allow 6 inches of compacted planting soil beneath the ball.

D. Drain: Install french drains for all trees, ornamental trees, and evergreens planted on berms and other locations where the grade permits, from bottom of planting pit to the finished grade with a trench 9 inches wide, filled with a 6-inch thick layer of 3/4-inch washed gravel. Cover the gravel layer with a filter mat before backfilling the trench with soil.

3.03 SOIL CONDITIONING

A. Disking: Before the application of topsoil, sodding or seeding, disk the area to be seeded, sodded or planted with groundcover to a depth of 6 inches. Continue the disking until the subsoil surface is sufficiently broken to provide a good bond between subsoil and topsoil. Spread 6 inches of planting soil over the disked area to a uniform depth and density.

B. Ground Limestone: Incorporate ground limestone, if required by the results of the soil test report, into the upper 3 inches of planting soil. Uniformly spread fertilizer and mix into the soil to a depth of 1-1/2 inches or as recommended by the manufacturer.

3.04 SEEDING AND SODDING

A. Seeding: Sow seed at the rate recommended by the seed producer. Evenly rake the surface after seeding with a fine-tooth rake. Mulch all newly seeded areas and cover with a minimum of 1/4-inch of straw or hay, approximately at the rate of 1 bale per 1,000 square feet, then thoroughly wet.

B. Sodding: Lay sod in such a manner that the surface is smooth and even and all edges abut one another tightly. Water and roll sod so that a bond is produced between the prepared topsoil and the sod. On slopes greater than 3 to 1, stake installed sod with approved wooden sod stakes at a minimum rate of three stakes per square yard of sod.

3.05 PLANTING

A. Layout: Outline locations for trees, shrubs, evergreens and bed and stake for approval. Obtain location approval prior to commencing planting operations.

B. Setting Plants: Set plants plumb and straight with the crown at finished grade. Compact soil around the base of the ball, and fill the void 3/4 of the way up from the bottom. Water each plant immediately. After the water has completely drained, fill the plant pits to finished grade. Properly spread out roots of bare root plants and carefully work topsoil among them. Cut off any broken or frayed roots with a clean cut. Form a shallow basin, the size of the ball with a ridge of soil to facilitate

watering. After that operation is completed, apply a second watering immediately. Finish all planting pits and beds within a period of 3 days following installation. Construct tree saucers, cultivate and outline planting pits with a neat edge, when necessary.

C. Mulching: Immediately after planting operations are completed, cover all tree and shrub pits with mulch to a minimum depth of 2 inches. Limit mulch for trees to saucer diameter and, for shrubs, the entire shrub bed.

D. Pruning: Prune each tree and evergreen with clean, sharp tools in accordance with standard horticultural practice to preserve the natural character of the plant. Remove suckers and all dead, broken or badly bruised branches.

E. Wrapping: Wrap the tree trunks of all trees with burlap tree wrapping securely tied with suitable cord at top and bottom and at 2-foot intervals along the trunk. Overlap the wrapping 2 inches top and bottom and entirely cover the trunk from the ground to the height of the second branch, neat and snug.

F. Guying: Guy trees as necessary to be plumb and straight through final inspection. Remove guy wires at completion of project.

G. Watering: During planting, thoroughly saturate the soil around each plant with water and as many times later as seasonal conditions require until the end of the guarantee period.

3.06 EDGING

A. General: Establish a neat edge where planting areas meet grass areas, with spade or edging tools, immediately after all planting and seeding is completed. Establish good flowing curves as shown. Maintain edging until the end of the guarantee period.

3.07 GRAVELED AREAS

A. General: Lay a weed barrier in accordance with the manufacturer's recommendations and top with a 4-inch layer of gravel. Edge graveled areas with metal edging.

END OF SECTION

SECTION 32 92 00
LAWN RESTORATION

PART 1 – GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. The work in this section consists of furnishing all labor, material and equipment to replace and maintain all areas disturbed during construction by establishing a stand of grass, within the areas called for by the furnishing and placing grass sod, or seeding, or seeding and mulching.

1.02 REFERENCE DOCUMENTS

A. The materials used in this work shall conform to the requirements of Florida Department of Transportation Standard Specifications for Road and Bridge Construction as follows:

1. Sod - Section 981-2
2. Fertilizer - Section 982
3. Water - Section 983

1.03 SUBMITTALS

A. Submit certifications and identification labels for all sodding supplied as specified in Section 01 33 00.

PART 2 – PRODUCTS

2.01 SODDING

A. Types: Sod may be of either St. Augustine or Argentine Bahia grass or as that disturbed, as established prior to construction. It shall be well matted with roots. When replacing sod in areas that are already sodded, the sod shall be the same type as the existing sod.

B. Sod shall be provided as required in accordance with Florida Department of Transportation Specifications 575 and 981. The Contractor shall furnish sod equal to and similar in type as that disturbed. Placement and watering requirements shall be in accordance with FDOT Specifications Section 575.

C. 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.

D. 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. It shall be reasonably free of weeds and other grasses. It shall be planted as soon as possible after being dug and shall be shaded and kept moist from the time it is dug until it is planted.

E. Sod should be handled in a manner to prevent breaking or other damage. Sod shall not be handled by pitch forks or by dumping from trucks or other vehicles. Care shall be taken at all times to retain the native soil on the roots of each sod roll during stripping and handling. Sod that has been damaged by handling during delivery, storage or installation will be rejected.

2.02 FERTILIZER

A. Chemical fertilizer shall be supplied in suitable bags with the net weight certification of the shipment. Fertilizer shall be 12-8-8 and comply with Section 982 of the FDOT Standard Specification for Road and Bridge Construction.

B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid and (3) water soluble potash, contained in the fertilizer.

C. The chemical designation of the fertilizer shall be 12-8-8, with at least 50 percent of the nitrogen from a nonwater-soluble organic source. The nitrogen source may be a unreaformaldehyde source provided it is not derived from a waste product of the plastic industry.

2.03 EQUIPMENT

A. The device for spreading fertilizer shall be capable of uniformly distributing the material at the specified rate.

2.04 NETTING

A. Netting is fabricated of material similar to Geoscope Landscape Fabric or approved equal.

2.05 GRASSING

A. The Contractor shall grass all unpaved areas disturbed during construction which do not require sod. All grassing shall be completed in conformance with FDOT Specifications Sections 570 and 981. The grassed areas shall be mulched and fertilized in accordance with FDOT Specifications.

B. Grass seed shall be Argentine Bahia, 60 #/acre March 1 to November 1, 50 #/acre with 20 #/acre of rye grass seed November 1 to March 1. Argentine Bahia seed shall be a scarified seed having a minimum active germination of 40% and total of 85%.

C. Mulch material shall be free of weeds and shall be oat straw or rye, Pangola, peanut, Coastal Bermuda, or Bahia grass hay.

2.06 TOPSOIL

A. Topsoil stockpiled during excavation may be used. If additional topsoil is required to replace topsoil removed during construction, it shall be obtained off site at no additional cost to the Owner. Topsoil shall be fertile, natural surface soil, capable of producing all trees, plants, and grassing specified herein.

2.07 MULCH

A. Mulch shall be fresh cypress mulch. Rate of application specified herein shall correspond to depth not less than 1-inch or more than 3-inches according to texture and moisture content of mulch material.

2.08 WATER

A. It is the Contractor's responsibility to supply all water to the site, as required during seeding and sodding operations and through the maintenance period and until the work is accepted. The Contractor shall make whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs for his work. He shall also furnish all necessary hose, equipment, attachments, and accessories for the adequate irrigation of lawns and planted areas as may be required. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

PART 3 – PART 3 EXECUTION

3.01 SOD BED PREPARATION

A. Areas to be sodded and/or seeded shall be cleared no all rough grass, weeds, and debris, and brought to an even grade.

B. The soil shall then be thoroughly tilled to a minimum 8-inch depth.

C. The areas shall then be brought to proper grade, free of sticks, stones, or other foreign matter over 1-inch in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.02 INSPECTION

A. Verify that soil preparation and related preceding work has been completed.

B. Do not start work until conditions are satisfactory.

3.03 SOD HANDLING AND INSTALLATION

A. During delivery, prior to planting, and during the planting of sod areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun. All sod shall be stacked during construction and planting so as not to be damaged by sweating or excessive heat and moisture.

B. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.

C. Sod shall be placed at all areas where sod existed prior to construction, on slopes of 3 horizontal on 1 vertical (3:1) or greater, in areas where erosion of soils will occur, and as directed by the Engineer. On areas where the sod may slide, due to height and slope, the Engineer may direct that the sod be pegged, with pegs driven through the sod blocks into firm earth, at suitable intervals.

3.04 SOD MAINTENANCE

A. The sod shall produce a dense, well established growth. The Contractor shall be responsible for the repair and re-sodding of all eroded or bare spots until project acceptance. Repair to sodding shall be accomplished as in the original work.

B. Sufficient watering shall be done by the Contractor to maintain adequate moisture for optimum development of the seeded and sodded areas. Sodded areas shall receive no less than 1.5 inches of water per week for at least 2 weeks. Thereafter, the Contractor shall apply water for a minimum of 60 days as needed until the sod takes root and starts to grow or until final acceptance, whichever is latest.

3.05 CLEANING

A. Remove debris and excess materials from the project site.

END OF SECTION

Division 33

SECTION 33 01 36
TELEVISING AND INSPECTION OF GRAVITY SEWER SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work specified herein:

1. Furnish all labor, tools, test equipment and materials, including any and all permits required to televise, inspect, video tape, still photograph and document the gravity wastewater collection systems.

1.02 QUALITY ASSURANCE

A. The Contractor shall provide a minimum of three (3) references proving competence in the field of TV/video inspection of wastewater collection systems.

B. Contractor shall do all work with the Engineer present. Contractor shall schedule all work with Engineer.

C. Equipment used shall be in good working order and provide continuous operation during video inspection.

D. Video shall be of good visual quality capable of slow motion and pausing without significant reduction of visual quality.

1.03 SUBMITTALS

A. Contractor shall submit to the Owner a list of equipment and materials to be used on the project, including all permits obtained prior to commencing with the Work.

B. Contractor shall submit to the Owner a copy of all television inspection log sheets and video recordings completed.

PART 2 – PART 2 MATERIALS

2.01 GENERAL

A. Equipment used shall be designed for use in gravity wastewater collection systems. Contractor has the option of an approved equal device or other material than that which is specified. Submittals are required prior to commencement of work.

2.02 TELEVISION CAMERA

A. Camera used shall be 360 degree camera. Camera shall be operative in 100% relative humidity and be specifically designed for the environment. Camera shall have an integral lighting system capable of producing clearly focused, well defined images of the entire periphery of the pipe. The quality of video picture and definition provided shall be to the satisfaction of the Engineer and, if unsatisfactory, equipment shall be removed and replaced with satisfactory equipment.

2.03 MONITOR

A. A high resolution TV monitor screen shall be used. Quality of monitor shall be to the satisfaction of the Owner.

2.04 RECORDING EQUIPMENT

A. Recording equipment shall be furnished by the Contractor to provide a visual and audio recording of all areas in the pipe. Recording system at the site shall be capable of rewind, play back, slow motion and stop motion. The recording shall contain an audio channel for clearly recording the camera locations and operator observations (cracks, leaks, service connections, etc.). The system shall continuously indicate distance, in feet, from manhole to manhole and the manhole to manhole run numbers on the recording.

2.05 WINCHES

A. Variable speed powered remote controlled winches shall be furnished for upstream and downstream manhole locations to control two-way movement of the camera. If a self-propelled camera is used, winches are not necessary.

2.06 POWER SUPPLY

A. Power supply shall be continuous. If night operations occur, Contractor shall supply all labor, power and lighting equipment for operations, traffic safety, permits, etc.

PART 3 – EXECUTION

3.01 GENERAL

A. All sanitary sewer gravity lines shall be televiewed at the Contractor's expense; and a videotape of the subject mains provided prior to acceptance by Owner. Televiewing may only occur after the stabilized subgrade has been installed and satisfactory density tests has been submitted to Owner. Owner must be present during the televiewing. Additionally, the Contractor shall provide by tabular form utilizing "Remote Televiewing Form" (see Owner's Utilities Design Manual).

B. The Contractor shall demonstrate the ability of the video equipment (camera/light/video tape/audio/ photograph system) to the satisfaction of the Owner. Distance meter shall be furnished on the recording. Meter shall be checked using distances between manholes. Meter distances and actual distances shall be consistent.

3.02 TELEVISING/INSPECTION

A. Inspection shall be done one manhole section at a time. Flow into the section being inspected shall be stopped prior to video inspection, unless otherwise approved in writing by the Owner. Contractor shall not begin inspection without the Engineer present unless prior written approval is obtained from the Owner.

B. Contractor shall locate recording vehicle on upstream side of manhole. Contractor shall always record in the downstream direction such that camera movement is with the flow.

C. Contractor shall insert the camera in the upstream manhole after flow restrictions required have been accomplished. Flow into the system being inspected shall be stopped, with the exception of service laterals into the system being inspected. Camera shall be moved through the pipe lines at a moderate speed not exceeding 30 feet per minute. Camera shall be stopped at locations where one or more of the following conditions is observed:

1. Infiltration/inflow sources.

2. Service Laterals.

3. Structural defects including broken pipe; collapsed or collapsing pipe, cracks, deterioration, punctures, etc.

4. Abnormal joint conditions such as misalignments, open joints and joints not sealed.

5. Unusual conditions such as root intrusion, protruding pipes, in-line pipe size changes, mineral deposits, grease and obstructions.

D. Camera shall be stopped long enough for a thorough visual inspection of the conditions. All such conditions as specified above shall be audio recorded on video tape and the inspection log sheet. The camera shall be moved and rotated to obtain optimum view of the conditions. If requested by the Owner's representative, problem areas shall be viewed in the opposite direction by pulling the TV camera from the opposite direction at no additional cost to the Owner.

E. While the camera is stopped at each service connection, the camera shall be rotated so as to be able to view the service connection for a length of time that enables a good visual inspection of the service connection for damage and infiltration. The Contractor will be

responsible for measurements such as service lateral locations, if used for subsequent rehabilitation work.

F. When, during the inspection operation, the television camera will not pass through the entire manhole to manhole section, Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole at no additional cost to the Owner.

3.03 DOCUMENTATION

A. Contractor shall furnish a detailed report and video recording of the system inspected. The minimum information supplied shall be the following:

1. Name and address of Contractor and the Engineer.

2. Name of Owner, system(s) inspected, and Owner's representative involved.

3. Log reports:

   a. Log sheet for each section of pipe

   b. Separate line for each deficiency and location

   c. Corresponding video recording and location of each section of pipe and deficiencies on the video.

4. Video recordings shall be labeled with the following information:

   a. System that is video recorded (street name and manhole to manhole numbers) and log report number corresponding to video recording

   b. Date video was recorded

   c. Contractor's name and representative

   d. Owner's name

5. All video recordings shall be backed up electronically after they are completed.

END OF SECTION

SECTION 33 05 01
LEAKAGE TESTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Testing for any signs of leakage in all pipelines and structures required to be watertight.

1. Test gravity sewers and drain lines by low pressure air testing.

2. Test all other pipelines with water under the specified pressures.

B. Operation of Existing Facilities: Conduct all tests in a manner to minimize as much as possible any interference with the day-to-day operations of existing facilities or other contractors working on the site.

1.02 PERFORMANCE REQUIREMENTS

A. Written Notification of Testing: Provide written notice when the work is ready for testing, and make the tests as soon thereafter as possible.

1. Personnel for reading meters, gauges, or other measuring devices, will be furnished.

2. Furnish all other labor, equipment, air, water and materials, including meters, gauges, smoke producers, blower, pumps, compressors, fuel, water, bulkheads and accessory equipment.

1.03 REFERENCES

A. Codes and standards referred to in this Section are:

1. AWWA C 600 – Installation of Ductile-Iron Water Mains and Their Appurtenances

1.04 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 01.

B. Testing Report: Prior to placing the sewer system in service submit for review and approval a detailed bound report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.

1. Reference Sewer Line Data

a. For Low Pressure Air Testing

1) The length and diameter of the section of line tested (MH to MH) including any laterals.

2) A complete description of test procedures and methods, including:

a) Trench backfilling and sewer cleaning status

b) Type of plugs used and where

c) Depth of sewer, and ground water pressure over sewer pipe

d) Stabilization time period and air pressure

e) Actual air test pressures used if ground water is present

f) The allowed time by specifications

g) The actual test time

h) The air pressure at beginning and end of test

3) The name of the inspector/tester and the date(s) and time(s) of all testing, including any retesting.

4) A description of any repairs made.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 LEAKAGE TESTING

A. All new sewer and water pipelines installed shall be tested for leakage. The test used will be Hydrostatic Testing for pressure lines and Low Pressure Air Testing for gravity lines. Tests to be performed will be indicated by the Engineer and witnessed by the Engineer and Owner.

1. Flushing

a. Piping shall be flushed to remove all sand and other foreign matter. The velocity of the flushing water shall be at least 4 fps. Flushing shall be terminated at the direction of the Engineer. Dispose of the flushing water without causing a nuisance or property damage.

2. Hydrostatic Testing

a. Perform hydrostatic testing of the system as set forth in the following, and shall conduct said tests in the presence of representatives from the Owner and other authorized agencies, with 48 hours advance notice provided.

b. Piping and appurtenances to be tested shall be within sections between valves unless alternate methods have received prior approval from the Owner. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

c. Hydrostatic testing shall be performed with a sustained pressure for a minimum of two (2) hours at 150 psi pressure or 2-1/2 times working pressure, whichever is higher, unless otherwise approved by Owner, for a period of not less than two (2) hours. Testing shall be in accordance with the applicable provisions as set forth in the most recent edition of AWWA Standard C600. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$L = SD (P)^{1/2}$ 133,200

Where,

L = Allowable leakage in gallons per hour;

S = Length of pipe tested in feet;

D = Nominal diameter of the pipe in inches;

P = Average test pressure maintained during the leakage test in pounds per square inch

For 150 psi, L = (9.195 x 10-5) SD

d. The testing procedure shall include the continued application of the specified pressure to the test system, for the one-hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.

e. Should the test fail, necessary repairs shall be accomplished by the Contractor and the test repeated until results are within the established limits. The Contractor shall furnish the necessary labor, water, pumps, and gauges at

specified location(s) and all other items required to conduct the required testing and perform necessary repairs.

3. General. All sanitary sewers and associated service lines shall be constructed watertight to prevent infiltration and/or exfiltration. All new sanitary sewer systems will be subject to low pressure air testing.

4. Low Pressure Air Test

   a. After completing backfill of a section of gravity sewer line, conduct a Line Acceptance Test using low pressure air. The test shall be performed using the below stated equipment, according to state procedures and under the supervision of the Engineer and Owner, with 48 hours advanced notice provided.

      1) Equipment:

         a) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.

         b) Pneumatic plugs shall resist internal bracing or blocking.

         c) All air used shall pass through a single control panel.

         d) Three individual hoses shall be used for the following connections:

         e) From control panel to pneumatic plugs for inflation.

         f) From control panel to sealed line for introducing the low pressure air.

         g) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

   b. Procedures:

      1) All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall be pressurized

      2) to 5 psi. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

      3) After a manhole to manhole reach of pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure,

the plugs shall be placed in the line at each manhole and inflated to 25 psi. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psi minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable", if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psi (greater than the average back pressure of any ground water that may be over the pipe) is greater than the time shown for the given diameters in the following table:

Pipe Diameter in Inches	Minutes
8	4.0
10	5.0
12	5.5
16	7.5
18	8.5
24	11.5

Time in minutes = 0.472 D

D = Diameter of pipe in inches.

4) In areas where ground water is known to exist, the Contractor shall install capped pipe adjacent to the top of one of the sewer lines. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, and a measurement of the height in feet of water over the invert of the pipe shall be taken. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psi. This increases the 3.5 psi to

5) 8.5 psi, and the 2.5 psi to 7.5 psi. The allowable drop of one pound and the timing remain the same).

6) If the installation fails to meet this requirement, the Contractor shall, at his own expense, determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship.

3.02 LEAKAGE TESTS FOR STRUCTURES

A. Structure Leakage Testing: Perform leakage tests of wet wells, tanks, vaults, manholes, and similar purpose structures before backfilling, by filling the structure with water to the overflow water level and observing the water surface level for the following 24 hours.

1. Make an inspection for leakage of the exterior surface of the structure, especially in areas around construction joints.

2. Leakage will be accepted as within the allowable limits for structures from which there are no visible leaks.

3. If visible leaks appear, repair the structure by removing and replacing the leaking portions of the structure, waterproofing the inside, or by other methods approved.

4. Water for testing will be provided by the Owner at the Contractor's expense.

END OF SECTION

SECTION 33 05 03
LAYING AND JOINTING BURIED PIPELINES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Installation of all underground pipelines. Provide pipeline materials, coatings and linings as specified and pipe of the types, sizes and classes shown or specified.

1. Use proper and suitable tools and appliances for the safe and convenient cutting, handling, and laying of the pipe and fittings.

2. Use suitable fittings where shown and at connections or where grade or alignment changes require offsets greater than those recommended and approved.

3. Lay all underground pipelines not supported on piles or concrete cradle in select fill bedding material.

4. Close off all lines with bulkheads when pipe laying is not in progress.

B. Related Work Specified in Other Sections Includes:

1. Section 31 23 16 - Excavation - Earth and Rock

2. Section 31 23 23 - Backfilling

3. Section 33 05 01 - Leakage Tests

4. Section 40 05 19 – Ductile Iron Pipe

5. Section 40 05 31 – PVC Pipe

1.02 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D2774 – Practice for Underground Installation of Thermoplastic Pressure Piping

2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances

3. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile

4. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, C25, 125, 250, 800

5. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges

6. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

7. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe With Threaded Flanges

8. ASTM E 165 - Practice for Liquid Penetrant Examination

9. ASTM E 709 - Practice for Magnetic Particle Examination

1.03 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:

B. Transportation and Delivery: Take every precaution to prevent injury to the pipe during transportation and delivery to the site.

C. Loading and Unloading: Take extreme care in loading and unloading the pipe and fittings.

1. Work slowly with skids or suitable power equipment, and keep pipe under perfect control at all times.

2. Under no condition is the pipe to be dropped, bumped, dragged, pushed, or moved in any way that will cause damage to the pipe or coating.

D. Sling: When handling the pipe with a crane, use a suitable sling around the pipe.

1. Under no condition pass the sling through the pipe.

2. Use a nylon canvas type sling or other material designed to prevent damage to the pipe and coating.

3. When handling reinforced concrete pipe or uncoated steel or ductile iron pipe, steel cables, chain or like slings are acceptable.

E. Damaged Piping: If in the process of transportation, handling, or laying, any pipe or fitting is damaged, replace or repair such pipe or pipes.

F. Blocking and Stakes: Provide suitable blocking and stakes installed to prevent pipe from rolling.

1. Obtain approval for the type of blocking and stakes, and the method of installation.

G. Storage for Gaskets: Store gaskets for pipe joints in a cool place and protect gaskets from light, sunlight, heat, oil, or grease until installed.

1. Do not use any gaskets showing signs of checking, weathering or other deterioration.

2. Do not use gasket material stored in excess of six months without approval.

1.04 FIELD CONDITIONS

A. Repair of Sanitary Sewers and Services: Rebed, in compacted select fill material, sanitary sewers which cross over the new pipe or which cross under the new pipe with less than 12 inches clear vertical separation. Compact the bedding to densities required for new pipeline construction and extend bedding below the sewer to undisturbed earth. Reconstruct sewers damaged by pipeline construction.

1. Furnish and install all materials and do all work necessary for the reconstruction or repairs of sanitary sewers and services.

2. Provide pipe for reconstruction of sanitary sewers and services meeting the appropriate specification requirements.

3. Provide pipe of the same size as the existing sewer or when the same size is not available, use the next larger size of pipe. Obtain approval of joints made between new pipe and existing pipe.

PART 2 – PRODUCTS

A. The materials allowed for buried sewer pipes are PVC, HDPE or fiberglass. Use of ductile iron pipe is not allowed for sewer construction without specific approval of Owner.

PART 3 – EXECUTION

3.01 PREPARATION

A. Dry Trench Bottoms: Lay pipe only in dry trenches having a stable bottom.

1. Where groundwater is encountered, make every effort to obtain a dry trench bottom.

2. If a dry trench bottom has not been obtained due to improper or insufficient use of all known methods of trench dewatering, then the order to excavate below grade and place sufficient select fill material, crushed stone, or 2500 psi concrete over the trench bottom may be given.

3. If all efforts fail to obtain a stable dry trench bottom and it is determined that the trench bottom is unsuitable for pipe foundation, obtain an order, in writing, for the kind of stabilization to be constructed.

4. Perform trench excavation and backfill in accordance with Sections 31 23 16 and 31 23 23.

3.02 INSTALLATION

A. General: Install all piping in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01. Where pipe deflections are used, do not exceed 80 percent of the maximum deflection limits shown in AWWA C600.

1. Arrange miscellaneous pipelines, which are shown in diagram form on the Plans, clear of other pipelines and equipment.

B. Code Requirements: Provide pipeline installations complying with AWWA C600 for iron pipe, AWWA Manual M11 for steel pipe, ASTM D 2774 for thermoplastic pressure piping, and as modified or supplemented by the Specifications.

C. Pipe Laying - General:

1. For pipelines intended for gravity flow, begin pipeline laying at the low end of a run and proceed upgrade.

2. Generally, lay all pipe with bells pointing ahead.

3. Carefully place each pipe and check for alignment and grade.

4. Make adjustments to bring pipe to line and grade by scraping away or filling in select fill material under the body of the pipe.

5. Wedging or blocking up the pipe barrel is not permitted.

6. Bring the faces of the spigot ends and the bells of pipes into fair contact and firmly and completely shove the pipe home.

7. As the work progresses, clean the interior of pipelines of all dirt and superfluous materials of every description.

8. Keep all lines absolutely clean during construction.

9. Lay pipelines accurately to line and grade.

10. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other material from entering the pipe.

D. Pipe Laying - Trenches:

1. Lay all pipelines in trench excavations on select fill bedding, concrete cradle or other foundations as shown, specified or ordered in writing.

2. Properly secure the pipe against movement and make the pipe joints in the excavation as required.

3. Carefully grade and compact pipe bedding.

4. Bell Holes:

a. Cut out bell holes for each joint as required to permit the joint to be properly made and allow the barrel of the pipe to have full bearing throughout its length.

b. Thoroughly tamp bell holes full of select fill material following the making of each joint.

E. Sleeve Type Couplings: For sleeve type couplings, equally tighten diametrically opposite bolts on the connection so that the gaskets will be brought up evenly all around the pipe.

1. Torque Wrenches: Do the final tightening with torque wrenches set for the torque recommended by the coupling manufacturer.

F. Concrete Encasement: Concrete encasement shall be constructed in accordance with Owner's standard details when:

1. A waterline crosses at a depth which provides less than 18 inches clear distance from sewer lines. Encasement shall extend a minimum 10 feet on each side of the point of crossing. Encase the sewer main unless specifically approved by Owner.

2. A waterline running parallel to a sewer line provides less than 10 feet separation. Encase the sewer main unless specifically approved Owner.

3. The Engineer has ordered the line encased. He points of beginning and ending of pipe encasement shall be not more than 6 inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

G. Valve Box Setting: Install valve boxes vertical and concentric with the valve stem.

1. Satisfactorily reset any valve box which is moved from its original position, preventing the operation of the extension valve stem.

2. Replace any extension valve stem which has been damaged so that it can be operated.

H. Identification:

1. Identification Tape: For all types of pipe to be installed, 3-inch detectable marking tape, of appropriate color, shall be placed along the entire pipe length. In all cases, marking tape shall be installed 12 inches to 18 inches below the finished grade during backfill operations. All PVC pipe, PVC fittings, and identification tape shall be color-coded per standards outlined in the Utility Location and Coordinating Council's Uniform Color Code as specified in Section 4 of the Owner's Utilities Operations Manual.

2. Locating Wire: A locating tracing wire shall also be installed with PVC, HDPE and fiberglass pipes and shall be a continuous No. 12 insulated copper tracing wire laid in the trench on top of the utility pipe and attached to the pipe at ten (10) foot intervals. This continuous tracing wire shall run along the entire pipe and be stubbed out at valves, pressure clean-outs and air release valves.

3.03 FIELD QUALITY CONTROL

A. Testing: Test pipelines in accordance with Section 33 05 01.

1. Test valves in place, as far as practicable, and correct any defects in valves or connections.

B. Inspection: Clean, inspect, and examine each piece of pipe and each fitting and special for defects before it is installed.

1. Cut away any lumps or projections on the face of the spigot end or the shoulder.

2. Do not use any cracked, broken, or defective pieces in the work.

3. If any defective piece should be discovered after having been installed, remove and replace this piece with a sound piece in a satisfactory manner at no increase in Contract Amount.

3.04 CLEANING

A. General: Thoroughly clean all pipe before it is laid and keep it clean until it is accepted in the completed work.

B. Removal of Materials: Exercise special care to avoid leaving bits of wood, dirt, and other foreign particles in the pipe. If any particles are discovered before the final acceptance of the work, remove and clean the pipe.

END OF SECTION

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SECTION 33 05 13
SEWER MANHOLES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for providing sewer manholes and all other appurtenances for a complete installation. Provide manholes built without steps and in accordance with the Drawings. Except as otherwise specified, construct sewer manholes of precast reinforced concrete sections conforming to ASTM C 478.

B. Related Work Specified in Other Sections Include:

1. Section 09 96 35 – IET Coating System

2. Section 05 56 00 – Metal Castings

1.02 REFERENCE

A. Codes and standards referred to in this Section are:

1. ASTM C 478 - Specification for Precast Reinforced Concrete Manhole

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings of sewer manholes as specified in Division 01.

B. Quality Control: Submit shop and field test reports of concrete samples tested in an approved laboratory.

1.04 DELIVERY, STORAGE AND HANDLING

A. General: Take every precaution to prevent injury to the manhole sections during transportation and unloading. Unload manhole sections using skids, pipe hooks, rope slings, or suitable power equipment, if necessary, and keep the sections under control at all times. Do not allow the manhole sections to be dropped, dumped or dragged under any conditions. Follow applicable requirements specified in Division 01.

B. Damaged Section: If any manhole section is damaged in the process of transportation or handling, reject and immediately remove such sections from the site, and replace the damaged manhole sections at no increase in Contract Amount.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. For acceptable manufacturers, see the Owner-Approved Materials List.

2.02 MATERIALS

A. Concrete, Steel Reinforcement and Aggregates: Provide reinforced concrete, cementitious materials, aggregates and steel reinforcement conforming to the requirements of ASTM C 478, with Grade 40 reinforcement bars, Type II cement, and a minimum wall thickness of 8 inches.

B. Manhole Frames and Covers: Provide manhole frames and covers as shown on the Lee County Standard details. Castings for manhole frames, covers and other items shall conform to the ASTM Designation A48, Class 35B. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects in positions which would impair their strength, or otherwise make them unfit for the service intended. The seating surfaces between frames and covers shall be machined to fit true so the frames and covers do not shift under traffic conditions or permit entry of storm water from flooding. Lifting or "pick" holes shall be provided, but shall not penetrate the cover. The words "SANITARY SEWER" and "LEE COUNTY" shall be cast in all manhole covers. All manhole frames and covers shall be traffic bearing unless otherwise specified. Frames and covers shall be fully bedded in mortar in the correct finish grade elevation with adjustment brick courses or concrete grade rings installed in conformance with the Drawings.

C. Preformed Joint Sealing Compound: Provide preformed joint sealing compound for joining manhole sections.

D. Concrete Protective Liner: Provide concrete protective liner conforming to 09 96 35.

E. Pipeline Connections: Provide neoprene boots with type 316 stainless steel clamps for joining sewers to manhole riser sections. The unfilled portion of the connection shall be filled with a plastic joint sealing compound (see Owner-Approved Materials List).

F. Inflow Protectors: All manholes under non-traffic bearing areas shall have a plastic inflow protector installed. All manholes under traffic bearing areas shall have an inflow protector installed manufactured from a high-quality 304 stainless steel with a consistent thickness of not less than 18 gage. The inflow shall have a deep-dish bowl design with no less than 8 inches in depth to allow easy and unobstructed removal of the manhole cover. The manhole inflow protector is to be manufactured with a one-piece rubber gasket installed at the factory for a tight, consistent fit. The rubber gasket is to be designed to securely wrap around the entire leading edge of the inflow protector at the point where it comes in contact with the manhole frame and cover. The wrap around rubber gasket is to be manufactured to a width of no less than 3/8 inches, consistent on top and bottom of the

leading edge of the inflow protector. The gasket shall be no more than 3/32 inches thick. The insert removal handle shall be manufactured of a high-quality stainless steel for strength and durability. The handle is installed in such a way that it does not interfere with the installation or removal of the manhole lid. The insert handle will be manufactured to withstand a minimum pull force of 500 pounds before it fails or separates from the insert. The inscription "PROPERTY OF LEE COUNTY UTILITIES" shall be etched, at the base of the handle frame, to provide a long-lasting identification marker for the owner. The inflow protector shall be from the Owner-Approved Materials List.

2.03 SOURCE QUALITY CONTROL

A. At least three cylinders will be taken each day that manhole sections are cast, with batch samples to be designated by the laboratory representative. At least one set of cylinders will be taken from each 9 cubic yards of concrete used in manhole section construction. These samples will be tested for strength. If the samples fail to meet specified minimum concrete strength requirements, all manhole sections manufactured from the concrete from which the cylinders were made will be rejected.

B. The Owner reserves the right to core manholes either at the job site or point of delivery to validate strength of concrete and placement of steel. If cores fail to demonstrate the required strength or indicate incorrect placement of reinforcing steel, all sections not previously tested will be considered rejected until sufficient additional cores are tested, at no increase in Contract Amount, to substantiate conformance to these requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Lifting Holes: Lifting holes through the structure shall be grouted with non-shrink grout.

B. Precast Base: The design of the structure shall include a precast base of not less than 8 inches in thickness poured monolithically with the bottom section of the manhole walls.

C. Joining Manhole Sections: Precast sections shall be joined using a plastic joint sealing compound (see Owner-Approved Materials List) and trimmed prior to grouting. Non-shrink grout shall be used inside and outside for sealing between manhole precast sections and shall be of a type acceptable to Owner and designed for use in water. All openings and joints shall be sealed watertight.

D. Top Termination: Manhole tops shall terminate at such elevations as will permit laying upgrade rings under the manhole frame to make allowances for future street grade adjustments.

E. Drop Connections: Drop connections, where required on precast manholes, shall be manufactured with the manhole elements at the casting yard. Drop manholes shall be as shown on the Drawings.

F. Internal Protection: Unless otherwise approved by Owner, all manholes shall be protected internally from deterioration by either of the following:

1. IET Coating system – surface preparation shall include pressure washing at 5,000 psi, abrasive blasting with black beauty steel slag and application of the IET coat at three (3) different intervals to a total thickness of 125 mils.

2. The liner or coating system must be installed per manufacturer's recommendation and completely protect the structure from corrosion. The liner or coating system must extend and seal onto manhole ring, seal onto and around pipe openings, and any other protrusions, completely cover the bench and flow invert. Provide a five (5)-year unlimited warranty on all workmanship and products. The work which includes the surface preparation and application of the coating or liner system, shall protect the structure for at least five (5) years from all leaks and from failure due to corrosion from exposure to corrosive gases such as hydrogen sulfide.

G. Coal Tar Epoxy: All manhole, wet well, and valve vault exteriors shall be coated with two (2) coats of coal tar epoxy to a minimum thickness of 18 mils. Where no corrosive conditions are expected in a wet well or manhole, with Owner specific written approval, the interior of the manhole may be coated with two (2) coats coal tar epoxy to a minimum thickness of 18 mils.

END OF SECTION

Division 40

SECTION 40 05 00
BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. Piping to be backfilled and/or encased in concrete is considered to be buried piping. Piping that is not buried is considered to be exposed.

B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.

C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.

D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.

E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.

F. The work shall include, but not be limited to, the following:

1. Connections to existing pipelines.

2. Test excavations necessary to locate or verify existing pipe and appurtenances.

3. Installation of all new pipe and materials required for a complete installation.

4. Cleaning, testing and disinfecting as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Division 02 – Existing Conditions

C. Division 05 – Metals

D. Division 09 – Finishes

E. Division 26 – Electrical

F. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment

G. Division 46 – Water and Wastewater Equipment

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

A. The Contractor shall furnish to the Owner (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.

B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with Section 01 33 00 – Submittals. In addition to the requirements of Section 01 33 00 – Submittals, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.

C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

PART 2 – PRODUCTS

2.01 GENERAL

A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Part 3.

C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

D. All buried piping shall have restrained joints for thrust protection unless otherwise specified or shown on the Drawings. All exposed piping shall have flanged joints, unless otherwise specified or shown on the Drawings.

E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 MODULAR MECHANICAL SEALS

A. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve/penetration shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations.

2.03 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters shall be furnished as required and as shown on the Drawings.

B. Flanged coupling adapters shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.

C. All flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs unless otherwise approved by the Engineer.

D. Flanged coupling adapters shall be manufactured by Smith-Blair Model 912 or 913, Romac Industries Model FCG or FC 400, Dresser Industries Model 128-W, or equal.

E. Flanged coupling adapters shall be provided with manufacturer’s fusion bonded epoxy painting system.

2.04 RESTRAINED FLANGED COUPLING ADAPTERS

A. Description: Wedge style restrained flanging system for adapting and restraining plain end pipe to flanged end pipe or fitting.

B. Products and Manufacturers: Provide one of the following:

1. Series 2100, as manufactured by EBAA.

2. Or equal.

C. Pressure and Service: Same as connected piping.

D. Material: Ductile iron.

E. Gasket: Recommended by the manufacturer.

F. Bols and Nuts: Alloy steel, corrosion-resistant, primer-coated.

2.05 DISMANTLING JOINTS

A. Dismantling joints shall be furnished at locations shown on the Drawings.

B. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall be rated for the same pressure as the connected piping.

C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.

D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer’s recommendations.

E. Dismantling joints shall be provided with manufacturer’s fusion bonded epoxy painting system.

F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

2.06 TAPPING SLEEVES AND TAPPING SADDLES

A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All taps shall be machine drilled; no burned taps will be allowed.

2.07 UNIONS

A. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.08 RUBBER EXPANSION JOINTS

A. Rubber-type Expansion Joints:

1. General:

a. Use rubber-type expansion joints at all expansion joint locations, except where other types of expansion joints are shown or specified.

2. Manufacturers: Provide products of one of the following:

a. General Rubber, Style 1101.

b. Mercer Rubber Company.

c. U.S. Rubber Supply Company, USA.

d. Or equal.

3. Liquid Service:

a. Construct expansion joints of neoprene or Buna-N suitable for temperatures up to 180 degrees F.

b. Expansion joints shall be filled arch type. Provide backup or retaining rings as recommended by expansion joint manufacturer.

c. Expansion joints shall be yoked in manner to provide transmission of tension loading to which expansion joint may be subjected during system operation. Compressive or lateral movement of expansion joint shall not be impaired by yoking system. Details of expansion joint yoking shall be submitted to Engineer for approval.

4. Harnessing:

a. Harness each expansion joint against thrust for test pressure in piping.

b. Harnessing shall be by control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion joint.

c. Provide epoxy-coated triangular plates to connect tie rods to flanges. Tie rods shall be Series 300 stainless steel. Rubber washers shall be used between triangular plates and tie rods.

PART 3 – EXECUTIONIT

3.01 INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.

C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.

D. All excavation required by this Contract shall be unclassified. No additional payment will be made for rock excavation required for the installation of pipe or structures shown on the Drawings.

E. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.

F. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.

G. Joint deflection shall not exceed 75% of the manufacturer's recommended deflection. Excavation and backfilling shall conform to the requirements of Division 31, and as specified herein. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.

H. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall any of the materials be dropped or dumped into the trench.

I. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

J. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

K. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.

L. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.

M. At the close of each work day, the end of the pipeline shall be tightly sealed with a cap or plug so that no water, dirt, or other foreign substance may enter the pipeline, and this plug shall be kept in place until pipe laying is resumed.

N. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.

O. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.

P. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.

3.02 JOINTS IN PIPING

A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.

B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed, and the condition corrected.

C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.

D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of

mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.

E. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.

F. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel

Notes:
● signifies dielectric isolation is required between the two materials noted.
Consult Engineer for items not listed in table.
Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment.
Contractor shall include all isolation descriptions with piping submittals.

G. Joints in polypropylene and polyvinylidelene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.03 FLUSHING AND TESTING

A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Gravity sewer piping shall be flushed and tested as specified in Division 33 specifications. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 40 06 20 – Process Pipe, Valve and Gate Schedules and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.

C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.

D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones,

pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.

E. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.

F. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

G. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.

H. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

I. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

3.04 PAINTING AND COLOR-CODING SYSTEM

A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition and in accordance with Section 40 05 97 – Piping and Equipment Identification Systems. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09 90 00 – Painting and Coating.

B. All piping specified in this Section shall be painted in accordance with Section 09 90 00 – Painting and Coating.

END OF SECTION

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SECTION 40 05 07
PIPE SUPPORTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 03 – Concrete

B. Division 05 - Metals

C. Section 40 05 00 – Basic Mechanical Requirements

1.03 SUBMITTALS

A. Pipe support submittals will not be reviewed prior to review and acceptance of pipe layout submittal. Pipe support submittal shall be fully coordinated with approved pipe layout submittal. Contractor shall use approved piping layout submittal drawings to show proposed pipe support type and location with accurate dimensions to demonstrate that supports meet all specified requirements.

B. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01 33 00 – Submittals, Section 40 05 00 – Basic Mechanical Requirements and other referenced Sections above.

1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type support.

2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.

3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer, licensed in the State of Florida in which the project is located, showing that the piping support system complies with the specified requirements, including all building code requirements pertaining to support of piping and other non-structural components.

4. Table showing the manufacturer's recommended hanger support spacing for PVC, CPVC and FRP pipe for the services listed in Section 40 06 20 – Process Pipe, Valve and Gate Schedules.

PART 2 – PRODUCTS

2.01 GENERAL

A. The Contractor shall be responsible for the design of all piping support systems unless noted otherwise herein or specifically detailed on the Contract Drawings. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a pipe support design sealed by a Professional Engineer, licensed in the State or Commonwealth in which the project is located. Standard details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor designed pipe supports that will be acceptable.

B. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.

C. Where special pipe support fabrications are required, products and execution shall be as specified in Division 05 and other related and referenced Sections of the Specifications.

D. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if the supports are strengthened to support the additional load.

E. Contractor's pipe support design should include, but not be limited to, the following criteria and loads imposed on the piping system:

1. Thrust Loads based on the design pressures as specified in Piping Schedules in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.

2. Dead loads and live loads per the latest version of ASCE/SEI 7 or the local building code if more stringent. Loads shall include, but not be limited to, the following:

    a. Weight of pipe

    b. Weight of pipe contents

    c. Wind loads

3. Loads associated with thermal expansion and contraction of the piping system over the full range of potential temperatures the piping system could experience that should include, but not be limited to, the following:

    a. Ambient temperature range per local historical weather data (historic high and low obtained from NOAA)

    b. Process operating temperature range

    c. Exposure to sunlight where applicable

4. Additional pipe support design considerations shall include the following:

    a. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.

    b. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.

    c. The design, sizing and spacing of anchors, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each support. The minimum anchor size shall be ½ inches in diameter.

2.02 HANGERS AND SUPPORTS

A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from seismic and/or wind. Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.

    1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 304L stainless steel.

    2. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, seismic, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along

pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hangar and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

B. Hangers and supports shall conform to the following requirements:

1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.

2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.

3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.

4. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless-steel hangers.

5. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).

6. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.

7. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 316 stainless steel.

C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Support piping connections to equipment by pipe support and not by the equipment.

B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.

C. Support no pipe from the pipe above it.

D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.

E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.

F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports, and hydraulic thrust protection are submitted.

END OF SECTION

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SECTION 40 05 19
DUCTILE IRON PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".

B. Ductile iron pipe (DIP) of the sizes shown or specified shall conform to ANSI A21.51 (AWWA C151), Grade 60-42-10 for ductile iron pipe centrifugally cast in metal molds or sand-lined molds. All ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) for thickness design and shall be supplied in 18 or 20 foot nominal lengths or as required to meet the requirements of the Drawings. Fittings and specials shall be cast iron or ductile iron, conforming to the requirements of ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153).

C. Minimum Class 53 pipe shall be used for flanged spools.

D. Reference Section 40 05 00 – Basic Mechanical Requirements

E. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, for pressure rating requirements for specific applications.

PART 2 – PRODUCT

2.01 DUCTILE IRON PIPE AND FITTINGS

A. All pipe and fittings shall be ceramic epoxy lined (Protecto 401). All exposed DIP and fittings shall have a shop applied prime coat in accordance with Section 09 90 00 – Painting and Coating.

B. Requirements for various types of joints are described in the following paragraphs. Unless otherwise noted herein or on the Drawings, all exposed ductile iron piping shall have flanged joints.

C. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges. All flanges and fittings shall conform to the requirements of ANSI B16.1. Flanges shall be ductile iron and shall be of the threaded or screw on type. The face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges. Flanged pipe shall conform to the

requirements of ANSI Specification A21.15, (AWWA C115). Pipe lengths shall be fabricated to meet the requirements of the Drawings.

D. Gaskets shall be the "Ring Gasket" type, 1/8-inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suitable for the service intended. Gaskets for glass lined pipe shall be TORUSEAL flange gasket, or equal. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B carbon steel and be in accordance with ANSI A21.10, (AWWA C110). The bolts shall have hexagonal heads and nuts, no washers shall be used.

E. Mechanical joints and fittings shall conform to the requirements of ANSI A21.11, (AWWA C111). Joints shall be made employing a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. If required by installation conditions, pipe and fittings shall have cast-on lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.

F. Bolts for mechanical joints shall be high strength corrosion resistant low-alloy steel tee-head bolts with hexagonal nuts.

G. Mechanical coupling joint pipe and fittings shall be split type, shouldered end. Coupling materials shall be malleable iron. Couplings shall have a minimum pressure rating and service equal to that of the connected piping. Gaskets shall be of rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated. After installation, buried couplings shall receive two heavy coats of coal tar epoxy (min. 24 mil thickness) which is compatible with the finish of the couplings. Couplings shall be as manufactured by Victaulic Company of America Style 31, or equal.

H. Restrained joint pipe shall consist of factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation, and factory welded retainer beads or rings on the spigot of the pipe. All components of the bolted or snap ring assemblies shall be constructed of corrosion-resistant, high strength, low-alloy steel. Restrained joint pipe shall be Flex-Ring or Lock-Ring type joints as manufactured by American Cast Iron Pipe Company, HP LOK or TR Flex as manufactured by US Pipe, Bolt-Lok or Snap-Lok as manufactured by Griffin Pipe Products, TR Flex or Super Lock as manufactured by Clow Water Systems Co., or approved equal.

I. Restrained fittings for pipe systems 14-inches in diameter and smaller shall be Mechanical Joint fittings with restraint assemblies such as Stargrip by Star Pipe Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, Grip Ring by Romac, or approved equal. Where threaded-rods are allowed, the rods and tabs shall be designed for the specified restraint system design pressure, shall have lengths less than 10 feet

between fittings, and shall be painted with two heavy coats of coal tar epoxy after installation.

J. The manufactured systems for thrust restraint indicated above shall be used where restrained joint ductile iron pipe and fittings are specified or indicated on the drawings. Gripping gaskets are not an acceptable form of restraint. Thrust restraint and harnessing systems such as threaded-rods, friction clamps, retainer glands shall be used only where specifically specified herein, indicated on the drawings or if allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. Concrete thrust blocks may be used in accordance with the schedule indicated on the drawings, if applicable.

END OF SECTION

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SECTION 40 05 31

PVC PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be manufactured in accordance with ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80, or SDR35, as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D1784 and D1785. Fittings shall conform to the following standard specifications:

1. Socket Type: (Schedule 40); ASTM D2466

2. Socket Type: (Schedule 80); ASTM D2467

D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment except at true (double) union valves. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed. Where flanged piping is used with chemical systems, the gasket material shall conform to the requirements of the following table. Flange bolts shall be type 316 stainless steel minimum, with higher grade materials used where necessary for fluid (chemical) compatibility.

Chemical	Elastomer Material
Polymer	FKM

E. Elastomeric materials shall be in accordance ASTM F-477. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

Non-Chemical Service	Elastomer Material
Sanitary Gravity Sewer	Neoprene, nitrile
Reuse Water	EPDM

F. Solvent cement for socket type joints shall conform to ASTM D2564 for PVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

G. PVC pressure rated pipe (PR 160) shall be in sizes between 1 1/2 inches and 12 inches and shall conform to all the requirements of ASTM D1784 and ASTM D2241 and shall be a minimum of SDR 26 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (1± inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed materials shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM D2672. Elastomeric gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 135 psi for all sizes when tested in accordance with ASTM D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 500 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. The pipe shall be designed to pass for 1000 hours a sustained test pressure of 340 psi when tested in accordance with ASTM D1598, as referenced in ASTM D2241.

H. Fittings for PR 160, SDR 26 shall be PVC and designed for the pipe being supplied.

I. Acrylonitrile-butadiene-styrene (ABS) shall conform to the requirements of ASTM D2661. Pipe and fittings shall have socket type couplings with solvent cement joints. Solvent cement shall conform to ASTM D2235.

J. Gravity sewer pipe and fittings shall be PSM polyvinyl chloride (PVC) and shall conform to the requirements of ASTM D3034 with a maximum SDR of 26. Pipe and fittings shall have bell and spigot ends with O-ring rubber gasketed, compression type joints. Joints shall conform to the requirements of ASTM Specification D3212. Reruns of reclaimed

materials shall not be accepted. Each wall pipe shall be of the same class and type as the piping to which it is joined.

K. Perforated and closed drainage pipe and fittings shall be rigid PVC pipe, Schedule 40 unless otherwise shown or specified with solvent welded type joints, or approved equal. Pipe shall be slotted or have two rows of 1/4-inch diameter holes spaced 4-inches apart along the circumference of the pipe. Longitudinal spacing of holes shall be 5-inches maximum.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Use care in handling and installing pipe and fittings. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation and with approval of the Engineer. Under no circumstances shall pipe or fittings be dropped either into the trench or during unloading. The interior of the pipe shall be kept clean of oil, dirt, and foreign matter, and the machined ends and couplings shall be wiped clean immediately prior to jointing.

B. Each length of pipe and fitting shall be marked with the nominal size, the SDR designation, the name of the manufacturer or his trademark, and the date of manufacture.

C. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.

D. Plastic piping shall not be installed when the temperature is less than 60 degrees F except as otherwise recommended by the manufacturer and approved by the Engineer.

3.02 TESTING

A. Gravity sewers shall be required to pass a leakage test before acceptance.

B. All polyvinyl chloride sewer pipe shall be subject to deflection testing assuring that the maximum deflection of 5% has not been exceeded. Any pipe failing this test is subject removal and replacement at the Contractor's expense. Do not use pipe rounders.

END OF SECTION

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SECTION 40 05 51
VALVES, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.

B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A-126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."

C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittals and Section 46 00 00 – Equipment General Provisions:

1. Performance tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Shop Drawings conforming to the requirements of Section 01 33 00 – Submittals, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the

Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

3. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) where required in the individual equipment specifications.

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.

D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes and

shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.

B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.

C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.

D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.

3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.

2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.

3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.

5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

END OF SECTION

SECTION 40 05 57
VALVE OPERATORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.

B. Valve operators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.

C. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer.

D. The valve operators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittals and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the force required to operate all valves is as specified herein.

1.03 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 01 78 36 – Warranties and Bonds and Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years.

PART 2 – PRODUCTS

2.01 GENERAL

A. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.

B. Quarter turn valves 8” and greater in size shall have geared operators. Gate valves 14” and greater in size shall have geared operators.

C. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:

1. Exposed valves up to 6-inch shall be lever operated (except gate valves).

2. Exposed gate valves shall be handwheel operated.

3. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.

B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.

C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.

D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24”.

F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.

G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions.

3.02 INSTALLATION

A. All valve operators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves and motor controls.

B. Valve operators shall be factory coated in accordance with the manufacturer's standard paint system.

3.03 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.

2. Submit written certification that:

    a. Shop tests for the electrical system and all controls were successfully conducted;

    b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.

3. Each operator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:

    a. Current at maximum torque setting

    b. Torque at maximum torque setting

    c. Flash Test Voltage

    d. Output Speed or Operating Time

e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

A. Field testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Valve operators shall be field-tested together with the associated valves.

2. Test all valves at the operating pressures at which the particular line will be used.

3. Test all valves for control operation as directed.

4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.

3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.

3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be

tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.

4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment and General Provisions.

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SECTION 40 05 61
SCREW CONVEYOR SLIDE GATES

PART 1 – GENERAL

1.01 REQUIREMENTS

A. The Contractor shall furnish, install, test, and place in satisfactory operation screw conveyor slide gates and actuators, complete with all necessary mounting hardware, and accessories, as specified herein, shown on the Drawings, and as required for a complete and operable system.

B. The slide gates and actuators shall be provided by the original equipment manufacturer for the existing Atara U320 shaftless screw conveyor system, scheduled to remain.

C. Gates shall be oriented as shown on the Drawings with all parts requiring maintenance and/or replacement being readily accessible from the existing elevated catwalk.

1.02 REFERENCES

A. AGMA - American Gear Manufacturers Association

B. AWS - American Welding Society

C. NEMA - National Electrical Manufacturers Association

D. AFBMA - Anti Friction Bearing Manufacturers Association

E. ANSI - American National Standards Institute

F. NFPA - National Fire Protection Association

G. ASTM - American Society for Testing Materials

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittals and Section 46 00 00 – Equipment General Provisions.

1. Catalog information and complete dimensional drawings of the gate and actuator assembly.

2. Layout drawing showing the orientation and location of gates, actuators, supports, and appurtenances.

3. Electric actuator wiring diagram and data sheet with FLA and LRA indicated.

4. Weight of complete valve and actuator assembly.

5. Manufacturer's installation, handling, and storage instructions.

6. O&M manuals.

7. Warranty.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The screw conveyor slide gates shall be provided by the existing screw conveyor manufacturer Atara Equipment, Ltd., or approved equal.

2.02 GENERAL REQUIREMENTS

A. Comply with requirements under Section 40 05 57 – Valve Operators and Electric Valve Actuators.

B. These specifications shall be considered as minimum requirements. The Contractor or Equipment Supplier shall add such additional features as are necessary for satisfactory operation and functioning of the conveying equipment.

C. Equipment shall conform to Section 46 00 00 – Equipment General Provisions unless modified herein.

D. Equipment provided shall be suitable for a humid and corrosive environment.

E. Structural design shall be in accordance with American Institute of Steel Construction AISC Standards.

F. Stationary gate guides shall be constructed of UHMW polyethylene and stainless steel. Gate rollers shall be corrosion resistant stainless steel. The gate shall be designed to be jam-proof and shall incorporate an adjustable blade scraper in the frame design.

G. Sealing gasketing subject to sliding shall be self-lubricating.

H. All materials of construction for gate frame shall be fabricated from structural shapes and plates.

I. Stainless steel shall be shop brush blasted to remove heat tint scale and provide a uniform finish and passivated.

J. All gaskets shall be minimum 1/8” with a minimum Durometer 50 hardness.

2.03 MATERIALS OF CONSTRUCTION

A. Materials of construction shall be as follows.

Component	Material
Frame	ASTM A276 type 304 stainless steel
Slide	ASTM A276 type 304 stainless steel
Guides, liners, and spacers	UHMW
Rollers	Type 304 stainless steel
Roller guides	ASTM A276 type 304 stainless steel
Scraper blade	UHMW
Gaskets	Neoprene

2.04 SLIDE GATES

A. Gates shall be heavy duty, single blade slide gates, with self-cleaning internals.

B. Gate wiping seals shall be made of adjustable UHMW polyethylene and shall contact the top of the gate blade along the perimeter of the throat opening.

C. Gates shall be capable of operating independently and each gate shall be provided with its own electric actuator.

D. Slide shall be a minimum of 3/8” thick.

E. Guides shall be a minimum 3/8” thick.

F. The minimum thickness of all other gate components shall be 1/4-inch. Greater thickness shall be provided, as required based on actual actuator thrust forces.

G. The slide gates shall include heavy duty bolted cover plates arranged to cover the gate when in the retracted position and to facilitate maintenance.

H. Slide gate frames shall be C-channel frame designed to withstand the thrust of the actuator.

I. The slide gates shall be designed for a head of 10 psig.

2.05 CHUTES

A. Conveyor Chutes

1. Existing flexible canvas discharge chutes shall be reused. Modify in the field as required to accommodate the wider slide gate lay length and maintain approximately 6 inches between bottom of chute and top of truck bed.

2. Provide new full-face gaskets at each flanged joint included those joints connecting conveyor discharge to slide gate and slide gate to discharge chute.

2.06 ELECTRIC LINEAR ACTUATORS

A. Manufacturer

1. Electrical linear actuators shall be:

a. Harold Beck Model 42-103.

b. Or approved equal

B. Electrical Requirements

Parameter	Value
Power supply	120V, 1 ph, 60 Hz
Maximum Rated Horsepower, hp	0.75
Enclosure	NEMA 4X
Service	Open/close (extend/retract)

C. Actuator shall provide simple open/close (extend/retract) operation.

D. Limit switches at each end of travel shall stop the drive and be available for use in external signaling of actuator status.

E. Maximum stroke length operating time from be 50 seconds with 1,000 lbs. thrust. Verify with slide gate manufacturer actual stroke length and thrust requirements.

F. Operating Conditions: - 40° to 185° F, 0 to 99% relative humidity.

G. Minimum Step: 0.1% of span

H. Hysteresis: 0.25% of span at any point.

I. Over-thrust Protection: If the output thrust of the drive exceeds 150% of the drive rating, the motor shall shut off.

J. Stall Protection: If the motor runs in one direction for more than 300 seconds (configurable from 30 to 300 seconds), the motor shall shut off.

K. Over-travel Protection Switches: Two Form C (Retract and Extend) switches shall provide over-travel protection.

L. Auxiliary Switches (Field Adjustable): Provide two Form C auxiliary switches.

M. Local Control: Provide Open/Close/Remote position switch integral to the actuator to allow manual operation at the slide gate or remote operation when in Remote.

N. Handwheel: Provides manual override handwheel, which operates without electrical power. Provide chainwheel to allow or operation of override handwheel from lower floor level. Secure the chain at edge of wall to prevent the chain from handing in the path of truck travel.

O. Motor shall be capable of a minimum of 60 starts per minute, outdoor rated, corrosion resistant.

P. Enclosure: Precision-machined aluminum alloy castings, painted with corrosion resistant polyurethane paint, to provide a rugged, dust-tight, weatherproof enclosure.

Q. Control Interface: The gates/actuators shall be factory pre-assembled, factory tested, and factory pre-wired. Any field connections shall terminate on screw-type terminal boards located in waterproof junction boxes. Actuator shall provide the following signals:

1. Gate fully opened.

2. Gate fully closed.

3. Open gate command.

4. Close gate command.

5. Fault.

6. In Remote mode.

R. Remote Manual Control Station:

1. Provide mirror image manual actuator controls in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Mount remote manual control stations as indicated on the Drawings. Manual control station controls shall

include Hand–Off-Auto Selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.

a. When the HOA is in the “Hand” position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.

b. When the HOA is in the “Off” position, the actuator shall not operate.

c. When the HOA is in the “Auto” position, the actuator shall be controlled by remote inputs to the valve actuator.

2.07 SUPPORTS

A. Contractor shall provide all supports for gate and actuator as shown on the Drawings. Type and location of supports shall be approved by Engineer. Supports shall be of the same material as the gate.

2.08 SPARE PARTS

A. Slide gate manufacturer shall provide any special tools required for servicing and/or maintenance of the slide gates and actuators.

B. The following spare parts shall be provided for each gate:

1. One set of piston rod bushings.

PART 3 – EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

A. The services of a qualified manufacturer’s technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions. Field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation, Testing, and Startup	1	1

3.02 INSTALLATION

A. Work shall be coordinated with the existing screw conveyors, discharge chutes, cat-walks, and supports to avoid conflicts and interferences.

B. Slide gates shall mount to the existing conveyor outlet chute top flange bolting pattern. Verify dimensions in the field.

C. Installation shall be in accordance with the manufacturer's installation instructions.

3.03 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.

3.04 FIELD TESTING

A. Preliminary and final field tests shall be performed in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

B. After installation, test each gate for a minimum of 5 full cycles of operation to test for any deficiency in time of travel, ease of travel, apparent full seating and unseating, and proper response for control interface in manual and automatic operation and status signal changes.

C. After startup, test each gate under actual intended operation to check for drip leaks when in the closed position. Preliminary tests for leakage may be performed as directed by the manufacturer but final tests shall be under actual working conditions. Any drip leaks found shall be corrected at no additional cost to the Owner.

END OF SECTION

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SECTION 40 05 62
PLUG VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. The Contractor shall furnish and install, complete with all assemblies and accessories, all plug valves shown on the Drawings and specified herein.

1.02 SUBMITTALS

A. As required in Section 40 05 51 – Valves General, and Section 01 33 00 – Submittals.

B. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit, utilizing the format specified in Section 46 00 00 – Equipment General Provisions.

C. Performance tests shall be conducted in accordance with the latest revision of AWWA C517 and affidavits shall conform to the requirements of the Specifications.

PART 2 – PRODUCTS

2.01 ECCENTRIC PLUG VALVES

A. General

1. Plug valves shall be of the non-lubricated, eccentric seating, full port plug type with synthetic rubber-faced plugs as manufactured by DeZurik Company Model PEF, Kennedy, Clow, or approved equal.

2. All valves shall be provided with limit stops and rotate 90º from fully-open to fully-shut.

3. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch.

4. Valve body shall be epoxy coated ductile iron, cast iron or semi-steel, unless specified otherwise, and coated as specified herein.

5. Seats shall have a welded overlay of one-half inch wide 90 percent pure nickel and machined to a finish containing no stress cracks. Minimum overlay thickness shall be one-eighth inch. The plug shall contact only the raised nickel seat surface.

6. Plug facings shall be of Chloroprene and completely suitable for use with domestic sewage.

7. The shaft seal shall be V-Type with minimum four sealing rings and a follower ring. Stuffing box shall be designed with a space between the bonnet and actuator so that packing can be inspected, adjusted, and replaced without removing the valve actuator.

8. Bearings shall be sleeve type with the following materials.

    a. Sizes 4 – 18 inch: Sintered, oil impregnated, permanently lubricated type 316 stainless steel.

9. Provide PTFE ring on the shaft between plug and body to serve as a thrust bearing and grit excluder.

10. Unless otherwise shown, all exposed valves 4-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150-pound standard with face-to-face dimensions of standard plug valves.

11. All valves 6" and larger shall be equipped with gear actuators. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. All actuator shafts shall be supported on permanently lubricated bronze bearings.

12. Manual operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.

13. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under the specified pressures and flow conditions.

14. Each valve shall by hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

15. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

16. The valve port area shall meet or exceed standard pipe area per ASME/ANSI B36.10M. Round ports are not acceptable. Port shall be a rectangular shaped cross section designed to seat with a cylindrical plug. Port cross-sectional area shall be equal to or greater than the cross-sectional area of the upstream pipe.

17. The flow passage through the valve body shall have a cross-sectional area equal to or greater than the cross-sectional area of the upstream pipe at any point along the valve flow axis.

18. Plug shall have a cylindrical seating surface and eccentrically offset from the center of the shaft. Plug shall not contact seat until at least 90 percent closed.

PART 3 – INSTALLATION

A. Install in accordance with the manufacturer's recommendations.

B. Install and test in accordance with Section 40 05 51, Valves – General.

C. In applications with suspended solids in the liquid or for dirty gases:

1. Vertical pipelines: Install valve with the seat end at the top.

2. Horizontal pipelines: Install valve so plug rotates upwards when opening. Higher pressure side of the valve, when closed, shall be on the valve end opposite of the seat.

END OF SECTION

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SECTION 40 05 65.23
CHECK VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 SWING CHECK VALVES

A. Check valves larger than 3-inches shall be rated for a minimum working pressure of 250 psi and shall be full flow body flexible disc type

B. Check valves shall be Swing-Flex as manufactured by Val-Matic, or approved equal.

C. The valves shall be designed, manufactured, tested and certified to American Water Works Association Standard ANSI/AWWA C508.

D. The valves shall have flanges with drilling to ANSI B16.1, Class 125.

E. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve.

F. Valve shall be capable of passing a 3 in. solid. The seating surface shall be on a 45-degree angle to minimize disc travel.

G. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion device (not in this Contract) without special tools or removing the valve from the line.

H. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content.

I. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator (not in this Contract).

J. The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface and reinforced with alloy steel. The flex portion of the disc shall contain nylon reinforcement. Non-slam closing characteristics shall be provided through

a short 35 degree disc stroke and a memory disc return action to provide a cracking pressure of 0.25 psig.

K. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures.

L. Materials of Construction

1. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.

2. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.

M. Valve exterior to be painted with manufacturer's standard coating system, appropriate for a corrosive environment.

N. For corrosion protection, the interior ferrous surfaces of all check valves used in sewage applications shall be coated with a factory applied, two-part epoxy coating to a minimum of 20 mils thick.

2.02 WARRANTY

A. All valves shall have a three-year 100% replacement guarantee.

PART 3 – EXECUTION

A. Install in accordance with the manufacturer's recommendations.

B. Install and test in accordance with Section 40 05 51, Valves – General.

END OF SECTION

SECTION 40 05 68.23
MISCELLANEOUS VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. Valves shall be constructed of materials suitable for the intended service.

1.02 SUBMITTALS

1. Provide submittals as specified under Section 40 05 51, Valves – General and Section 01 33 00, Submittals.

1.03 WARRANTY

A. Provide manufacturer's standard 5-year warranty.

PART 2 – PRODUCTS

2.01 AIR AND VACUUM/PRESSURE AIR RELEASE VALVES

A. Manufacturer

1. Air/vacuum and combination air/vacuum and air release valves shall be as manufactured by:

   a. H-TEC Inc.

   b. Or approved equal.

B. Wastewater air and vacuum/pressure air release valve assemblies shall be installed at all the locations specified herein or indicated on the Drawings and shall be installed complete with all appurtenant piping and valves as required for a complete and operable installation. All working parts shall be corrosion resistant. The body of the valves shall be conical shaped to maintain maximum air gap to prevent contact between the sewage and the seal. The valves shall be constructed with materials as follows:

1. Body: Type 316 stainless steel.

2. Diaphragm: Buna HNBR or NBR.

3. Debris shield: Homopolymer.

4. Float, debris screen, diaphragm holder: Thermoplastic.

5. Hardware: Type 316 stainless steel.

C. The valves shall be designed for a minimum working pressure of 250 psi and a test pressure of 360 psi. The valves shall include isolation valve provided by Contractor. All air valves shall be provided with "soft seating" material to provide drip tight closure at 0 psi. The exhaust from the valve shall be piped to a suitable disposal point. All valves 1-inch diameter and larger shall have a 1/4-inch minimum diameter blowdown valve.

D. The valves shall include both a primary and secondary debris screen to prevent solids from entering sealing area.

E. The air valve design shall provide water hammer inhibition.

F. Provide belt filter press feed pump discharge air valves as specified herein and as shown on the Drawings.

1. Quantity: As indicated on the Drawings.

2. Type: Air release only.

3. Service: Wastewater sludge with solids concentration between 0.5% and 1.0%.

4. Location: Outside.

5. Size: 2-inch.

6. Inlet End Connection: NPT, threaded

7. Discharge Connection: NPT, threaded.

8. Accessories: Isolating valve and drain plug.

G. The air and vacuum valves and pressure air release valves shall be similar to the following types and models listed.

Location	Size	Manufacturer and Model No.
Belt filter press feed pump discharge header	2"	H-Tec Model 986

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and test in accordance with Section 40 05 51, Valves – General.

END OF SECTION

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SECTION 40 05 97
PIPING AND EQUIPMENT IDENTIFICATION SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all components of the system for identification of piping and equipment as specified hereinafter. The system shall include the application of color coding to all new and altered plant piping. The Contractor shall paint the equipment and piping of all Contracts in the colors herein specified, and in accordance with the requirements of Section 09 90 00 – Painting and Coating.

B. In addition to the legends specified herein, the Engineer may order the Contractor to furnish and install additional identification legends and arrows at no additional cost to the Owner. Such additional signs may be requested near completion of the work and shall be limited to no more than five (5) signs for each type specified herein. The legends and color combinations for additional signs shall conform to the requirements specified herein.

C. The Contractor shall submit a schedule of the colors and designations proposed in accordance with Section 01 33 00 – Submittals and this Section. A minimum of four (4) color charts with cross-references to the colors listed herein shall be included with the Submittal.

D. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 BURIED PIPING

A. Buried piping shall be marked with marking tape at a maximum depth of 12 inches.

B. Locating wire is required for all pressurized pipelines.

2.02 PIPING BAND

A. All new and altered piping shall receive identification bands. Such bands shall be 6-inches wide, neatly made by masking, and spaced at intervals of 30-inches on centers regardless of the diameter of the pipe being painted. The Contractor may use approved precut and prefinished metal bands on piping, in lieu of the masked and painted bands, where approved by the Engineer.

2.03 PIPING IDENTIFICATION LEGEND

A. The Contractor shall apply identification legends to all types and sections of piping as shown on the Drawings or as designated by the Engineer. Such legends shall be in the form of plain block lettering giving the name of the pipe content in full or abbreviated form and showing the direction of flow by arrows. All lettering and arrows shall be of the plastic snap-on type, Seton nameplate "setmarks", or equal, or they shall be formed by stenciling in an approved manner using white or black as directed and shall have an overall height in inches in accordance with the following table:

Diameter of Pipe or Pipe Covering	Height of Lettering
3/4 to 1-1/4 inches	1/2-inches
1-1/2 to 2-inches	3/4-inches
2-1/2 to 6-inches	1-1/4-inches
8 to 10-inches	2-1/2-inches
Over 10-inches	3-1/2-inches

B. Identification lettering shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each fifteen (15) feet in pipe length, and shall be properly inclined to the pipe axis to facilitate easy reading. In the event lettering and arrow identifications are required for piping less than 3/4-inch in diameter, the Contractor shall furnish and attach approved color-coded tags where instructed.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 06 20

PROCESS PIPE, VALVE, AND GATE SCHEDULES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 - Basic Mechanical Requirements.

1.02 PIPING SCHEDULES

A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.

B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

PIPE SIZE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	TEST PRESSURE
4-IN AND LARGER	DIP	FLANGED (EXPOSED)	CLASS 53	(1)
		RESTRAINED (BURIED)	PRESSURE CLASS 350	
6-IN TO 12-INCH	PVC	PUSH ON (BURIED)	SDR 35	(1)
LESS THAN 4-IN	PVC	SOCKET	SCH 80	(1)
(1) Test at 150 percent of working pressure or 10 psi, whichever is greater.				

1.03 VALVE SCHEDULES

A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.

B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

SERVICE	MATERIAL	INTERIOR LINING	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI)[1]			
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	EXTERIOR COATING	WORKING	SURGE	RESTRAINT	FIELD TEST
BELT FILTER PRESS FEED PUMP SUCTION AND DISCHARGE	6" DIP	CERAMIC EPOXY	N/A	N/A	FLANGED	CLASS 53	PAINTED	40	N/A	60	60
REUSE PIPING (INCLUDING WASHWATER PIPING AND POLYMER DILUTION WATER)	< = 4" PVC	N/A	N/A	N/A	SOCKET/ FLANGED	SCH 80	N/A	40	N/A	60	60
POLYMER TRANSFER PUMP SUCTION AND DISCHARGE PIPING	< = 2.5" PVC	N/A	N/A	N/A	SOCKET/ FLANGED	SCH 80	N/A	40	N/A	60	60
DILUTE POLYMER AND NEAT POLYMER	< = 1.5" PVC	N/A	N/A	N/A	SOCKET/ FLANGED	SCH 80	N/A	40	N/A	60	60
SANITARY SEWER GRAVITY	12" PVC	N/A	PUSH-ON	SDR 35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	12" DIP	CERAMIC EPOXY	RESTRAINED	CLASS 53	FLANGED/ RESTRAINED PUSH-ON	CLASS 53	PAINTED				

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.

SECTION 40 61 00

INSTRUMENTS AND CONTROLS

PART 1 – GENERAL

1.01 SCOPE

A. The INSTRUMENTATION SUBCONTRACTOR shall provide all programming as defined herein, shall supply the new field instruments as listed herein and noted on the Drawings, and shall supply a new Dewatering System Main Control Panel and a Conveyor Control panel as listed herein and shown on the drawings.

B. Programming shall be performed using the standards set by the Lee County Utilities.

C. The scope of the work to be performed under this Section includes, as a minimum:

1. The CONTRACTOR shall retain overall responsibility for the modifications to the plant instrumentation and control system as specified herein.

2. The CONTRACTOR shall be responsible to install all new instruments as specified herein and as indicated on the Drawings.

3. The CONTRACTOR shall furnish and install new instrument supports, sunshield, and mounting hardware as shown on the Drawings.

4. The ELECTRICAL SUBCONTRACTOR shall provide final termination and testing of all instrumentation and control system signal wiring and power supply wiring at all equipment furnished under this Section.

5. The INSTRUMENTATION SUBCONTRACTOR shall furnish the field instruments as specified herein to be installed by the CONTRACTOR and wired by the ELECTRICAL SUBCONTRACTOR.

6. The INSTRUMENTATION SUBCONTRACTOR shall furnish and fully program the new Belt Filter Press Main Control Panel (BFP-MCP) as specified herein to be installed by the CONTRACTOR and wired by the ELECTRICAL SUBCONTRACTOR.

7. The INSTRUMENTATION SUBCONTRACTOR shall furnish and install transient voltage surge suppression systems for all new analog instruments.

8. The INSTRUMENTATION SUBCONTRACTOR shall provide testing, calibration, training and startup services as specified herein.

9. The INSTRUMENTATION SUBCONTRACTOR shall provide the new fiber optic cable, and terminations on both ends after installation by the ELECTRICAL SUBCONTRACTOR, to allow full communications between the new BFP-MCP and the plant SCADA system. Communication between the BFP-MCP and the two (2) new belt filter press local control panel PLCs (BFP-CP-01 & BFP-CP-02) supplied under Division 46, the two (2) new operator interface units (BFP-LP-01 and BFP-LP-02), the new conveyor local control station (C-CP), the two (2) new polymer make-up unit control panels (P-CP-01 and P-CP-02) supplied under Division 46, and the two (2) new sludge feed pump VFDs (SP-VFD-01 and SP-VFD-02) supplied under Division 26 shall be as shown on the network drawing.

10. The INSTRUMENTATION SUBCONTRACTOR shall provide the necessary programming changes on the facility's existing plant SCADA workstation operator interface software as described herein to fully incorporate the new instruments and equipment installed under this project.

1.02 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be linear 4-20 milliamperes and shall operate at 24 volts D.C. Signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels and appurtenances.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

1.03 DISCRETE INPUTS

A. All discrete inputs from field devices shall be dry contacts in the field device or equipment, powered from the signal source with isolation to the PLC inputs.

B. Sensing power (wetting voltage) shall be 120V AC.

1.04 DISCRETE OUTPUTS

A. All discrete outputs to field devices shall be through isolation relays in the source control panel with coil voltage rated for 24 VDC powered (sourced) from the PLC. Contacts on the relays are to be rated for up to 120V AC power and be as required for interfacing device.

1.05 INSTRUMENT AND HARDWARE SUBMITTALS

A. Submit information for all new hardware including, but not limited to, the following:

1. Product (item) name and tag number.

2. Catalog cuts.

3. Manufacturer's complete model number.

4. Location of the device.

5. Input - output characteristics.

6. Range, size, and graduations.

7. Physical size with dimensions, NEMA enclosure classification and mounting details.

8. Materials of construction of all enclosures, wetted parts and major components.

9. Instrument or control device sizing calculations where applicable.

10. Certified calibration data on all flow metering devices.

11. Environmental requirements during storage and operation.

12. Associated surge protection devices.

13. Mounting requirements.

14. Environmental requirements during storage and operation.

15. Complete panel fabrication shop drawings including panel layouts and wiring diagrams.

1.06 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. PLC input/output schedules for interface with values being sent to and received from the existing plant PLC for new field I/O and internal data registers. List complete addresses and tagnames for each new register.

2. Existing plant workstation operator interface software (OIS) new database points including OIS tagname, corresponding PLC register cross reference, scales, functions, etc.

3. Written control strategy documentation to describe the proposed control logic interface with the new signals logic.

4. Upon approval of PLC input/output schedules, new OIS database point list, and written control strategy documentation, submit a complete hard copy of fully commented PLC ladder logic programming and a complete hard copy of proposed OIS display screen modifications.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Provide equipment operation and maintenance manuals for new instruments. 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 modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. 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.

B. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches and searchable PDF files of the material shall be provided on electronic media. The manuals shall include 15% spare space for the addition of future material. The instructions shall include Drawings reduced or folded and shall provide at least the following as a minimum.

1.08 FINAL SYSTEM DOCUMENTATION

A. Provide two copies on electronic media for all software modifications for the new PLC and existing OIU system revisions. PLC files shall include all comments. Provide panel fabrication drawings and wiring diagrams in dwg and pdf format on electronic media.

1.09 SHIPPING HANDLING AND STORAGE

A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of all new field instrumentation and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.10 INSTALLATION

A. All instrumentation and control system installation work shall conform to all applicable codes and standards and be in accordance with manufacturer's recommendations.

B. All labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of five years of documented experience on similar projects.

C. All equipment and materials shall fit properly in their installations. Any required work to correct improperly fit installations shall be performed at no additional expense to the County.

D. The CONTRACTOR shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports.

1.11 OPERATOR TRAINING

A. Provide a minimum of two sessions, each approximately 2 hours in duration, to train operations staff on the new controls.

1.12 CONTROL SYSTEM SUPPLIER

A. The existing plant SCADA system human machine interface (HMI) software is Citect. The INSTRUMENTATION SUBCONTRACTOR shall be a qualified system integrator to implement the needed modifications to the Citect displays and database to monitor and control the new equipment and fully depict and allow full monitoring and remote interface with the new dewatering system equipment. SCADA interface shall follow standard County practices for Citect development and shall provide full interface with the new equipment as specified herein.

B. The INSTRUMENTATION SUBCONTRACTOR shall be able to offer personnel that have at least ten years of proven Citect experience as well as the programming of the type of PLC supplied under this project. Individual proposed for the Citect programming on plant workstations shall have at least three projects completed in the last 3 years using Citect software.

PART 2 – PRODUCTS

2.01 BELT FILTER PRESS MAIN CONTROL PANEL (BFP-MCP)

A. Provide a new main control panel for the monitoring and control of the two sludge feed pumps, conveyor system (through a new conveyor control panel), new electric actuated gates on the existing truck loading conveyor, polymer activation and feed system, and two belt filter presses. Control panel shall be designed for 120 volt, single phase service.

B. The panel shall be a free-standing panel on support legs, constructed in accordance with UL 508 requirements for enclosed industrial control panels and shall bear the serialized UL label. Enclosure shall include the following:

1. The Control Panel shall be formed or welded construction, reinforced with stainless steel members to facilitate mounting of internal components or equipment. Door shall be of sufficient opening size to facilitate maintenance and testing of the internal components. Panels shall be provided with a means to facilitate safe moving and lifting of the panel during installation.

2. Panel enclosure shall be all Type 316 stainless steel, minimum 12 USS gauge, fully enclosed NEMA 4X with gasketed doors. The panel exterior shall be coated with a phosphatized baked enamel white coating.

3. The enclosure shall have a 12-ga steel, formed, removable subpanel. The subpanel shall be degreased, cleaned, treated with a phosphatizing process, then primed and painted with white industrial grade baked enamel

4. All conduits extending outside of the panel shall be sealed to prohibit condensation and vapor entry into the panel.

5. Panel door shall be designed for front access and fitted with lockable, three-point door latches that maintain the NEMA 4X rating when fully engaged.

6. Panel shall be provided with a folding laptop programmer shelf on the inside of the door and a metal print pocket for the control panel as-built drawings.

7. Panel enclosure shall be a prefabricated panel by Hoffman, Steeline, or approved equal.

C. The panel shall consist of the following components:

1. Branch Circuit Breakers: Circuit breakers shall be quick-make, quick-brake and trip free. The thermal and magnetic elements shall operate independently and be designed with a common trip bar breaking all poles when a fault is received on any pole. The circuit breakers shall be as manufactured by Square D for 120V (QOU1 series) service. Provide breakers for the main panel 120V feed, the panel receptacle and light, the panel air-conditioner, the UPS power feed, and branch circuit breakers on the UPS power to each PLC module.

2. Uninterrupted Power Supply (UPS): Provide a UPS in the panel to power the 120V control logic, PLC CPU and I/O modules, network communications, OIT, and field instrument loop power supply. The UPS shall be securely mounted inside the panels (loose installation at bottom of panel not acceptable). The UPS shall be APC SMT1000 with AP9640 Ethernet card with outputs to the PLC to indicate battery life low, running on battery status, UPS fault. Panel shall incorporate a true UPS bypass switch inside the panel that allows operators to send line power to the UPS directly to the load side circuits, completely bypassing the UPS for maintenance purposes.

3. Surge Suppression: Provide a surge arrestor installed on the line side of the main breaker in accordance with manufacturer's instructions. Provide surge suppression devices on all signal and power leads on all circuits that have any part of the control or power circuit that extends past the limits the panel. Surge devices shall match the components used by the County throughout the WRF facility:

   a. EDCO HSP for 120V power

   b. Erico UTB110SP for 120V signals

   c. Allen Bradley 4983-DD24 for 4-20mA signals, panel end

4. Network Switch: Ethernet interface for all network components shall be through a local area managed network switch, as manufactured by Allen Bradley Stratix, mounted within the panel. The network switch shall have the number of CAT6 ports as needed to connect all required devices with at least one spare port. The network switch shall provide communications with County-assigned IP addresses for the PLC, OIT, UPS, VFDs, and SCADA fiber modem. Cable between the network switch and connected components shall be furnished under this section and be industrial grade CAT6 cable with ST connectors.

5. Programmable Controller (PLC): The PLC shall be Allen-Bradley CompactLogix Catalog No. 1769-L series controllers, latest processor utilizing ladder logic programming, Rockwell Automation RSLogix 5000 Professional Edition software to match PLC components and software versions supplied under Division 40. Provide I/O modules Catalog No. 1769-IQ16 24Vdc discrete input modules, Catalog No. 1769-OB16 24Vdc discrete output modules, Catalog No. 1769-IF8 4-20mA analog input modules (with Allen Bradley or Phoenix Contact Hart enabled isolators), and Catalog No. 1769-OF8C 4-20mA analog output modules. Discrete inputs shall be fused. Power supplies shall be Allen Bradley 1769-PA series. PLC hardware and software shall be provided to allow operators to make changes to setpoints and control settings within the PLC over the plant SCADA network. Software ladder programming shall be set up to allow modifications to the programming either through direct laptop connection at the PLC or over the telemetry link. Provide input/output modules in sufficient quantities specified herein and as required to meet functional requirements of the Specification. PLC hardware and power supplies shall be provided with all necessary cabling, mounting hardware, racks and connectors for a fully functional system. I/O terminal strips shall be removable without disturbing field wiring. Provide a minimum of 10% spare slot capacity in the card rack for future expansion and 15% spare I/O capacity for each type of input (rounded up to the next whole number of required points or channels). Provide 25% spare memory on the PLC CPU after the PLC has been programmed for full operation.

6. Operator Interface: Operator Interface Terminal (OIT) mounted on the control panel front door shall be a 15" color display touch screen, capable of being

configured for use with Citect software. The OIT shall communicate with the PLC through a network switch in the panel over a copper CAT6 Ethernet link. OIT shall be as manufactured by C-more or Automation Direct and shall be programmed to allow full and complete control and monitoring of the dewatering system as shown on the P&IDs. The OIT shall be mounted behind the panel door with a clear window on the panel door that allows viewing of the OIT without opening the panel.

7. Fiber Optic Interface: The panel PLC shall communicate with the plant PLC network directly over a fiber optic link. PLC Fiber Optic module, fiber cable, and fiber conduit shall match existing fiber optic network equipment using Rockwell Automation 1783-BMS06SGA Media Converters. Fiber optic cable connections shall match existing cable connection type.

8. Panel Air Conditioner: The panel shall be fitted with a side-mounted air-conditioning unit to maintain internal panel temperatures below 95°F, and shall be Kooltronic, GuardianDP Series, ICEqube, Blade series or IECEx/ATEX for Zone 1 & 2, or Hoffmann Thermoelectric Unit. Cooling shall be closed loop to separate sealed internal panel air from outside air to maintain the panel NEMA 4X rating. The unit shall be of stainless steel construction with exterior shields and special coatings applied to coils and copper lines exposed to ambient air to protect the unit from corrosive ambient conditions. Units shall operate on 120V ac power. Thermostat shall be mounted inside the panel. Provide a sensor to send an alarm to the PLC on high internal panel temperature.

9. As-built Drawings: A laminated "As Built" copy of the panel wiring diagrams shall be provided and placed in the panel print pocket for all panels that include PLCs. All panel drawings shall be developed using AutoCad®. The drawings shall have a complete Bill of Materials, panel exterior and interior layouts, and show all electrical wiring. As-built drawings shall be submitted with the O&M materials on electronic media in both AutoCad® (.dwg) and searchable Adobe Acrobat® (.pdf).

10. Terminals: Terminal blocks shall be as follows:

    a. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Allen Bradley or Phoenix Contact.

    b. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

    c. Discrete signal terminal blocks shall be 2-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal.

d. Analog signal terminal blocks shall be 3-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal and the shield/drain wire shall be installed on the bottom or right-most terminal.

e. Only one wire shall be terminated under a single wire clamp or screw.

f. Terminal blocks for field wire connections shall be added as needed in 10-pole increments. Terminal blocks shall be mounted with a minimum of 2" from both enclosure sides and from the bottom of the enclosure for easy access to terminal screws.

g. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

h. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.

11. Wiring: All wiring shall be color-coded using tinned copper MTW #14 AWG minimum for power and control wiring and #16 twisted pair for analog signal wiring. Wiring and cables shall be numbered at each end. Wire numbers shall be printed on non-removable heat-shrink tags. Wires shall be color coded as follows:

    Equipment Ground - GREEN

    120 VAC Power - BLACK

    120 VAC Power Neutral - WHITE

    120 VAC Control (Internally Powered) - RED

    120 VAC Control (Externally Powered) - YELLOW

    24 VAC Control - ORANGE

    DC Power (+) - BLUE

    DC Power (-) - GRAY

    Analog Signal – BLACK/WHITE

12. Component Labels: The panel shall include a panel nameplate and each front panel mounted device shall include legend nameplates to describe the function of the device. All interior panel components shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back. The tags shall be

black background with white letters and match the nomenclature indicated on the as-built wiring diagrams.

13. Mounting Hardware: All mounting hardware such as screws or bolts used in the manufacturing of the control panel shall be Type 316 stainless steel. All holes in the back plate and dead front shall be drilled and tapped. No self-tapping screws, adhesive tapes, or Velcro will be accepted for the mounting of any hardware.

14. Interposing relays shall be provided on all discrete outputs on the PLC and shall be DIN rail mounting type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil. Relays shall be as manufactured by Square D or Phoenix Contact.

15. Timing Relays shall be provided for any direct wired equipment protection circuits to prevent nuisance tripping. Timing relays shall be the general purpose DIN rail mounting type, as manufactured by Square D or Phoenix Contact. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.

16. Corrosion Protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts, and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

17. Panel Seal-Offs: All conduits entering the panel shall be sealed at the conduit entry point with a removable, expandable conduit seal material to prohibit outside air from entering the panel.

18. Selector switches shall be heavy-duty, oil-tight type with gloved-hand or wing-lever operators. Position legends shall be engraved on the switch legend plate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10A continuous at 120 VAC. Contact configuration shall be as indicated on the Drawings, or as required for the application. Switches used in electronic signal circuits shall be contacts suitable for that service duty. Switches shall be Cutler-Hammer “Type 34”, Micro-Switch equivalent, General Electric equivalent, or Square D Type SK, or approved equal. Switches shall be supplied with a minimum of two (2) spare contact blocks on both hand and auto positions of selector switches for every switch.

19. Indicating lights shall be heavy-duty, oil-tight type. Legends shall be engraved on the legend plate. Lamps shall be easily replaceable from the indicating light. Indicating lights shall be Square D Type SK, or approved equal.

20. Pushbuttons shall be heavy-duty, oil-tight type. Legends shall be engraved on the legend plate. Contacts shall be rated 10A continuous at 120 VAC. Pushbuttons shall be Square D Type SK, or approved equal.

D. Programming: See Paragraph 2.05.

2.02 CONVEYOR CONTROL PANEL (C-CP)

A. Provide a new conveyor control panel for the monitoring and control of the two existing conveyors. Control panel shall be designed for 480 volt, three-phase service with a main disconnect, branch breakers for each conveyor starters, conveyor starters, 120V control power transformer, and panel components as described for the dewatering system main control panel other than as noted below. This panel is all hard wired with control logic through the dewatering system main control panel (panel does not require a PLC, UPS, network switch, or OIT). Hard-wired interlocks to the existing conveyor pull chords and speed sensors shall be incorporated into this new panel. Programming and I/O shall be as listed under Paragraph 2.05.

B. Panel shall be supplied with a dead front panel door with all control switches, lights, and pushbuttons mounted on the dead front door.

C. Panel shall be supplied with a main breaker and conveyor motor branch circuit breakers rated for 480V service and shall be thermal magnetic molded case units. The main circuit breaker and motor branch circuit breakers shall be as manufactured by Square D. and shall be operable through the dead front panel door.

D. Motor Starters: Motor starters for each conveyor motor shall be mounted behind the dead front panel and be full voltage, non-reversing, IEC style across the line units. Coils shall be 120 VAC. The starters shall be as manufactured by Square D.

2.03 PRESSURE GAUGES

A. Provide one gauge for each new sludge feed pump suction and discharge line. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers and resettable maximum reading pointers shall be provided. Gauge full scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full scale range.

C. Features

1. Mounting: 1/2-inch NPT, lower stem mount type

2. Accuracy: ±2% full scale

3. Case: Solid front, black phenolic material, process pumps

4. Stainless steel, smaller lines

5. Dial: 4-1/2 inch dia. dial size, white background, black letters

6. 5 Glass: Shatterproof

7. Blow-out protection: Back

8. Pressure element: stainless steel bourdon tube

9. Movement: Stainless steel, Teflon coated pinion gear and segment

10. Gaskets: Buna-N

D. Gauges shall be liquid filled. Silicone oil filling fluid shall be suitable for ambient temperature ranging from -10^{0}F to +150^{o}F. Seals shall be oil filled, all 316 stainless steel construction with iaphragms of 316L stainless steel unless a more suitable material of equal corrosion resistance is recommended for lower operating pressures. Seals shall have 1/2" instrument connection upper housing, over-sized 1.5" process connection bottom housing with 1/2-inch NPT valved flush port, and oil fill connection port capable of disassembly without loss of filler fluid. Provide 1/2" stainless steel ball valves for the flush port with hose connection. Provide 1.5" stainless steel ball valves for the process connection. Coordinate process connection type (threaded or flanged) with the process piping supplied. Seals shall be as manufactured by Ashcroft, or approved equal.

E. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A 1/2-inch stainless steel isolation ball valve shall be provided for each gauge assembly.

F. Pressure gauges shall be as manufactured by Ashcroft, US Gauge, Marshalltown, Marsh, or approved equal.

2.04 PRESSURE SWITCHES

A. Provide low and high pressure switches for each of the sludge feed pumps. Pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated

and activated S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.

B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by Ashcroft.

C. Switch assemblies shall be liquid filled and may be combined with the associated pressure gage mounted to the same diaphragm seal assembly.

2.05 PRODUCTS AND PROGRAMMING REQUIREMENTS

A. Programming software for dewatering system PLC and plant workstation Citect displays shall be completed using the County's standard, existing programming software, current version.

B. Transient Voltage Surge Suppressors (TVSS): Provide surge protection for the incoming 120V power to and analog output at the existing panel end for all new analog signals (if not already available as spare devices in the panel). TVSS devices shall match existing components for other signals (or approved equal) at the facility for both the field end and the existing PLC control panel end.

C. Programming Requirements:

1. POLYMER FEEDER CONTROL: Control of the polymer feeders shall be as programmed through the BFP-CP-01 and BFP-CP-02 PLCs supplied under Division 46. Controls shall be from the BFP-CP-01 and BFP-CP-02 or the OITs (BFP-LP-01 and BFP-LP-02) only (no remote override).

    a. Selection logic for which polymer feeder is dedicated to which belt filter press shall be resident in the BFP-MCP accessible through the panel OIT on the BFP-MCP. Normally, feeder 1 is dedicated to BFP-1 and feeder 2 is dedicated to BFP-2. If either feeder is switched to the other BFP, the BFP not selected shall be disabled (piping arrangement cannot accommodate both BFP operation if polymer feeder assignment is switched).

    b. Provide programming of the fiber optic communications link and the plant Citect displays for status monitoring of the feeders.

c. The OIT on the BFP-MCP shall display the items noted below along with allowing manual override control from the OIT through an HOA software switch and manual speed adjustment software device. Remote override control from the plant SCADA work stations shall not be provided.

d. Manual control independent of PLC operation or Ethernet link will be through the polymer control panel physical controls (supplied under Division 46) or through start/stop pushbuttons for each polymer feeder provided on the BFP-MCP front panel door enabled through a Manual / PLC switch on the panel front door.

e. The OIT on the BFP-MCP shall include a dose setpoint adjustment control for the polymer feed rate when in Remote at the VFD and Auto at the MCP.

f. Interface between the BFP-MCP and the plant SCADA network for display on Citect includes:

1) Feeder Running indication

2) Feeder Runtime display (based on calculation from PLC logic)

3) Feeder Common Fault

4) Polymer feed rate (based on polymer feeder feedback signal using calculations to display in gph)

5) Feeder speed 0-100%

6) Feeder In Remote

7) Feeder Low Flow alarm

2. CONVEYOR CONTROLS: Control of the dewatered cake inclined belt conveyor and truck loading screw conveyor shall be through a conveyor control panel (C-CP) supplied under this section.

a. The panel shall include the motor starters and the following control devices on the front panel face:

1) HOA for each conveyor

2) Low speed alarm for each conveyor

3) Conveyor running indicator for each conveyor

4) Starter overload alarm for each conveyor

5) Emergency stop pushbutton and indication (when pull chords engaged)

6) Alarm reset pushbutton

b. In AUTO position of the HOA switch for each conveyor, that conveyor shall run based on signals from the BFP-MCP PLC output as called for by either of the belt press BFP-CP's. In HAND position of the HOA switch for each conveyor, the conveyor shall run continuously.

c. The truck diverter gates shall be control through the BFP-MCP. An OCA software switch on the panel OIT shall open a gate if in OPEN, close a gate if in CLOSE, or operate the gates on a timer basis if in AUTO. Timer control shall be based on individual timer setpoints set at the OIT for each gate and the chute without a gate. Once a new truck trailer is in place, the operators shall initiate a truck fill sequence by pressing a START SEQUENCE software pushbutton on the OIT. The gates shall open in sequence and close after the timing settings time out and the sequence shall stop when the last chute timer setting times out.

d. Interface related to the conveyors shall be between the BFP-MCP and the plant SCADA network (majority based on interface between the C-CP and the BFP-MCP) for display on Citect includes:

1) Belt Conveyor Running, Fault, and In Remote status

2) Belt Conveyor Low Speed alarm

3) Belt Conveyor Runtime (hours and 10nths of hours)

4) Conveyor System Emergency Stop alarm (any pull chord or C-CP pushbutton engaged)

5) Screw Conveyor Running, Fault, and In Remote status

6) Screw Conveyor Low Speed alarm

7) Screw Conveyor Runtime (hours and 10nths of hours)

8) Diverter gate Opened, Closed, In Remote, and Fault status for each of two gates

9) Existing truck bed level for each existing sensor

3. BELT FILTER PRESS CONTROL: Control of the belt filter press units and associated equipment shall be as programmed through the belt filter local control panel PLC supplied under Division 46. Controls shall be from the BFP-CP-01 and BFP-CP-02 or the OITs (BFP-LP-01 and BFP-LP-02) only (no remote override).

Passthrough interface between the BFP-CP's (via the BFP-MCP network switch) and the plant SCADA network for display on Citect includes:

a. Thickener and Dewatering Belt Filter Drives Running

b. Thickener and Dewatering Belt Drives speed indication

c. Hydraulic Pump Running

d. Washwater Pump Running

e. All alarm conditions generated from the BFP-CP's

f. Belt Filter Press Runtime (hours and 10nths of hours when press is in operation as calculated by the BFP-CP PLCs)

g. Sludge feed rate and daily flow total (as calculated by the BFP-CP PLCs)

4. SLUDGE FEED CONTROL: Control of the Sludge feed pumps shall be as programmed through the BFP-CP-1 & 2 supplied under Division 46. Controls shall be from the BFP-CP-01 and BFP-CP-02 or the OITs (BFP-LP-01 and BFP-LP-02) only (no remote override).

a. Selection logic for which sludge feed pump is dedicated to which belt filter press shall be resident in the BFP-MCP accessible through the panel OIT on the BFP-MCP. Normally, pump 1 is dedicated to BFP-1 and pump 2 is dedicated to BFP-2. If either pump is switched to the other BFP, the BFP not selected shall be disabled (piping arrangement cannot accommodate both BFP operation if pump assignment is switched).

b. Provide programming of the fiber optic communications link and the plant Citect displays for status monitoring of the pumps.

c. The OIT on the BFP-MCP shall display the items noted below along with allowing manual override control from the OIT through an HOA software switch and manual speed adjustment software device. Remote override control from the plant SCADA workstations shall not be provided.

d. Manual control independent of PLC operation or Ethernet link will be through the sludge pump VFD physical controls (supplied under Division 26) or through start/stop pushbuttons for each sludge pump provided on the BFP-MCP front panel door enabled through a Manual / PLC switch on the panel front door.

e. The OIT on the BFP-MCP shall include a flow setpoint adjustment control for the sludge feed rate when in Remote at the VFD and Auto at the MCP.

f. Interface between the Controls shall be from the BFP-CP-01 and BFP-CP-02 or the OIUs (BFP-LP-01 and BFP-LP-02) and the plant SCADA network for display on Citect includes:

1) Sludge Pump Running

2) Sludge Pump Runtime display (based on calculation from PLC logic)

3) Sludge Pump Current (amps)

4) Sludge Pump VFD Fault

5) Sludge Pump Low Suction Pressure

6) Sludge Pump High Discharge Pressure

7) Sludge Pump High Motor Temperature

8) Sludge Pump In Remote

9) Sludge Pump speed 0-100%

10) Remote alarm reset

D. REQUIRED CITECT DISPLAYS

1. Plant Overview Display – revise the existing display (see end of this section) to add the running and alarm indication for the new sludge feed pumps, add the running and alarm indication for the belt presses, and utilize the sludge flow rate indicators to connect to the new flow meters.

2. Totals and Runtime Popup – connect and/or add the runtime values to existing displays where applicable.

3. Dewatering System Display – revise the existing display (see end of this section) to add running and alarm conditions for the belt presses, polymer feeders, and conveyors.

4. Digester Display – revise the existing display (see end of this section) to add running and alarm conditions for sludge feed pumps.

5. Alarm Summary – display all belt filter press, sludge feed, polymer and conveyor system alarms with indication, acknowledgement, historical logging, and reset features similar to existing alarm displays.

6. Historical Displays – add signals for all flows and level signals to the existing historical logging data collection system and allow these signals to be displayed on the historical trend displays.

E. PLC Programming: Programming of the PLC shall follow all formatting, documentation, conventions, data transfer, and signal conditioning standards utilized and established by the County for plant PLC ladder logic programming. Program software shall match the type and version utilized by the County throughout the plant.

F. Programming revisions required for the plant network communications and operator interface software shall be performed by the control system programmer. Signal interface shall be coordinated with the new polymer, sludge feed pumps, conveyor and dewatering system PLC programming to match registers, IP, and internal addresses to completely integrate the new systems into the plant monitoring and control system. All operator interface functions and graphics are to be supplied to allow complete and full access, automated control setting, manual control override, and remote status monitoring and recording of the new systems. Programming revisions required for the plant network communications and Citect software shall be made such that functions and graphic displays match that supplied for similar existing devices and controls.

PART 3 – EXECUTION

3.01 TESTING REQUIREMENTS

A. The CONTRACTOR shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

B. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

C. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements which require turndown limits such as VFDs shall be initially set during this test.

D. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator work station or loop controller level, for continuity and for proper operation and calibration.

E. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

F. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

G. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

H. Upon completion of the startup tests and prior to final system acceptance, the new controls shall be tested under normal operating conditions, initiated either automatically or manually, over a 30 day test period to demonstrate continuous reliable operation as intended.

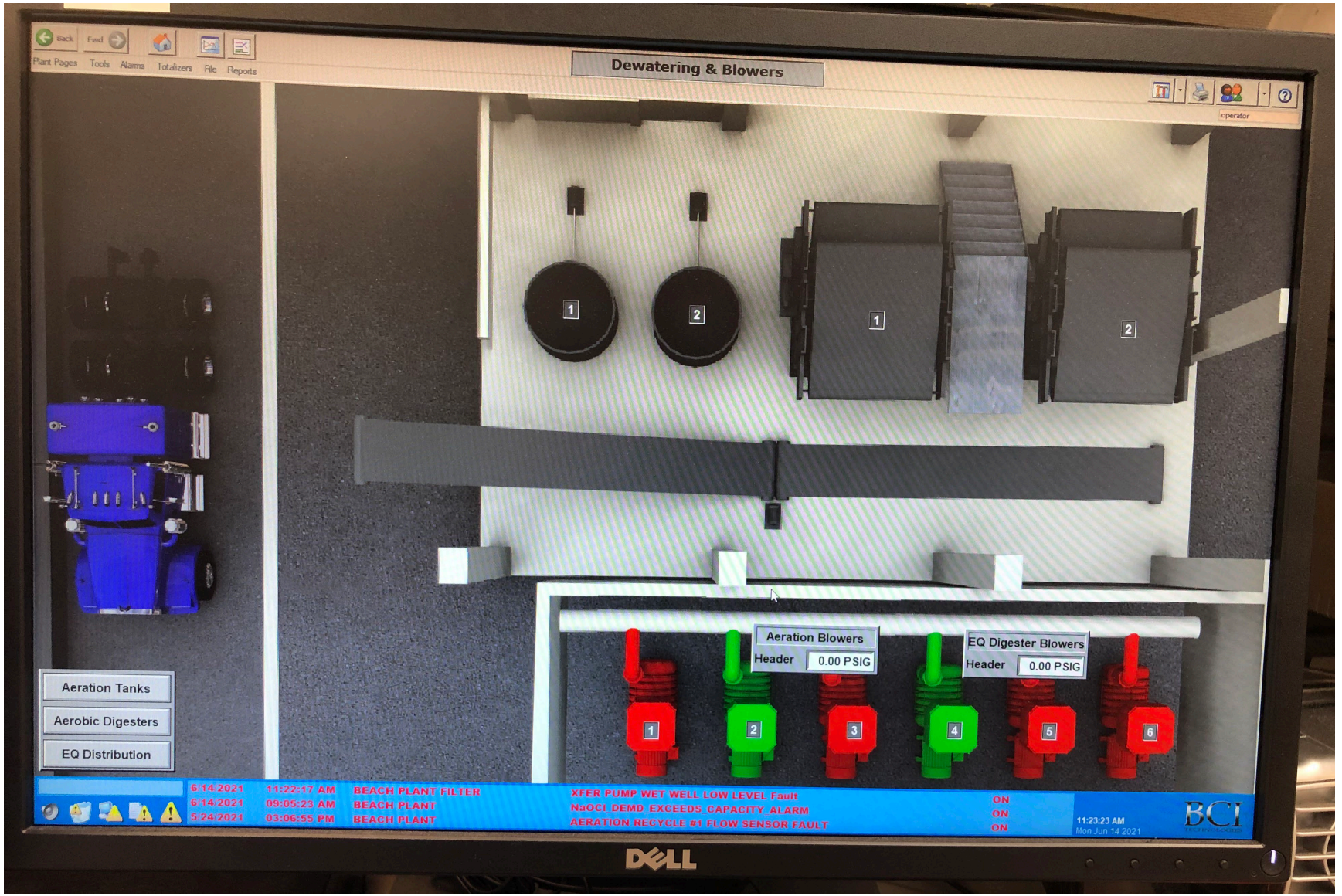
I. If the system fails the 30 day availability test, the 30 day test period shall be restarted after the failed component or software is repaired / replaced and full operation is restored.

3.02 FINAL ACCEPTANCE

A. Final acceptance of the instrumentation programming will be determined complete by the Engineer, and shall be based successful completion of startup testing and training of the operations staff to the County's satisfaction.

END OF SECTION


172.16.14.90
Main Menu
Overview
Plant Pages
Tools
Alarms
Totalizers
File
Reports
operator
Raw Plant Influent
3.18 MGD
Today 975 kGal
Yesterday 2686 kGal
Influent pH
8.09 PH
EQ Tank
1.38 FT
Digester 1
13.0 FT
1 SCFM
Digester 2
13.1 FT
25 SCFM
Digester 3
13.3 FT
2 SCFM
PCCC Analyzers
Chlorine 0.02 ppm
pH 6.99 pH
Turbidity 1.72 NTU
Filter
3.00 mg/l
7.1 pH
0.49 NTU
Aeration 1
8.11 mg/L
1 SCFM
Aeration 2
0.39 mg/L
1709 SCFM
Aeration 3
0.82 mg/L
726 SCFM
Aeration 4
0.00 mg/L
110 SCFM
BFP 1 Feed
0 GPM
BFP 2 Feed
0 GPM
Filter Influent
0.000 MGD
0 gpm
Generator Fuel
9174 GAL
91.7 %
RAS 1 Flow
1415 GPM
RAS 2 Flow
675 GPM
Transfer Well
5.9 FT
DIW Flow
0 GPM
Distribution
3060 GPM
19 PSIG
Effluent Tank
4.23 FT
Transfer Pumps
Aeration Blowers
EQ Dig. Blowers
6/14/2021 11:22:17 AM BEACH PLANT FILTER XFER PUMP WET WELL LOW LEVEL Fault ON
6/14/2021 09:05:23 AM BEACH PLANT NaOCl DEMD EXCEEDS CAPACITY ALARM ON
5/24/2021 03:06:55 PM BEACH PLANT AERATION RECYCLE #1 FLOW SENSOR FAULT ON
11:22:59 AM
Mon Jun 14 2021
BCI


Back
Fwd
Plant Pages
Tools
Alarms
Totalizers
File
Reports
Dewatering & Blowers
operator
1
2
1
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Aeration Blowers
Header
0.00 PSIG
EQ Digester Blowers
Header
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1
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Aeration Tanks
Aerobic Digesters
EQ Distribution
6/14/2021 11:22:17 AM BEACH PLANT FILTER XFER PUMP WET WELL LOW LEVEL Fault ON
6/14/2021 09:05:23 AM BEACH PLANT NaOCl DEMD EXCEEDS CAPACITY ALARM ON
5/24/2021 03:06:55 PM BEACH PLANT AERATION RECYCLE #1 FLOW SENSOR FAULT ON
11:23:23 AM
Mon Jun 14 2021
BCI
DELL


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Back
Fwd
File
Reports
Aerobic Digesters
operator
Bar Screen
Equalization
Aeration Tanks
Secondary Classifiers
RAS Pumps
Transfer Pump Station
PreCCC Chlorine Pumps
Gravity Filter
Site Effluent
Deep Injection Well
Aerobic Digesters
BFP - Sludge - Waste Pumps
WAS / TWAS Pumps
Belt Thickeners
Blowers
Plant Lift Station
Generator
Aerobic Digester 3
13.4 FT
2 SCFM
Aerobic Digester 1
Level
12.9 FT
Air Intake
0 SCFM
Aerobic Digester 2
Level
13.1 FT
Air Intake
26 SCFM
Digester Pumps
6/14/2021 11:22:17 AM BEACH PLANT FILTER XFER PUMP WET WELL LOW LEVEL Fault ON
6/14/2021 09:05:23 AM BEACH PLANT NaOCl DEMD EXCEEDS CAPACITY ALARM ON
5/24/2021 03:06:55 PM BEACH PLANT AERATION RECYCLE #1 FLOW SENSOR FAULT ON
11:23:53 AM
Mon Jun 14 2021
BCI
DELL

Division 41

SECTION 41 22 00
CRANES AND HOISTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install and make fully operational the crane and hoist systems in the locations and conditions of service, as shown on the Drawings and as specified in the Crane and Hoist Schedule.

B. These Specifications shall be considered as minimum requirements. The Contractor shall add such additional features as are necessary for satisfactory operation.

C. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

D. All equipment supplied under this Specification shall comply in all respects with the provisions of the Occupational Safety and Health Act of 1970, including all standards promulgated under the authority of such Act, and shall also meet all applicable industrial codes in the State of Florida.

E. The manufacturer and ultimately the Contractor shall be totally responsible for structural design of the crane and hoist systems, for the compatibility of all equipment, and for verification of required operating clearances.

F. All parts of the mechanism furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation. All equipment specified herein shall be designed for the Crane Manufacturer's Association of America Duty Classification as specified herein.

G. If the Contractor elects to utilize the crane and hoist equipment in any way during the erection of piping and installation of equipment, he shall notify the Owner in writing and shall provide for an inspection by the equipment manufacturer and shall take any steps necessary to return the equipment to "as new" condition. He shall also obtain recertification by the manufacturer and reinstate all warranties and guarantees.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. CMAA – Crane Manufacturers Association of America

    a. CMAA Specification No. 74-1994 Specifications for Top Running and Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.

2. AGMS Standards (American Gear Manufacturers Association.)

3. AISC (Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings)

4. ANSI B30.11 – Safety Code for Underhung Cranes and Monorail Systems

5. ANSI B30.16 – Safety Code for Overhead Hoists

6. ASTM A36, Specification for Structural Steel.

7. ASTM A48 – Standard Specifications for Gray Iron Castings

8. MMA MH27.1 – Monorail Manufacturers Association

9. NEMA Standards (National Electrical Manufacturers Association.)

10. OSHA 1910-179 – Occupation Safety and Health Administration

11. Latest edition of the Florida Building Code

1.03 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the systems have been designed to resist all loads implied herein and loadings stipulated in the applicable building codes of the State of Florida. The Certification shall also state that the design has been performed and signed and sealed by a Professional Engineer registered in the State of Florida.

B. Certification that the equipment has been field tested and passed.

C. Details and design calculations shall be submitted, signed, and sealed by a Professional Engineer registered in the State of Florida for any of the following components furnished by the Manufacturer:

1. Runway beams.

2. Monorail patented track.

3. Monorail suspension systems.

4. End stops and connections.

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The equipment covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment.

B. Traveling bridge crane systems shall be supplied by:

1. Dearborn Overhead Crane.

2. Crane Equipment and Service, Inc.

3. Advanced Overhead Systems Inc.

4. Or approved equal.

2.02 CAPACITY AND DESIGN LOADS

A. The crane shall be designed to withstand the dead load (caused by the weight of the crane and components themselves), the live load and hoist load, and the inertia forces caused by movement of the crane, components, and loads during standard operation.

B. Standard capacity ratings shall represent the net rated load at the hook of any type of trolley hoist with the same load rating installed on the crane having a trolley hoist weight within the established limits.

C. All design loads shall meet CMAA requirements. The design load for stress calculations shall be based upon the capacity plus 15% for the weight of the hoist and trolley and an additional 25% for impact (capacity x 1.4). Design load for deflection calculations shall be based upon the capacity plus 15% for the weight of the trolley hoist (capacity x 1.15).

D. The rated load capacity of each crane shall be clearly labeled on each crane using a label size easily read from the floor level and/or loading position.

2.03 CRANE AND HOIST SCHEDULE

Location	Dewatering Area
General	
Indoor / Outdoor	Outdoor, covered
Area Classification	Non-classified, corrosive
Capacity, tons	2.0
Operating Floor Elevation	14.50
Power Voltage, VAC	480
Control Voltage, VAC	120
Control System	Wireless radio controls
Crane	
Crane Type	Traveling bridge crane
Mounting	Single girder, top running
CMAA Duty Classification	Class C
Approx. Span, ft	37'-8"
Approx. Length of Runway Travel, ft	44'-0"
Frame Spread, ft	N/A
Bridge Drives Type	Electric motor driven
Max. Bridge Speed, fpm	100
Bridge Control	Variable speed
Bridge Cross-conductor System	C-track festoon
Bridge Girder	Wide flange beam with ASCE trolley rail
Trolley	
Trolley Type	Electric motor driven
Trolley Control	Variable speed
Max. Trolley Speed, fpm	65
Hoist	
Hoist Type	Electric, wire rope
Hoist Control	2-speed
Hoist Speed, fpm	20/3

Location	Dewatering Area
ASME Duty Classification	Class H4
Approx. Lift Height, ft	16’-8”

2.04 GENERAL

A. The crane system shall be constructed of structural steel, in accordance with current AISC (American Institute of Steel Construction) and ASTM (American Society for Testing and Materials) A-36 specifications minimum.

B. All crane components will have properly finished ends and surfaces.

C. Welding shall follow the current recommended practices of the AWS (American Welding Society) D14.1 specifications.

D. Moving members of the crane shall be separated by a clearance of at least 3 inches vertically from any overhead obstruction, and 2 inches horizontally from any lateral obstruction.

2.05 BRIDGE CRANES

A. Bridge cranes shall be underhung and/or top running, single or double girder type, traveling bridge cranes with motorized bridges as shown on the Drawings and as specified in the Crane and Hoist Schedule herein.

B. Runway tolerances shall be within those specified in Table 1.4.1-1 from the CMAA. Cranes shall be built to operate on specified level runways held to nominal span within plus or minus 1/8-inch tolerance. The runways shall be straight and level with a maximum of 1/2 degree horizontal variation and within span tolerance limits.

C. Cranes shall be designed with a minimum safety factor of 5 to 1 in relation to the ultimate strength of the materials and a minimum resistance to permanent deformation of any of its parts of 3 to 1 in relation to the yield point of the materials, whichever of the two conditions will set the minimum.

D. Runways shall be designed by the Manufacturer to support and carry the end trucks of the bridge crane. Track supports, clamps, stops, couplings, and other items required for a complete installation shall be supplied and installed by the Contractor. Runways shall be suitably supported to withstand loading and impact shocks incurred under normal operation conditions. ASCE standard rails shall be sized per the CMAA specifications and secured by hook bolts or other approved mechanical means to top member of each runway to provide a track for the end trucks of top running cranes. Standard rolled beams or beams with channel caps shall provide a track for end trucks of underhung cranes. All beams shall be furnished with splices and end stops and shall be designed

for spans, as shown on the Drawings. Provisions shall be made for connection of beams to support locations designated on Drawings.

E. Bridge crane girder(s) shall be an I-beam, wide flange, or box girder of proper size, designed to hold the rated load and in accordance with CMAA Specifications for standard structural shapes. Bridge beam shall be a select structural member and shall provide level and straight tread surfaces for the trolley hoist. The bridge beam shall be braced and welded to maintain squareness with end trucks. End trucks for top running cranes shall be designed to run on the top of the A.S.C.E. standard runway rails. End trucks for underhung cranes shall be designed to run on the bottom flange of runway beams. The end trucks shall be so designed that in the event of a wheel axle or wheel failure the drop of the load would be limited to 1-inch. End trucks shall be equipped with sweeps which extend below the top of runway rails and project in front of the crane wheels. Top-running crane wheels shall be double-flange alloy steel and have tread surfaces hardened to minimum 280 Brinell. Class C end truck design shall be of a fixed axle, pin and taper design with double-row ball bearings and flat or tapered wheel treads. Class D end truck wheels shall revolve on tapered roller bearings capable of carrying radial and axial thrust loads. One (1) wheel in each end truck shall be provided with a helical gear motor reducer for connection to the dual motor drive. Rated capacity of bridge crane shall be painted with stencil on the hoist, crane girders, and runway beam.

F. Crane drive shall be of the dual drive type incorporating two (2) squirrel cage induction motors with variable frequency control with 2-step in. The dual drive motors shall provide synchronous drive to both end trucks for all possible trolley, hoist, and load positions. The motor gear heads shall be fully enclosed and oil lubricated. The motor and gear reduction shafts shall be supported by permanently lubricated ball or roller bearings. All bearings in the crane wheels and gear reduction shafts shall be designed for a B-10 life of 5,000 hours, minimum. The crane drives shall each include an integrally mounted electrically released disk brake.

2.06 TROLLEY HOISTS

A. Trolley hoists shall be as manufactured by ACCO Industries, Electrolift, Yale, or approved equal.

B. All load carrying parts shall be of steel. The wheels shall have hardened treads. Wheels and axles shall be equipped with antifriction bearings which are permanently sealed and lubricated. The gear head of the motor shall have an alloy steel, heat-treated gear train operating in a fully enclosed oil bath. The gear shaft shall have precision, oil lubricated ball bearings. Where monorail track as specified or shown on the Drawings is curved, trolleys shall be the swivel-type to negotiate curved sections.

1. Electrically operated trolleys shall include variable frequency control with 2-step in, a gear-motor with solid-state soft start with adjustable time and torque, and electric brake.

2. Manual trolleys shall be of hand-driven geared type.

C. The hoist drive shall be of the standard-headroom, single reeved type and shall include a geared train with inherent or mechanical load brake, hook, wire rope, and drum.

D. Rated capacity shall be stamped on the hoist frame.

E. The frame shall be oil-tight, of cast steel construction, with no part of the load carried by assembly bolts.

F. Gearing shall be machine cut and heat-treated, and shall operate in an oil bath. Except for the drum pinion, no gears shall be cantilever mounted.

G. Shafting shall be ground and polished and all bearings shall be of the antifriction type. Grease fittings and oil reservoir shall be readily accessible.

H. The drum shall be of the large diameter, guarded, flanged type with machine cut grooves to accommodate the hoist cable without overwrapping. Right- and left-hand drum grooving shall be utilized in close-headroom, double-reeved, cross-mounted hoist applications to provide a true vertical lift.

I. The wire ropes shall be of the preformed extra-flexible improved plow steel with hemp core, have a safety factor of at least five, and be anchored to the hoist drum. Length of wire rope shall be such that a minimum of two full wraps of wire rope will remain on the hoist with the hook at operating floor level.

J. The load block shall be of the safety type with guarded sheaves and heat-treated drop forged steel swiveled hooks. Hooks shall open slowly when subjected to heavy overloads.

1. Electrically driven hoists shall include a two (2) speed, direct coupled motor, electrical controls, and solenoid brake. The solenoid brake shall be spring set with magnetic release operated by and interlocked with the electrical control equipment.

2. Either a worm gear drive with an inherent load brake or a mechanical load brake designed in accordance with the Hoist Manufacturer's Institute standards shall be provided for controlling the speed when lowering, and for holding maximum hook load for any load up to capacity.

3. Stressed parts shall be of cast or forged steel.

4. In the event of a power failure the braking system shall automatically lock the piece of equipment being lifted to prevent further movement. Hoists shall also include either a clutch-type or electric-type overload cut-off device to protect hoist from an overload condition.

5. Manual hoists shall include a handwheel and chain and a clutch-type overload cut-off device to protect hoist from an overload condition.

K. Rated capacity of trolley hoists shall be painted with stencil on the trolley hoist.

2.07 ELECTRICAL AND CONTROL REQUIREMENTS

A. All electrical appurtenances furnished by the equipment manufacturer shall be rated for installation in classified and/or corrosive areas where such areas are indicated on the Drawings or specified in the Crane and Hoist Schedule contained herein.

B. All wiring between motor, limit switches and starters shall be short, compact, and protected by rigid aluminum conduit unless otherwise indicated. In corrosive areas, PVC-coated rigid aluminum conduit of Schedule 40 PVC conduit shall be used.

C. The electrical system providing power to bridge crane drives, trolley drives, and hoists shall be either the insulated channel conductor type or the festoon type as specified in the Crane and Hoist Schedule contained herein.

1. Insulated Channel Conductor Type: An insulated channel conductor shall be supplied along the bridge crane rails and girder or monorail where specified herein. The conductor shall be capable of carrying 100 amperes per pole, 3-phase, 460V. The conductor shall be supported as recommended by the manufacturer. The conductor shall be "Saf-T-Bar" enclosed electrification as manufactured by Howell Corporation, Midland Ross, SAFPOWER as manufactured by Cleveland Tramrail, Duct-O-Bar, Magnetek, Conductix, or equal. The conductor channels shall be of stainless steel, flame retardant, amply double insulated. The system shall permit longitudinal movement of the housing and busways only to the extent to allow for expansion and contraction. An expansion joint section shall be provided as required for expansion and contraction and still maintain true alignment. Collectors shall be of the type required by the conductor manufacturer.

2. Festoon Type: A track supported festoon system shall be supplied where specified herein and shall include trolleys with tandem wheels of a corrosion resistant material which shall provide suitable service with the track that is used. The trolleys shall have saddles for supporting the cables in equal loops not exceeding 9'-0" of cable per loop. The track shall be stainless steel and supported at spans not exceeding 6'-0". The track shall be adequately supported with horizontal arms spanning to the festoon tow bar. The equipment manufacturer shall be fully responsible for the design and suitability of the festoon system.

D. Starting equipment shall be integral with the crane drives and/or trolley hoist unit with three overload elements. Equipment shall be housed in an enclosure suitable to the conditions of service and as specified herein.

E. The motor rating shall be on a 30-minute 55 degrees C, duty cycle basis.

F. Electrical/Control Requirements

	Dewatering Area
Area Classification	Unclassified, corrosive
NEMA Rating of Components	NEMA 4X
Electrical System	Festoon
Control System	Remote
Rating	460V, 3 ph, 60 Hz
Max. Bridge Motor HP	0.75 (each of 2)
Max. Trolley Motor HP	0.25
Max. Hoist Motor HP	2.0
Enclosure Type	TEFC
Minimum Insulation Class	Class F
Anti-condensation Space Heater	Yes
Motor Winding Temperature Switches	Yes

G. Limit switches shall be approved geared typed, positive in action, compact, oil proof and readily accessible. Solenoid brakes shall be disk type, spring set with magnetic release. Solenoids shall be totally enclosed, protected from oil and moisture, readily accessible for adjustment and maintenance and shall develop the required forces without overheating.

H. All electrical and control components shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

2.08 CONTROLS

A. The Control System providing control of the bridge crane drives, trolley drives, and hoists shall be through wireless radio controls as specified in the Crane and Hoist Schedule contained herein.

1. Radio controls for lift and travel shall be provided complete with transmitter, receiver, and mounting hardware, designed for both indoor and outdoor installations. Transmitter shall be battery powered, consisting of a NEMA 4X gasketed, glass reinforced nylon enclosure with removable power key. Two speed control of the hoist drive shall be affected by a two-step pushbuttons. A 110 VAC, 60 Hz receiver shall be panel mounted with NEMA 4X sealing. LED lights shall be furnished with the receiver for visual diagnostic feedback. Radio frequency shall be microprocessor controlled with a range of no less than 300 feet. Radio controls shall be manufactured by Enrange, Telecrane, or equal.

B. Control power shall be 120-volt, provided by a control power transformer within the starter units. One side of this transformer shall be grounded, the other side shall be connected via a fuse of adequate rating.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for each crane and hoist system:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

A. All crane equipment shall be installed in accordance with the applicable sections of Division 05 – Metals, Division 26 – Electrical, and the manufacturer's instructions and recommendations.

3.03 FIELD TESTS

A. Field tests shall be conducted in accordance with Section 46 00 00 – Equipment General Provisions and the manufacturer's instructions and recommendations. Prior to initial use,

all cranes shall be proof-tested at 125% of their rated load in accordance with all OSHA requirements.

B. Crane shall be certified prior to Substantial Completion.

3.04 PAINTING

A. Painting shall be in accordance with Section 09 90 00, Painting and Coating.

B. The crane shall be shop painted OSHA safety yellow before shipment.

C. A wire-brushing and/or solvent wipe shall be performed prior to painting to clean and remove debris, mill scale, dirt, and oils.

D. At least one spray can of matching color paint shall be shipped with each crane for field touch-ups.

E. The crane shall be properly banded and skidded prior to shipment. Any paint damage, scratches, blemishes to the finish of the crane, caused by shipping, transportation via common carrier, etc., shall be repaired by the Contractor.

F. Rated capacity of crane system shall be painted with stencil on all components of crane system as specified herein.

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Division 43

SECTION 43 20 00
PUMPS – GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Comply with the requirements of Section 46 00 00 – Equipment General Provisions.

B. The pumps shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.

D. All pumps provided under an individual specification section shall be by the same manufacturer unless otherwise indicated in the specification.

E. All equipment for the pumps, including motors, cans and bases, shall be provided as a complete unit by the pump Manufacturer.

F. The pump supplier shall have unit responsibility for coordinating the proper pump mounting system with the Contractor to ensure stable pump operation free from abnormal vibration.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – Reference Standards.

B. Pumping system equipment, installation and testing shall be in accordance with the following applicable codes and standards. All standards shall be the latest version as of the date of project bidding.

1. Hydraulic Institute

    a. ANSI/HI 3.1-3.5 Rotary Pumps for Nomenclature, Definitions, Application and Operation

    b. ANSI/HI 3.6 Rotary Pump Test

    c. ANSI/HI 9.6.1 Rotodynamic Pumps – Guideline for NPSH Margin

d. ANSI/HI 9.6.3 Rotodynamic Pumps – Guideline for Operating Regions

e. ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values

f. ANSI/HI 9.6.5 Rotodynamic Pumps Guideline for Condition Monitoring

g. ANSI/HI 9.6.6 Rotodynamic Pumps for Pump Piping

h. ANSI/HI 9.6.8 Rotodynamic Pumps -Guideline for Dynamics of Pumping Machinery

i. ANSI/HI 9.8 Rotodynamic Pumps for Pump Intake Design

j. ANSI/HI 14.1-14.2 Rotodynamic Pumps for Nomenclature and Definitions

k. ANSI/HI 14.3 Rotodynamic Pumps for Design and Application

l. ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

2. American Society for Testing and Materials

a. A36 Specification for Structural Steel

b. A48 Specification for Gray Iron Castings

c. A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

d. A148 Specification for Steel Castings, High Strength, for Structural Purposes

e. A193 Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service

f. A276 Specification for Stainless Steel Hot/Cold-Finished Bars

g. A322 Specification for Steel Bars, Alloy, Standard Grades

h. A514 Specification for High Yield Strength, Quenched and Tempered alloy Steel Plate, Suitable for Welding

i. A532 Specification for Abrasion-Resistant Cast Irons

j. A536 Specification for Ductile Iron Castings

k. A565 Specification for Martensitic Stainless Steel Bars

l. A582 Specification for Free-Machining Stainless and Heat-Resisting Steel Bar, Hot-Rolled and Cold-Rolled

m. A743 Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel and Nickel-Base, Corrosion-Resistant for General Application

n. B148 Specification for Aluminum-Bronze Sand Castings

o. B584 Specification for Copper Alloy Sand Castings for General Application

3. American National Standards Institute

a. B16.1 Standard for Cast Iron Pipe Flanges and Flanged Fittings

b. B16.5 Standard for Pipe Flanges and Flanged Fittings

4. ANSI/NFPA 70 National Electric Code

5. Society of Automotive Engineers SAE J404 Chemical Compositions of SAE Alloy Steels

6. Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

C. Related contract specification sections:

1. Section 43 23 69 – Double Disc Pumps

2. Section 46 00 00 – Equipment General Provisions

3. Section 46 76 21 – Belt Filter Presses

4. Section 46 77 20 – Liquid Polymer Preparation System

1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data:

1. Comply with Section 01 33 00 – Submittals

2. Fabrication information

B. Provide submittals identified in Specification Section 46 00 00 – Equipment General Provisions in addition to the submittals identified herein and in addition to the submittals identified in the individual pumping specification sections.

C. Shop Drawings shall include the following information in addition to the requirements of Section 01 33 00 – Submittals and shall include the following information in addition to the requirements of Section 01 33 00 – Submittals:

1. Pump name, identification number and specification number.

2. Performance characteristics and descriptive data, including but not limited to pump performance curves at rated speed and reduced speeds (if reduced speeds are specified). Curves shall indicate flow, head, impeller diameter, efficiency, brake horsepower, and NPSH required. Curves shall identify minimum continuous stable flow (minimum flow to avoid suction recirculation), preferred operating region (POR) and allowable operating region (AOR) per the latest version of ANSI/HI 9.6.3. Performance curves submitted shall be for the entire pump assembly, including efficiency corrections and losses. Pump performance curves shall be submitted both in the form of performance data cut sheets and in tabular format. Tabular data shall include the following:

   a. Flow

   b. Pump Head

   c. NPSH required

   d. Pump Efficiency

   e. A minimum of 10 data points shall define rotodynamic pump performance curves listed above. Performance curve data points shall include the following:

      1) best efficiency point

      2) all specified operating points

      3) preferred operating range minimum and maximum

      4) allowable operating range minimum and maximum

      5) shutoff condition

      6) runout.

      7) The remainder of the points shall be distributed evenly to clearly define the shape of each of the curves.

      8) Each data point shall be reported to a minimum of three (3) significant figures.

9) The curve data shall align with the HI acceptance grade (i.e., 1U) as specified in the individual pump specification and shall explicitly state the applicable tolerance band, as defined by the Hydraulic Institute Standards, associated with each value.

3. Detailed dimensional drawings and setting plans including but not limited to:

   a. General cutaway sections

   b. Materials

   c. Dimension of shaft projections

   d. Shaft and keyway dimensions

   e. Shaft diameter

   f. Shaft-impeller connection details

   g. Dimension between bearings

   h. General dimensions of pump

   i. Suction head bolt orientation

   j. Anchor bolt locations

   k. Forces

   l. Assembly views

   m. Provide weight of entire pump assembly, including motor and base weight of individual major subassemblies. Indicate the weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.

   n. Drawings shall identify each component by tag number to which the catalog data and detail sheets pertain.

4. Drive and motor data as required by Division 26 – Electrical. Complete motor data shall include but not be limited to size, make, type and characteristics along with wiring diagrams. Where pump and motor speeds are to be regulated by variable speed drives, the Contractor shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit pump, motor and variable speed drive shop drawings together as a complete system.

5. Information on bearing types and bearing life.

6. Gear box design and performance criteria and AGMA service factor.

7. Equipment protective device details and connection diagrams.

8. Details of shaft sealing system including seal/packing type, seal water control devices, and seal water piping schematic.

9. Information on pump appurtenances including couplings, shaft guards, v-belt drive systems, etc.

10. Any additional information required to demonstrate compliance with the specifications.

D. Shipment, Delivery, Handling and Storage instructions.

E. Installation instructions.

F. Manufacturers literature and brochures

G. Lubrication Information: Complete lubrication instructions and lubricant schedule, including manufacturer's recommended lubricant. All lubricants shall be food grade, NSF 61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application

H. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.

I. Coatings: Coating system data and description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

1.04 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittals

2. Section 01 61 00 – Material and Equipment

B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittals and Section 01 78 23 – Operation and Maintenance Manuals.

1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittals

2. Section 01 78 23 – Operation and Maintenance Manuals.

B. Comply with Section 01 79 00 – Training.

C. Comply with Section 46 00 00 – Equipment General.

1.06 QUALITY ASSURANCE SUBMITTALS

A. Factory testing plan.

B. Factory Test Results shall be submitted and approved prior to shipment of equipment.

C. Field testing plan.

D. Preliminary field test data.

E. System field quality control testing.

F. Final field test data.

G. Certified test reports.

1.07 GENERAL INFORMATION AND DESCRIPTION

A. Comply with Section 46 00 00 – Equipment – General Provisions.

1.08 WARRANTY

A. Warranty requirements shall be as specified in Section 01 78 36 – Warranties and Bonds. Warranty requirements are supplementary to the individual equipment specifications.

B. Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

1.09 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS:

A. When operating at the maximum output speed each pump shall have a characteristic performance curve which meets the conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full-range of

speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency as defined herein shall include all mechanical losses from bearings and shaft seals.

B. Pump manufacture shall certify a Minimum Continuous Stable Flow (MCSF) rating at maximum speed that is lower than the specified minimum operating flow. Where a reduced speed operating condition is specified, the manufacturer shall also certify MCSF at the pump speed required to meet this condition.

C. Factory test acceptance grade for rating point shall be as specified herein, except where superseded via specification and/or scheduled values in the individual pump specifications, however power required shall not exceed the rated motor horsepower.

D. Pump Operating Conditions: Refer to respective individual pump specifications for specific performance requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Performance Curves:

1. All centrifugal pumps shall have a continuously rising curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or drive, unless otherwise specified under the individual equipment Specifications.

2. Pump curves shall be non-overloading throughout the curve.

B. Suction and discharge flanges shall conform to ASME B16.1 or B16.5 dimensions.

C. For pumps in raw sewage or sludge service and as required by individual pump specifications, handholes shall be provided on the pump suction nozzle and the pump volute and shall be shaped to follow the contours of the casing or adjoining piping to avoid any obstructions in the water passage.

D. The minimum ABMA L10 bearing life for all pump, motor and drive bearings shall be 60,000 hours unless otherwise specified in the individual pump specification sections.

2.02 ANCHORS AND SUPPORTS

A. Comply with the following Specification Sections:

1. Division 05.

2. Specification Section 46 00 00 – Equipment General Provisions.

3. Comply with individual pump specifications.

B. Comply with ACI 351.3R-04 – Foundations for Dynamic Equipment.

2.03 DEFAULT MATERIALS

A. Pumps shall be constructed out of the materials specified in respective individual pumping specification sections. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:

Component	Material
Casings and Bowls	Close-grained gray cast iron, conforming to ASTM A 48, or equal
Shafts, wetted	Type 400 series stainless steel
Shafts, non-wetted	AISI 4140 steel
Miscellaneous stainless steel parts	Type 316 series stainless steel
Anchor Bolts and Fasteners	Type 316 stainless steel

2.04 COMPONENTS:

A. Refer to individual specification sections for specific requirements.

B. Bearings:

1. Bearings shall be designed for continuous heavy duty loads and for both axial and radial thrust loads.

2. The specified AFBMA B-10 life for bearings shall be under worst possible operating conditions.

2.05 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment supports, etc. shall conform to the requirements of Division 05.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications

2.06 DISSIMILAR METALS

A. All dissimilar metals shall be isolated in accordance with Division 05 and to the satisfaction of the Engineer.

2.07 GALVANIZING

A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Division 05.

2.08 STANDARDIZATION OF GREASE FITTINGS

A. Grease Fittings: Comply with Section 46 00 00 – Equipment General Provisions.

2.09 APPURTENANCES

A. Seals:

1. Mechanical seals shall be furnished as specified in individual pumping equipment sections.

2. If the pump manufacturer recommends a better seal or alternate flushing arrangement for a specific application, it may be submitted to the Engineer for approval in accordance with the requirements of the Contract Documents.

B. Pressure Gauges:

1. Contractor shall supply all pressure gauges for all pumps by one manufacturer.

2. Gauges shall be provided through the instrumentation subcontractor to match other gauges on the project.

3. All gauges shall be provided with diaphragm seals or isolating ring seals.

4. The Contractor shall furnish and install pressure gauges as shown on the Drawings, but the following gauges shall be provided as a minimum:

a. On the suction and discharge of each pump..

C. Equipment Guards: Provide guards in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.

2.10 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the

applicable requirements of the Division 26 specifications and the latest National Electric Code.

B. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation. The use of service factor will not be allowed in determining overloaded condition.

C. In the individual pump specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

D. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 26 unless otherwise specified in the pump specification.

E. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual pump specifications.

2.11 SPARE PARTS AND SPECIAL TOOLS

A. Accessories, spare parts, and special tools shall be provided in accordance with individual specifications.

B. Spare parts for equipment shall be furnished where indicated in the equipment Specifications and/or where recommended by the equipment manufacturer.

C. Spare parts shall be identical and interchangeable with original parts.

D. The Contractor shall furnish a one-year supply of all recommended lubricating oils and greases.

2.12 EQUIPMENT IDENTIFICATION

A. Comply with the requirements of Section 46 00 00 – Equipment General Provisions.

B. All pumps shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with:

1. the manufacturer's name

2. year of manufacture

3. model number

4. serial number

5. and principal rating data including the following at the primary design point:

    a. Capacity in gallons per minute

    b. rated total dynamic head

    c. speed in rotations per minute

    d. efficiency at the primary design point.

C. Each pump shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump – 1 (RWP-1)". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

D. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

A. The terms Shop Testing and Factory Testing shall be considered to be interchangeable.

B. Perform Shop Testing in conformance with Section 46 00 00 – Equipment General Provisions.

C. The Contractor shall be responsible for the coordination of factory testing of each pump, variable speed drive, and motor. Pump tests shall utilize the actual motors and pump motor bases and couplings to be furnished with the pumping equipment. Where required as indicated by the individual pump specification sections, variable speed pumps shall be tested with the actual variable speed controllers supplied for the project. Use of the pump manufacturers standard test motors and test stand is not acceptable.

D. Factory testing shall be conducted in accordance with the latest version of Hydraulic Institute Standard 14.6, Hydraulic Performance Acceptance Tests. For submersible pumps, testing shall be conducted in accordance with the latest version of ANSI/HI 11.6.

E. Hydraulic Performance Acceptance Tests

1. The testing procedure shall be submitted to the Engineer for review and approval before scheduling the testing. The Owner/Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.

2. Notification and payment of expenses for witness testing shall be as described in Section 46 00 00 – Equipment General Provisions wherever individual pump specifications call for witness testing

3. Pump rating point shall be within the tolerances specified for Acceptance Grade 1U unless otherwise specified in the individual pump specifications.

4. Factory performance test shall include a minimum of seven test points between shutoff and runout.

5. Where required by the individual equipment specification sections, NPSH tests shall be conducted to demonstrate compliance with the specified NSPH requirements. Where full curve NPSH testing is required, a minimum of four points shall be tested.

6. Certified test curves shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications.

    a. Certified curves shall identify minimum continuous stable flow (minimum flow to avoid suction recirculation) and preferred operating region (POR) and allowable operating region (AOR) per the latest version of ANSI/HI 9.6.3.

7. Where required by the individual pump specification sections, factory vibration testing shall be performed to demonstrate compliance with HI 9.6.4.

8. All instruments shall be calibrated as required by ANSI/HI 14.6 or 11.6 as applicable.

F. Where required in the individual pump specifications, a certified hydrostatic test shall be completed on each pumping unit in accordance with ANSI/HI 14.6 or 11.6 as applicable. Test pressure shall be 1.5 times maximum operating head or 1.25 times shutoff head, whichever is greater.

G. Where required in the individual pump specifications, each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E-10. Results shall be certified by a registered professional engineer.

H. Shop testing of electric motors shall conform to:

1. Individual equipment specifications.

2. Section 46 00 00 – Equipment General Provisions.

3. Division 26 sections.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery and handling of equipment and materials shall be in accordance with Section 01 61 00 – Material and Equipment.

B. Storage of equipment shall be in accordance with Section 01 61 00 – Material and Equipment.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

D. Machined surfaces of all exposed pump openings or other exposed unpainted surfaces shall be protected by wooden blanks or Cosmoline, as appropriate, strongly built and securely bolted thereto.

E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

3.03 MANUFACTURER'S FIELD SERVICES

A. Manufacturer’s field services shall be in accordance with:

1. Section 01 61 00 – Material and Equipment

2. Section 01 79 00 – Training

3. Section 46 00 00 - Equipment General Provisions

B. As a minimum the services of the manufacturer's representative shall be provided for as stated in individual pump specifications:

C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

3.04 INSTALLATION

A. Pumping equipment shall be installed in accordance with Section 46 00 00 – Equipment General Provisions, the manufacturer's recommendations, accepted procedures submitted with the shop drawings and as indicated on the Drawings, unless otherwise accepted by the Engineer.

B. Level pump and motor and grout feet or baseplate with non-shrink grout. Ensure minimum grout depth is obtained as recommended by the pump and grout manufacturers.

C. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with stainless steel pipe or copper tube (as appropriate for the environment), properly supported with brackets.

D. Contractor shall have unit responsibility for the proper coordination, sizing, and installation of the pump foundation/mounting requirements based on the manufacturer's recommendations, subject to Engineer's review and comment.

3.05 ALIGNMENT

A. Pumping equipment shall be aligned in accordance with Section 46 00 00 – Equipment General Provisions, the manufacturer's recommendations, accepted procedures submitted with the shop drawings and as indicated on the Drawings.

B. Equipment shall be aligned and free from binding, scraping, excessive vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.

C. As a minimum, comply with International Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.

3.06 FIELD TESTING

A. Comply with Section 46 00 00 – Equipment General Provisions for applicable preliminary and final field testing requirements supplementary to those described in this specification.

B. All pumping units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation over the full operating speed range, without excessive noise, vibration, cavitation, and overheating of the bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Pumps shall be tested for vibration over the full specified speed range. Unless otherwise required by individual specification sections, vibration shall be within the limits identified in the latest version of ANSI/HI 9.6.4 (or ANSI/HI 11.6 for submersible pumps), or manufacturer's limits if more stringent. If vibration is greater than 80% of the limits identified in ANSI/HI 9.6.4, follow-up vibration testing shall be completed after a 90-day break-in period to ensure that vibration remains within ANSI/HI 9.6.4 allowable limits. If vibration exceeds the allowable limits during the follow up testing, modifications shall be made as a warranty repair.

2. Bearing temperatures shall be determined. A running time of at least 20 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.

3. Where specified in the individual pump specifications, the natural frequencies of each installed pump shall be determined using the “bump test” method. Natural frequency testing shall demonstrate a minimum of 10% separation from the 1x running speed, 2x running speed and vane pass frequencies.

4. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage,-amperage, motor power, flow, pump suction head, and pump discharge head, for at least five (5) pumping conditions at full speed. One of the points shall be within -5% and 0%, and one being within 0% and +5% of the guarantee point flow rate; the remaining three points shall be spaced over the allowable operating range of the pump performance curve with points taken at or near the maximum allowable (shutoff) head region and at or near the maximum allowable flow (runout). Additional reduced speed testing shall be performed to demonstrate that pumps can achieve performance at turndown conditions where specified in individual pump specification sections. Each power lead to the motor shall be checked for proper current balance. Flow shall be measured to the extent possible by permanently installed instrumentation or drawdown measurement. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing. Field performance testing shall meet HI 14.6 pump acceptance test grade and tolerance band grade 1U.

C. The field testing shall be witnessed by the Owner or its representative. The Contractor shall submit to the Engineer a written notification of all pump field tests a minimum of one (1) week prior to testing. In the event of failure of any pump to meet any of the above requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional compensation, until found satisfactory. The Contractor shall then certify in writing that the equipment has been satisfactorily tested, and that all final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The costs of all Work performed in this Paragraph by factory-trained representatives shall be borne by the Contractor.

3.07 FAILURE OF EQUIPMENT TO PERFORM

A. Comply with Section 46 00 00 – Equipment General Provisions.

3.08 PAINTING

A. Comply with Section 46 00 00 – Equipment General Provisions.

B. Comply with Section 09 90 00 – Painting and Coating.

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SECTION 43 23 57
PROGRESSIVE CAVITY PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place into satisfactory operation progressive cavity pumps at the locations shown on the Drawings and as specified herein. All pumps specified herein shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 43 20 00 – Pumps General.

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittals

B. Section 01 61 00 – Material and Equipment

C. Section 01 78 23 – Operation and Maintenance Manuals

D. Section 01 78 36 – Warranties and Bonds

E. Section 01 79 00 – Training

F. Section 43 20 00 – Pumps General

G. Section 46 00 00 – Equipment General Provisions

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with Section 43 20 00 – Pumps General

B. Comply with the following standards:

1. American Bearing Manufacturers Association, (ABMA).

2. American National Standards Institute, (ANSI).

3. American Water Works Association, (AWWA).

4. Hydraulic Institute, (HI).

5. Institute of Electrical and Electronic Engineers, (IEEE).

6. National Electrical Code, (NEC).

7. National Electrical Manufacturers Association, (NEMA).

1.04 ACTION SUBMITTALS

A. Provide submittals identified in Section 46 00 00 – Equipment General Provisions in addition to the submittals identified herein.

B. Provide submittals identified in Section 43 20 00 – Pumps General.

C. Product Data:

1. Manufacturer's literature, illustrations, specifications and engineering data.

2. Performance data and curves showing flow rate, head, brake horsepower, motor horsepower, speed, and NPSHr. Where variable speed units are specified, curves shall have at least five speeds plotted between maximum and minimum rpm.

3. Weight of complete pump and motor assembly.

4. Motor data including full load amps and locked rotor amps data.

5. Include a compatibility statement to indicate that motor and VFD are compatible, that the pump is compatible with the upper end of the polymer's viscosity range, and that the motor size accounts for polymer's specific gravity.

6. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.

D. Shop Drawings:

1. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.

2. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

3. Drawings of control panels, furnished in accordance with the requirements of Section 40 61 00.

1.05 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with Section 01 78 36 – Warranties and Bonds.

B. Submit preliminary and final Operation and Maintenance (O&M) manuals in accordance with Section 01 78 23 Operation and Maintenance Manuals. Include all shop and field test reports, maintenance data and schedules, description of operation, spare parts information, and contact information for local authorized service facility.

C. Submit training plan and copy of training materials.

1.06 INFORMATIONAL SUBMITTALS

A. Source Quality Control Submittals

1. Submit copies of pump performance test results and hydrostatic test.

2. Submit results of required control panel shop tests.

B. Field test results.

1.07 WARRANTY

A. Warranty requirements shall be as specified in Section 01 78 36 – Warranties and Bonds. Warranty requirements are supplementary to the individual equipment specifications.

B. Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

PART 2 – PRODUCTS

2.01 GENERAL

A. Comply with Section 43 20 00 – Pumps General, except where superseded in this specification section.

B. Pump Type: Positive displacement, progressive cavity.

2.02 ACCEPTABLE MANUFACTURERS

A. Pump Manufacturer:

1. Seepex

2. Or approved equal

B. All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump manufacturer.

C. The Contractor shall be responsible for design modifications and alterations in the Work required to accommodate substitution equipment differing in dimensions or other characteristics.

2.03 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

Parameter	Polymer Transfer Pump
Number of Pumping Units	1
Orientation	Horizontal
Rating Point (at Full Speed)	-
Flow (gpm)	35
Design Pressure (psig)	43
Maximum NPSH Required (ft)	4.6
Rated Pump Operating Speed (rpm)	306
Fluid Pumped	Neat Polymer (SNF Clarifloc SE-1496)
Polymer Viscosity (cPs)	500 – 2,000
Polymer Specific Gravity	1.02 – 1.04
Polymer Density (lbs/gal)	8.5 – 8.7
Polymer Temperature (degrees F)	Ambient
Polymer pH	Slightly acidic
Suction Diameter (in)	2.0
Discharge Diameter (in)	2.5
Drive Configuration	Right angle direct coupled gear motor
Direction of rotation when viewed from driven end	Clockwise (Reversed)
Minimum ABMA L-10 Bearing life (hours)	26,000
Factory test acceptance grade	1U
Area Classification	Unclassified, humid, corrosive
Control Panel Rating	NEMA 4X
Suction Condition	Flooded
Motor Control	VFD
Turndown Ratio	10:1

2.04 MATERIALS OF CONSTRUCTION

Component	Materials of Construction
Casing	Type 316/316L stainless steel
Rotor	Type 316/316L stainless steel
Universal Joint Sleeve	FKM
Stator	FKM
Stator Tube	Steel
Shaft	Type 316/316L stainless steel
Pump, Gear Box & Motor Base	Fabricated Steel
Fasteners and Hardware	Type 316/316 stainless steel
Mechanical Seal	Silicone carbide, FKM, stainless steel

2.05 COMPONENTS

A. Suction Housing:

1. Inspection Ports:

a. Shape: Rectangular.

b. Quantity: two (2)

c. Inspection ports shall be 180° apart.

d. Inspection ports shall provide access to the universal joints within the suction housing.

B. Pump Ends: Flanged suction and discharge connections shall be 150 pound ANSI Standard flat face flanges.

C. Rotor Design: Single helix.

D. Stator:

1. Stator Design: Double helix.

2. Stator shall be chemically bonded to stator tube.

3. Stator Clamp Rings:

a. Stator shall use 720° clamp rings to fasten the normal horizontal flange and suction housing, with sealed ends or thru-bolts.

b. The clamp rings shall facilitate stator removal.

c. The stator seals shall be designed to prevent the material being pumped from contracting the stator bonding and tube.

E. Universal Joints:

1. Type: Grease lubricated, totally enclosed sealed and shielded, crowned gear.

2. Maximum operating angle: 1-1/2° off center. The low angularity shall maximize universal joint life.

3. Universal joint life: Mechanical components of the gear joints shall be designed to operate for 10,000 hours at the maximum speeds and pressures specified.

4. Function: Transmit the required thrust and torque while allowing the rotor to move in its eccentric path.

5. Joint seal shall prevent any liquid from contaminating the gear

6. Shield shall prevent any foreign objects from rupturing the seal.

F. Connecting Rod:

1. Design: Splined.

2. Function: Connect the gear joints of the eccentrically moving rotor and the drive shaft.

3. The connecting rod shall pass through the suction housing/shaft seal area within the hollow drive shaft quill so that no eccentric loads are imparted on the packed seal.

4. The connecting rod shall be rigid and not susceptible to chipping.

G. Shafting:

1. Shaft design shall be two-part hollow quill removable for repair.

2. Shaft quill shall be:

a. Replateable

b. Removable without removing the bearings from the bearing housing or disconnecting the driver.

H. Bearings:

1. Type: Grease lubricated, tapered roller, with diverging pressure angles for maximum shaft stability.

2. The scheduled minimum L-10 life of the bearing shall exceed 26,000 hours based on maximum operating conditions.

3. Bearing cover plate:

a. The bearings shall be protected from contamination by means of a bearing cover plate.

b. Bearing cover plate shall be bolted to the bearing housing.

I. Base:

1. Equipment Support: Common pump, speed reducer and motor base shall be suitably constructed to support the full weight of pump drive unit and motor.

2. Base shall be especially fabricated for, the pump, motor and gearbox components and sufficiently sized to ensure rigid support.

3. Materials of construction shall be heavy welded steel construction, fabricated steel, steel open channel design, or cast iron as scheduled in herein.

4. Shall be provided with bolt holes, grout holes/openings and drain connections with a drip lip.

J. Speed reducer:

1. Manufacturer: SEW Eurodrive or approved equal.

2. Type: Double reduction parallel shaft helical gear drive.

3. Speed reducer shall be provided by the pump manufacturer.

4. Speed reducer construction:

a. The case shall be cast with integral mounting feet.

b. The gears shall be A.G.M.A. Class I.

c. Minimum hardness: Rockwell "C" hardness of 60.

d. Lubrication: Splash type with oil maintained in the housing.

e. Speed reducer bearings:

1) Anti-friction bearings shall be used throughout

2) Shafts shall be sealed with shielded, spring-loaded, lip type seals.

f. Speed reducer motor mount:

1) Motor mount shall be rabbeted, doweled or sleeved so that automatic alignment is maintained when bolted to the gearbox.

2) It shall be designed to accept a standard frame NEMA motor.

2.06 ANCHORAGE

A. Comply with Section 05 05 23 – Metal Fastening.

B. Contractor shall provide anchorage in accordance with Manufacturer's recommendations.

2.07 STANDARDIZATION OF GREASE FITTINGS

A. Grease Fittings: Comply with Section 46 00 00 – Equipment General Provisions.

2.08 APPURTENANCES

A. Shaft Seals

1. Single mechanical seal shall not require an external flush water source.

2. Acceptable Manufacturer:

a. AESSEAL Converter II

b. Or approved equal.

3. Shaft sealing shall be accomplished by one of the following methods as identified in the schedule below.

	Service 1
Shaft Sealing Arrangement	Single Mechanical Cartridge Seal
Seal Flush Source / API Flush Plan	None
Seal Face Material	Silicon Carbide vs. Silicon Carbide

	Service 1
Metallic Components	316 SST
O-rings	FKM/Viton

B. Pressure Gages: Provide pressure gages as indicated on the drawings and as specified under Section 43 20 00 – Pumps General.

C. Shaft Couplings:

1. Comply with Section 43 20 00 – Pumps General.

2. Pump shaft connections to drives and/or speed reducers shall be through flexible couplings.

3. Coupling shall be provided with coupling guard.

4. Manufacturer:

a. Falk

b. Dodge

c. Or equal.

2.09 ELECTRICAL REQUIREMENTS

A. Comply with Specification Section 43 20 00 – Pumps General.

B. Electrical motors shall be premium efficiency and as follows:

Motor Parameter	Polymer Transfer Pump
Rating	460V, 3 ph, 60 Hz
Horsepower, hp	5
Speed, rpm	1,800
Enclosure	TEFC
Insulation	Class F
Inverter Duty	Yes
Service Factor	1.15
Anti-condensation Space Heater	No
Motor Winding Temperature Switches	Yes

2.10 PUMP INSTRUMENTATION REQUIREMENTS

A. Pump instrumentation shall be as follows:

Instrument	Polymer Transfer Pump
Low Suction Pressure Switch	Yes
High Discharge Pressure Switch	Yes
In-Line Fluid Detection System	Yes
Dry Run (Pump Stator High Temperature) Protection Device	Yes
Full line-size isolating ring seals	Yes

B. High discharge and low suction pressure switches and associated full line size isolating ring seals shall be furnished and installed where specified. The pressure switches and isolated ring seals shall be furnished under Division 40.

C. Dry Run Protection Device:

1. Run Dry Protection:

a. The stator shall be fitted with a sensor sleeve and thermostat sensor. A digital controller shall also be provided in the local control panel. The controller shall monitor the stator temperature and activate shutdown if the stator temperature reaches the pre-set adjustable limit at the controller. Additional contacts shall be provided for an external alarm. The controller shall include a manual local and remote reset function.

D. In-line Fluid Detection System:

1. Function:

    a. In-line system that shall protect pumps from damage caused by an absence of liquid in the suction piping of the pump.

    b. The system must be capable of ignoring errors caused by coating "build-up" on the sensing element. System shall continue to operate with up to 10% of pipe diameter coating on the sensor. Coating could be wet or dry or a series of wet and dry layers.

2. Construction:

    a. The system shall consist of an in-line, non-intrusive, ring-shaped sensor with sensor condulet, a remote 120 VAC 60 Hz powered electronic unit, and interconnecting cable.

        1) Ends:

            a) Flange mounting shall mate with 150# flat faced flanges per ANSI B16.5.

            b) Flange and pipe size to be as shown in the Contract Drawings. Wetted metal parts to be 316 stainless steel.

        2) Sensing Element:

            a) The sensing element shall be of a non-intrusive design with no moving parts.

            b) The sensing element shall be a 3 terminal type with exposed metal active and shield elements.

            c) The sensing element shall be installed in a vertical line and mounted on the suction port of the pump.

        3) Electronic Unit

            a) Type: Solid state, radio frequency admittance type, with circuitry designed to ignore errors generated by coating build-up on the sensing element.

            b) Mounting: The electronic unit shall be mounted in a NEMA 4X housing.

            c) Indicator Lights: Liquid presence/absence status shall be indicated with red and green status lights.

d) The unit shall be furnished with empty-pipe fail-safe relay which shall be de-energized to alarm in the event of a malfunction or power loss.

e) Time Delay: The unit shall have as standard an adjustable 0 to 90 second time delay circuit for pump priming and for preventing premature pump shutdown caused by momentary air pockets.

f) Ambient Temperature Limits: -40° to 140°F.

g) Outputs shall be DPDT contacts rated 10A at 120 VAC.

4) Cable:

a) The cable connecting the fluid detector and the electronic unit shall be 4 conductor driven shield type and shall be used to connect the sensing element to the electronic unit.

b) The manufacturer and Contractor shall examine the Drawings to determine the required cable length.

b. The unit shall be calibrated and adjusted in the field by the pump supplier.

c. Acceptable Manufacturers:

1) Drexelbrook Engineering Company, model 506-7032 Series In-Line Fluid Detector,

2) Princo Model L3545 with sensor flange L632 presence/absence detector,

3) Or approved equal.

2.11 CONTROLS

A. A manufacturer-supplied, relay-based local pump control panel shall be provided.

B. Controls shall be provided in a NEMA 4X, 316 stainless steel enclosure.

C. The panels shall contain and be sized to house all controls necessary for the operation of the pump/motor units, including VFD.

D. VFD shall be constant torque type.

E. VFDs shall meet the requirements of Section 26 29 23 – Variable Frequency Drives.

F. Control devices shall include the following:

1. Indicator lamp for motor: running - green light; and alarm condition - red light.

2. Mechanical, non-reset, elapsed time counter.

3. VFD.

4. Dry-run protection device.

5. In-line fluid detection system.

6. Relay circuitry for suction and discharge pressure switches.

G. The control panels shall be provided by the pump system supplier, along with all of the related field mounted instruments specified herein, as required to make the system a completely functioning pump system.

2.12 SPARE PARTS AND SPECIAL TOOLS

A. Comply with Section 43 20 00 – Pumps General.

B. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following for each series of pumps.

Component	Quantity
Set of motor and pump bearings	1
Set of gaskets and O-ring seals	2
Spare stator (with TSE sensor sleeve)	1
Spare rotor	1
Mechanical seal	1

2.13 SHOP PAINTING

A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill/scale, rust, grease, dirt and other foreign matter.

B. Pumping shall receive manufacturer’s standard enamel blue shop-applied prime and finish coating system

C. Gears, bearing surfaces and other similar surfaces obviously not to be painted, shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating

shall be maintained as necessary to prevent corrosion during periods of storage and erection.

2.14 EQUIPMENT IDENTIFICATION

A. Comply with Section 43 20 00 – Pumps General.

2.15 SHOP TESTING

A. Factory testing shall be in accordance with Section 43 20 00 – Pumps General, and shall include:

B. Shop tests may be completed using shop motor.

Test	Polymer Transfer Pump
Hydraulic Performance Testing	Yes
Certified Performance Curves	Yes
NPSH Test	Single Point

PART 3 – EXECUTION

3.01 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery and handling of equipment and materials shall be in accordance with Section 01 61 00 – Material and Equipment.

B. Storage of equipment shall be in accordance with Section 01 61 00 – Material and Equipment.

3.02 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 43 20 00 – Pumps General. Field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1

3.03 INSTALLATION

A. Install pump in strict accordance with manufacturer's recommendations and Section 43 20 00 – Pumps General.

B. Install with recommended clearances provided for service and maintenance.

C. Install base mounted pumps and steel foundation plates on concrete base. Set and level pump. Grout under pump base with non-shrink grout.

D. Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

E. Lubricate pumps before start-up. Start up in accordance with manufacturer's instructions.

F. Have manufacturer's representative onsite to inspect installation and provide Engineer with a written report as to any installation or start up problems. Should any problems be noted the manufacturer's representative will describe procedures to resolve them.

G. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.

3.04 ALIGNMENT

A. Comply with Section 43 20 00 – Pumps General.

3.05 FIELD TESTING

A. Field testing shall be in accordance with Section 43 20 00 – Pumps General, and shall include:

Test	Polymer Transfer Pump
Field Performance Testing	Yes
Vibration Testing	Yes
Megger Test	Yes

END OF SECTION

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SECTION 43 23 69
DOUBLE DISC PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install reciprocating positive displacement double disc pumps at the locations shown on the Drawings and as specified herein.

B. The same manufacturer shall supply all pumps provided under this Section. Pumps shall be complete pumping units consisting of pump, v-belt drive arrangement, and motor all completely assembled on fabricated stainless-steel base and shall conform to the pump requirement described herein.

C. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 43 20 00 – Pumps – General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

	Belt Filter Press Feed Pumps
Quantity	2
Configuration	Duplex, compact motor mount
Material Being Pumped	Non-thickened aerated WAS
Solids Concentration	0.50 to 1.0%
Normal Design Flow Condition	240 gpm at 45 ft TDH
Maximum Design Flow Condition	400 gpm at 100 ft TDH
Maximum Pump Speed, rpm	230
Suction Diameter, inches	6
Discharge Diameter, inches	6
Drive Type	V-belt
Minimum Motor Horsepower	25
Maximum Motor Speed	1200
Service Factor	1.15

	Belt Filter Press Feed Pumps
Motor Enclosure	TEFC
Motor Electrical	460/3 Ph/60 Hz
Motor Control	VFD
Low Suction Pressure Switch	Yes (To be supplied by Systems Integrator)
High Discharge Pressure Switch	Yes

1.03 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittals and Section 46 00 00 – Equipment General Provisions.

B. Shop Drawings: Complete assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, drive unit, parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section.

1. Pump data:

    a. Manufacturer

    b. Type and model

    c. RPM at rated condition

    d. Size of suction and discharge flanges

    e. Complete performance curves

    f. Net operating weight of pump and baseplate

    g. Base and anchor bolt details

    h. Data on pressure sensor and switch assemblies

    i. Data on pulsation dampeners

2. Motor data:

    a. Manufacturer

b. Type, model, and enclosure

c. Rated size of motor, hp and service factor

d. Temperature rise and insulation rating

e. Full load rotative speed

f. Net weight

g. Efficiency at full, ¾, and ½ load

h. Full load current

i. Locked rotor current

j. Overall dimensions and base details

k. Power factor at no load and at full load

C. Operation and Maintenance Manuals: Complete with manufacturer's instructions for equipment installation, equipment function, start-up procedures, operation, preventative maintenance, servicing, and troubleshooting.

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 01 78 36 – Warranties and Bonds and Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years against defects in workmanship and materials under normal use, operation, and service. If the equipment should fail during the warranty period due to a defective part, it shall be replaced and the units restored at no expense to the Owner.

1.05 UPGRADE OR EXCHANGE PROGRAM

A. Manufacturer shall offer an upgrade/exchange program that allows Owner to exchange an existing pump for a separate factory-reconditioned pump (at reduced cost to Owner) throughout the life of the pump with no limit on the quantity of exchanges that may be completed for each unit.

B. Owner will be responsible for palletizing an existing pump in accordance with Manufacturer's recommendations. Manufacturer shall load and transport the existing pumping equipment off site and shall deliver the refurbished unit to the Site.

C. Manufacturer shall provide a one-year warranty on material and workmanship on all exchanged refurbished units. This warranty shall cover the reconditioned bareshaft pump or drive assembly only (excludes existing motors, gearmotors, and VFDs).

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The reciprocating positive displacement double disc pumps shall be furnished by

1. Penn Valley Pump Company, Inc.

2. Or approved equal.

2.02 MATERIALS OF CONSTRUCTION

A. Materials of construction shall conform to the following minimum requirements unless otherwise specified:

Component	Material of Construction
Housings	Cast iron
Discs	Fabric-reinforced neoprene
Trunnion seals	Fabric-reinforced neoprene
Clack valve	Fabric-reinforced neoprene
Connecting rods	Aluminum
Drive shaft	Hardened 400 series stainless steel
Eccentric cams	Cast bronze alloy
Bearing pedestals	Aluminum
Covers	Type 304 stainless steel
Subbase frame	Type 304 stainless steel
Pulsation dampeners main tube	Sch. 40 carbon steel

2.03 COMPONENTS

A. Each pump shall be a duplex, heavy duty, free disc style positive displacement type pump.

B. The duplex pump arrangement shall consist of two pumps mounted on a common sub-base with common suction and discharge manifolds terminating into single suction and discharge connections.

C. Each individual pump shall consist of housings horizontally split to allow access to the internal components.

D. The pumps shall incorporate a maintain-in-place hinged housing design that allows the pumps to be serviced and discs replaced without removal of the pump or disturbing the suction and discharge piping.

E. The discharge housing shall contain the mounting lugs and be bolted directly to the mounting frame.

F. The discharge, intermediate and suction housings shall incorporate an integral hinge arrangement that allows the suction and intermediate housings to be lowered and removed. The hinges shall be connected to each other with a quick release ball detent pin allowing for easy pin removal.

G. The pumps shall be capable of operating dry for an indefinite period without damage.

H. The pumps shall be capable of self-priming up to 14” Hg, and up to 25” Hg when fully primed.

I. The pumping action of each individual pump shall be achieved by two (2) free floating reciprocating discs attached to connecting rods driven by a rotating eccentric shaft.

J. Each disc shall be mounted to the connecting rod by a stub shaft.

K. The discs shall be of integral design and constructed of multiple layers for longevity and strength. The suction and discharge discs shall be universal and interchangeable. The reciprocating action of the discs shall also perform the duty of check valves.

L. Sealing of the pump fluid chambers shall be achieved by flexible trunnions. The trunnion seal shall not be designed to provide any pumping action. The trunnion construction shall be capable of withstanding pressures from 0 to 110 PSI on an intermittent basis and a maximum operating pressure is 140’ TDH.

M. Pump designs utilizing packing glands, mechanical seals, or water seal systems will not be accepted.

N. For each individual pump the swan neck entry port to the suction housing shall be a two (2) piece design allowing for mounting of the suction connection in 90-degree increments and easy access for clack replacement.

1. The opening shall be a full port and of a diameter that matches the suction connection size so as to minimize debris buildup and blockages.

2. The seating surface for the clack valve shall be machined on the mounting face of the swan neck. The clack valve shall be integrally mounted to the swan neck to facilitate access and replacement.

3. The clack valve shall be manufactured of neoprene construction with multiple layers of fabric encapsulating a rigid core.

4. The clack valve shall incorporate an integral O-ring seal for positive sealing.

O. For each individual pump the bearing drive assembly shall consist of two (2) aluminum modular pedestals designed to provide accurate bearing alignment, superior bearing loading and ease of assembly.

P. The drive shaft shall be a minimum 1-$^{15}/_{16}$" diameter and capable of withstanding a dead head situation. The shaft shall be mounted on self-aligning, sealed bearings.

Q. The eccentric cams shall be pinned to the shaft by spiral drive pins to allow for the absorption of reciprocating loads generated by the pumping action

R. All drive bearings shall be completely sealed and not require grease fittings.

S. The duplex assembly shall be driven through a v-belt and drive assembly consisting of a 2-belt timing belt system. The pulley ratios shall be sized to provide the maximum pump speed listed in the pump schedule in this section and to provide the required torque generated between the pump and motor.

T. The duplex assembly shall be provided with OSHA approved guards and covers.

U. The pumps shall be mounted on a common sub-base. Base design shall have raised cross-members on the suction and discharge end to allow for complete wash-out and draining without trapping liquid. Each sub- base shall be manufactured from minimum 2-1/2" square tubing. Base shall be sufficiently gusseted, reinforced, and braced to withstand all shock loads and resist all wearing and buckling during pump operation. Tubing ends shall be capped with black plastic plugs for neat appearance.

V. The suction and discharge port connections shall be ANSI Class 150 raised face flanges.

2.04 PULSATION DAMPENERS

A. Pulsation dampeners shall be provided on the suction and discharge manifolds.

B. The main tube shall be minimum 8” diameter schedule 40 carbon steel pipe with fully welded end caps.

C. The dampeners shall be pressure tested to 60 psi for leaks.

D. Each dampener shall be provided with a 1-inch half coupling located at the top. This connection shall be suitable for the pressure switch assembly or the ball valve/quick disconnect assembly. An isolation valve on each dampener shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

E. Each manifold shall be supplied with a 1 ½” NPT coupling and plug to act as a drain/sample port.

2.05 SUCTION INDICATION

A. The pump manufacturer shall provide a suction sensor and gauge assembly mounted on one of the two pulsation dampeners for each duplex assembly. The other shall be provided with an isolation ball valve.

B. The sensor shall be PVP420 pressure sensing assembly, Red Valve 42/742 diaphragm seal/pressure sensor assembly, or approved equal. These sensor assemblies shall include a gauge.

C. The sensor shall be a 1-inch NPT isolation pressure sensor with type 316 stainless steel body and EPDM elastomeric sensing tube connected to the suction gauge.

D. The gauge shall be attached to the sensor using type 316 stainless steel fittings.

E. The gauge shall be 4” diameter stainless steel with 30” Hg – 30psi scale range.

F. The units shall include a type 316 stainless steel isolation valve mounted to the top of the sensor.

G. The opposite end of the valve shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

2.06 DISCHARGE PRESSURE PROTECTION

A. The pump manufacturer shall provide a discharge pressure sensor and switch assembly mounted on one of the two discharge pulsation dampeners for each duplex assembly. The other shall be provided with an isolation ball valve.

B. The sensor shall be PVP420, Red Valve 42/742, or approved equal.

C. The sensor shall be a 1-inch NPT isolation pressure sensor with type 316 stainless steel body and EPDM elastomeric sensing tube connected to the gauge using type 316 stainless steel fittings.

D. The gauge shall be 4” diameter stainless steel with a 0 - 100 psi pressure scale range.

E. The gauge shall be connected to a pressure switch. Pressure switch shall be as manufactured by Ashcroft B400, or qpproved equal. Pressure switch shall include a NEMA 4X enclosure and shall be field adjustable. Switch shall be factory preset at 30 psi. .

F. The units shall be provided with a type 316 stainless steel isolation valve mounted to the top of the sensor.

G. The opposite end of the valve shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

2.07 ELECTRICAL REQUIREMENTS

A. Electrical Requirements

Motors	Belt Filter Press Feed Pumps
Rating	460V, 3 ph, 60 Hz
Horsepower, minimum	25
Speed, maximum, rpm	1200
Enclosure	TEFC
Insulation	Class F
Inverter Duty	Yes
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	Yes

2.08 MOTOR

A. The duplex arrangement shall be driven by a single motor.

B. The motor shall be adequately sized to withstand the loads during starting and pump operation.

C. The power, the horsepower, and motor speeds shall conform to the specifications as outlined in the schedules specified herein.

D. Motor shall be severe duty, premium efficient, inverter duty per NEMA STD MG1 Part 31.4.4.2.

E. Motor shall be shop finish coated with manufacturer's standard epoxy coating system.

2.09 CONTROLS

A. VFD-based pump control panel shall be provided by Contractor's Systems Integrator. Refer to Drawings and individual Division 40 specifications.

B. VFDs provided under Division 26 shall be heavy duty, constant torque, oversized units. Submit VFD compatibility statement for actual motors being supplied.

2.10 TOOLS AND SPARE PARTS

A. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following.

Qty.	Component
4	Discs
4	Trunnions
1	Set of all special tools required for normal operation and maintenance
2	Complete sets of gaskets
2	Clack valves
1	Pressure sensor and diaphragm seal for suction
1	Discharge pressure sensor, diaphragm seal, and switch

2.11 FINISHES

A. All cast iron and carbon steel components shall be finished with manufacturer's standard industrial grade coating system.

B. All stainless steel and aluminum surfaces shall remain unpainted.

C. All weld splatter shall be removed and all welds ground smooth for a neat appearance.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions.

B. The manufacturer's technical representative shall inspect the installation and shall provide a written certification that the pump is installed in accordance with the manufacturer's requirements and in accordance with Section 46 00 00 – Equipment General Provisions.

C. Field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation	1	1
Field Testing and Startup	1	2
Training	1	2

3.02 INSTALLATION

A. Install all items in accordance with the printed instructions of the manufacturer, as indicated and specified.

B. Dowel to frame after alignment in the field to facilitate realignment after disassembly.

C. Install and align on a concrete grout layer as specified and as shown on the Drawings.

D. Brace all piping at suction and discharge connections to withstand all shock loads and vibration.

3.03 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and Section 43 20 00 – Pumps – General.

3.04 FIELD TESTING

A. Furnish labor, piping, equipment, and material for conducting the tests.

B. Field testing shall be in accordance with Section 43 20 00 – Pumps – General. Give each pump a running test in the presence of Engineer demonstrating its ability to operate without vibration or overheating and deliver its rated capacity under specified

conditions. Specifically, the following items shall be measured at five (5) points over the entire operating range:

1. Discharge Head
2. Suction Head
3. Capacity
4. Pump Speed
5. Amperage

C. Correct all defects or replace defective equipment revealed and noted during tests. Make necessary adjustments at the time of tests at no cost to the Owner.

D. Repeat tests, if necessary to obtain results acceptable to Engineer.

END OF SECTION

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SECTION 43 41 43
POLYETHYLENE STORAGE TANKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, deliver, install, test, and place into satisfactory operation cross-linked, high-density, polyethylene storage tanks, complete with all necessary accessories, at the locations shown on the Drawings, and as specified herein.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

1.02 CONDITIONS OF SERVICE/STORAGE TANK SCHEDULE

	Polymer Tank
Number of Tanks	One (1)
Tank Wall	Single
Chemical Fill Method	Mechanical (pumping)
Polymer Type	SNF Polydyne Clarifloc SE-1496
Maximum Polymer Solution Concentration	Neat
Specific Gravity of Chemical	1.02 – 1.04
Freezing Point of Chemical	7°F
Viscosity of Chemical	500 – 2,000 cPs
Density of Chemical	8.5 – 8.7 lbs/gal
Design Temperature	50-100 degrees F
Type	Vertical, Cylindrical
Tank Color	Natural (unpigmented)
Bottom Configuration	Flat Bottom with integrally molded flanged outlet
Top Configuration	Dome Top
Maximum Design Working Capacity	547 gallons

	Polymer Tank
Maximum Outside Diameter	4'-0"
Maximum Straight Shell Height	5’-11”
Maximum Overall Height	7'-6"
Fill Connection	2"
Outlet Connection	2"
Overflow Line	None
U-vent	4”
Manway Diameter	19"
Continuous Level Instrument Connection	3”
Continuous Level Instrument Universal Ball Dome Fitting [1]	3”
Spare Instrument Mounting Flange	3”
Materials of Construction for Metal Components	316 Stainless Steel
Materials of Construction for Elastomers [2]	Viton (FKM)

1 Locate centerline of universal ball dome fitting a minimum of 8 inches off of inside face of tank wall to accommodate the mounting of a radar transmitter, by others under Section 40 61 00.

2 EPDM is not allowed, due to potential for swell.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

B. American Society of Testing Materials (ASTM)

1. ASTM D638 – Standard Test Methods for Tensile Properties of Plastics.

2. ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact.

3. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

4. ASTM D883 – Standard Definitions of Terms Relating to Plastics.

5. ASTM D1505 – Density of Plastics by the Density-Gradient Technique.

6. ASTM D1525 – Vicat Softening Temperature of Plastics.

7. ASTM D1693 – ESCR Spec. Thickness .125” F50-10% Igepal.

8. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.

9. ASTM F412 - Standard Terminology Relating to Plastic Piping Systems

C. Florida Building Code

1.04 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittals and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings.

2. Preliminary and final O&M Manuals, including:

   a. Manufacturer’s recommendations for installation.

   b. Fitting installation and adjustment procedures.

   c. Repair procedures for typical situations, including small holes, pinholes, and minor cracks in the tank.

   d. Certification by the Manufacturer that the tank has been factor tested and meets the requirements indicated.

3. Warranty

4. List of at least five similar installations of the tank type, size, chemical service, and location conditions being proposed, including date installed, contact name, address and phone number.

5. Dimensions of each tank, and dimensions, location, and orientation of openings, fittings, accessories, attachments, restraints and supports, manways, flexible connections, and vents.

6. Gasket style and material.

7. Weight of each tank.

8. Detailed instructions for pipe connections and bolt torque values.

9. Wall thickness calculations per ASTM D 1998 using 600 psi design hoop stress @ 100°F.

10. A complete manufacturer's specification of the resin used.

11. Factory test report, including:

    a. Wall thickness verification

    b. Fitting placement verification

    c. Visual inspection

    d. Impact test

    e. Gel test

    f. Hydrostatic test

12. Statement that materials, resin, and fittings used are suitable for intended service and chemically compatible with the liquid being stored.

13. Statement that fabrication is in accordance with these Specifications.

14. Instructions for handling, storage, loading and unloading, and installation of tanks.

15. Field inspection and testing reports as specified under Part 3 of this Specification.

1.05 QUALITY ASSURANCE

A. Tanks shall be constructed by a firm that has at least ten years prior experience in construction of similar polyethylene tanks in similar applications.

B. Tanks shall be manufactured from virgin materials.

1.06 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty shall be a limited 5-year full replacement warranty after Substantial Completion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The polyethylene storage tank(s) shall be as manufactured by:

1. Poly Processing Company.

2. Or approved equal.

2.02 MATERIALS AND CONSTRUCTION

A. Each tank shall be one-piece construction, rotationally molded, high-density cross-linked polyethylene. Tank shall be completely resistant to corrosion by the specified chemicals. The tank manufacturer shall be fully responsible for the structural design and integrity and watertightness of the tank, including all connections.

B. Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories.

C. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

D. Resin used in the tank manufacture shall contain ultraviolet stabilizer as recommended by resin manufacturer. The resin shall be commercially available at the time of tank manufacture.

E. The plastic shall not contain any fillers. All plastic shall contain a long-term UV stabilizer.

F. The nominal properties of the material are as follows based on molded parts:

Property	ASTM Specification	Value
Density	D1505	0.943 to 0.946 g/cc
ESCR Condition A, F50 100% Igepal 10% Igepal	D1693	 F_0 > 1,000 hours F_0 > 1,000 hours
Tensile Strength at Yield 2 in/min	D638	2,700 – 2,900 psi
Elongation at Break 2 in/min.	D638	640 percent
Flexural Modulus	D790	110,000 psi
Impact Strength, -40 °C	ARM	450 ft-lbs
Deflection Temperature @ 66 psi	D648	157 °F

G. Design Requirements

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be sufficient to support its own weight in an upright position without external support and shall be determined in accordance with ASTM D 1998 using the following equation; but in no case shall wall thickness be less than 0.187 inches

thick.

T	=	P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T	=	wall thickness, inches
SD	=	Hydrostatic design stress, PSI
P	=	pressure (.433 x S.G. x H), PSI
H	=	fluid head, ft.
S.G.	=	specific gravity, g/cm∧3
O.D.	=	outside diameter, inches

2. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit.

3. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

4. The minimum design specific gravity shall be 1.5.

5. For dome top tanks, the top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall.

6. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	**Min. Knuckle Radius, in**
less than or equal to 6	1
greater than 6	1-1/2

H. All tank capacities (volumes) specified shall include only that volume in the straight shell below the maximum tank fill level and above the top of the outlet pipe.

2.03 CONNECTIONS AND ACCESSORIES

A. All connections/openings shall be flanged in accordance with ANSI B 16.5, Class 150. Flanged connections, nozzles, and openings shall be perpendicular to the straight shell of the tank. All pipe supports, hardware, accessories, etc., shall be provided. All piping

connected to the tanks shall be perpendicular or parallel to the straight shell of the tanks. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections. Piping supports requiring holes through the side wall of the tanks shall not be allowed.

B. Each sidewall tank connection shall be provided with a flexible connector resistant to the specified chemical to allow for lateral and vertical expansion and contraction of the tank and to isolate the tank from pump and piping vibration. Expansion joints shall be PTFE and have a minimum of three convolutions, stainless steel limit cables and FRP composite flanges. Flexible connectors shall be provided by the tank manufacturer and shall meet the following minimum performance criteria:

   1. Axial Compression ≥ 0.67”

   2. Axial Extension ≥ 0.67”

   3. Lateral Deflection ≥ 0.51”

   4. Angular Deflection ≥ 14º

   5. Torsional Rotation ≥ 4º

C. Sidewall fittings above the chemical fill level shall be PVC bulkhead fittings. Opening for outlet connection/drain line shall be integrally molded full drain outlet. Bolts and gaskets shall be constructed of materials as shown in the Storage Tank Schedule.

D. Dome fittings shall be PVC/FKM bulkhead style flanged universal ball dome fittings. Bolts and gaskets shall be constructed of materials as shown in the Storage Tank Schedule.

E. Vent shall be top-mounted U-vent with a stainless steel insect screen. Each tank must be vented for the material and flow and withdrawal rates expected. U-vents shall be sized by the tank manufacturer. Vents shall be oversized to account for reduction in ventilation capacity associated with the insect screen.

F. Tank fill shall be provided with a PVC internal drop pipe with internal elbow to divert flow down the internal tank wall.

G. Tank level instrumentation shall be provided under Section 40 61 00. The mounting and connecting requirements, including mounting flange diameter, required clearance between mounting flange and tank wall, and height above liquid level, shall be coordinated with the actual instruments being supplied. Tank shop drawing shall not be approved until level transmitter submittal is reviewed and approved.

H. Provided tank with a top-mounted, chemically-resistant, bolted manway.

I. The tank shall be provided with a permanently attached type 316 stainless steel label providing the following minimum information:

1. Name, concentration, and specific gravity of material stored
2. Tank resin
3. Tank capacity
4. Maximum temperature rating of tank
5. Manufacturer
6. Date of manufacture
7. Tank serial number

J. All metallic parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant metals as specified in the Tank Schedule.

2.04 PIPING SUPPORT

A. For vertical piping exterior to the tank, all pipe supports, hardware, and accessories shall be provided for connections as shown in the Tank Schedule. Vertical piping into the tanks shall be supported every six feet and shall be parallel to the tank wall. External vertical piping shall be not less than 6 inches from the tank wall.

B. All piping into the tanks shall be supported such that no weight is placed on the tank or its connections.

2.05 SPARE PARTS

A. Furnish and deliver the following spare parts as specified below:

1. Two sets of each size of all gaskets, washers, and o-rings.

B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location.

2.06 SHOP TESTING

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank. Submit results.

2. Degree of Crosslinking. Use Method C of ASTM D 1998- Section11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

3. Perform actual wall thickness testing. Submit results.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.

2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

PART 3 – EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle in accordance with Section 01 61 00, Material and Equipment.

B. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. Avoid sharp objects on trailers.

C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit.

3.02 INSTALLATION

A. The Contractor shall furnish and install the polyethylene storage tanks and related items in accordance with the manufacturers' recommendations and in accordance with Section 46 00 00 – Equipment General Provisions.

B. A manufacturer's field representative shall be on site when each tank is installed to observe installation and verify that each tank has been installed per manufacturer's recommendations. The manufacturer shall provide a report certifying that each tank has been installed properly.

C. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed by the Contractor.

D. All metallic fasteners, brackets, mounting hardware, and accessories located in chemical storage and feed areas shall be constructed of corrosion-resistant metals as specified in the Tank Schedule.

E. All tanks shall be mounted on concrete pads only when demonstrated to be fully cured. The finished surface of each tank bottom shall be sufficiently flat, smooth, and free of irregularities, to prevent the possibility of tank failure from point loads or other sources. The bottom drain nozzle of the tank shall fit within a notch provided in the concrete foundation such that the tank bottom is properly seated per the manufacturer's recommendations.

F. The Contractor shall install two layers of elastomer between each concrete pad and storage tank, if recommended by the tank manufacturer. The tanks shall be installed on level pads.

3.03 FIELD TESTING

A. Field testing shall be performed in accordance with Section 46 00 00 – Equipment General Provisions.

B. Upon completion of installation of tank and prior to connecting piping, the Contractor shall provide blind flanges or other suitable plugs for all openings in the tanks, fill tanks with clean water provided by the Owner from a source approved by the Engineer and conduct a leakage test as specified herein. Tanks shall be filled up to the top of the straight shell of the tank and left to sit over a 24-hour test period. There shall be no leakage over the test period. Leakage around openings in the tanks shall be stopped by tightening nuts and bolts or replacing gaskets as required. Upon satisfactory completion of leakage test, Contractor shall drain the tanks and dispose of water in a suitable manner.

3.04 CERTIFICATION

A. Provide a written certification from the tank manufacturer that the polyethylene storage tanks have been properly installed according to the Drawings, specifications and manufacturer's recommendations, and that the equipment is operating normally. Make all necessary corrections and adjustments including but not limited to materials, equipment, labor, parts or freight at no additional cost to the Owner.

3.05 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for each series of tanks:

Service	Number of Trips	Number of Days/Trip
Inspection and Testing	1	1
Training	1	1

END OF SECTION

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Division 46

SECTION 46 00 00
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.

B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.

D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.

E. The requirements of this section shall apply to equipment furnished under Divisions 40, 41, 43, and 46.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – Reference Standards.

1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data: Comply with Section 01 33 00 – Submittals

B. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01 33 00 – Submittals and shall include the following additional information:

1. Equipment name, identification number and specification number.

2. Performance characteristics and descriptive data.

3. Detailed equipment dimensional drawings and setting plans.

4. Drive and motor data as required by Division 26 – Electrical. Where pump and motor speeds are to be regulated by variable speed drives, the Contractor shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit pump, motor and variable speed drive shop drawings together as a complete system.

5. Information on bearing types and bearing life.

6. Gear box design and performance criteria and AGMA service factor.

7. Piping schematics.

8. Equipment protective device details and connection diagrams.

9. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.

10. A list of spare parts and special tools to be provided.

11. Any additional information required to demonstrate conformance with the equipment specifications.

12. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

13. Shipment, delivery, handling, and storage instructions.

1.04 CLOESOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittals

2. Section 01 61 00 – Material and Equipment

B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittals and Section 01 78 23 - Operation and Maintenance Manuals.

1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittals

2. Section 01 78 23 – Operation and Maintenance Manuals

B. Spare Parts and Extra Materials:

1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

2. Submit complete list of spare parts, extra stock materials, maintenance supplies and special tools required for maintenance for one year with unit prices and source of supply. Indicate number/quantity specified and furnished, manufacturer, part number, description,

C. Comply with Section 01 79 00 – Training.

1.06 QUALITY ASSURANCE SUBMITTALS

A. Factory testing plan.

B. Factory Test Results shall be submitted and approved prior to shipment of equipment.

C. Field testing plan.

D. Preliminary field test data

E. Final field test data

1.07 GENERAL INFORMATION AND DESCRIPTION

A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.

B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.

C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.

D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.

E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.

H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.

J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.

1.08 EQUIPMENT WARRANTIES

A. Warranty requirements shall be as specified in Section 01 78 36 – Warranties and Bonds. Warranty requirements are supplementary to the individual equipment specifications.

PART 2 – PRODUCTS

2.01 ANCHORS AND SUPPORTS

A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.

B. Anchor bolts and fasteners shall be furnished in accordance with Division 05 and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, guard bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.

C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6” high, unless otherwise shown on the Drawings and shall be doweled.

D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with

non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Division 03.

2.02 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05 12 00 – Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.03 DISSIMILAR METALS

A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

2.04 STANDARDIZATION OF GREASE FITTINGS

A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

2.05 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit, and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 26 specifications and the latest National Electric Code. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual pump specifications.

B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 26 unless otherwise specified in the equipment specification.

D. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment specifications.

2.06 EQUIPMENT IDENTIFICATION

A. All mechanical equipment shall be provided with a substantial stainless-steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless-steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

C. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.

C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.

D. Shop testing of electric motors shall conform to:

1. Division 26 and individual equipment specifications.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery, and handling of equipment and materials shall be in accordance with Section 01 61 00 – Material and Equipment.

B. Storage of equipment and materials shall be in accordance with Section 01 61 00 – Material and Equipment.

3.03 MANUFACTURER’S FIELD SERVICES

A. Manufacturer’s field services shall be in accordance with individual specifications.

B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.

C. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment specifications.

D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

E. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer’s requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary

services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: Training shall be provided in accordance with Section 01 79 00 – Training.

5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

3.04 INSTALLATION

A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.

B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies

normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.

D. All equipment sections and loose items shall be match-marked prior to shipping.

E. For equipment that requires field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the equipment and motor prior to making piping connections or anchoring the equipment base. Alignment shall be as specified herein.

F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.

B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10-foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

C. Grouting

1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.

4. Finishing. Point the edges of the grout to form a smooth 45-degree slope.

5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint, and dirt.

F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.

H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.

I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.

J. Rotating Shaft Alignment

1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.

2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.

3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.

4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.

5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.

6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

A. Field testing shall be in accordance with individual equipment specifications.

B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer’s representative.

C. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:

a. Verify that the equipment is free from defects.

b. Check for alignment as specified herein.

c. Check for direction of rotation.

d. Check motor for no load current draw.

2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.

3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

D. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.

2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.

3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:

a. Check equipment for excessive vibration and noise as specified herein.

b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.

c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.

E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.

F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.

G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further

construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.

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

K. Field testing of electric motors shall be in accordance with Division 26 and individual equipment specifications.

3.07 VIBRATION TESTING

A. Vibration testing shall be in accordance with individual equipment specifications.

3.08 FAILURE OF EQUIPMENT TO PERFORM

A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.

B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.

D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the

premises until the Owner obtains from other sources other equipment to take the place of that rejected.

F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable paragraphs of Section 09 90 00 – Painting and Coating.

B. All shop coatings shall be compatible with proposed field coatings.

C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high-quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

END OF SECTION

SECTION 46 76 21
BELT FILTER PRESSES

PART 1 – GENERAL

1.01 REQUIREMENTS

A. The Contractor shall furnish, install, test, and place in satisfactory operation belt filter press sludge dewatering equipment, including:

1. Belt filter press units.

2. Sludge/polymer mixers.

3. Washwater booster pumping equipment.

4. Local controls.

5. Other ancillary equipment required for a fully functional system.

B. The belt filter press system shall receive process feed sludge and discharge dewatered cake product onto the existing conveyor system as shown on the Drawings.

C. The belt filter press equipment shall be provided by a single manufacturer, complete with all necessary components, drives, motors, instrumentation, controls, ancillary items and supports.

D. The Contract Drawings and this Section provide equipment descriptions, minimum requirements and required features of the equipment to be furnished. It is the Supplier's responsibility to design and furnish the equipment complete in all details, performance, and reliability meeting the requirements and intent of the Contract Drawings and these Specifications.

E. The equipment shall be furnished complete with all accessories, special tools, spare parts, base attachments, mounting anchor bolts, and other appurtenances as specified herein or as may be required for a satisfactory installation.

F. The system shall be designed to use Owner's current emulsion polymer Polydyne SE-1496. No changes to polymer type or manufacturer shall be permitted.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. American National Standards Institute (ANSI).

2. APHA/AWWA/WEF, Standard Methods for Examination of Water and Wastewater.

3. American Society of Mechanical Engineers (ASME).

4. ASTM A36/A36M, Specification for Carbon Structural Steel.

5. ASTM A123 Standard Specifications for Zinc (Hot-Dip Galvanizing) Coatings on Iron and Steel Products.

6. ASTM A384/A384M, Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

7. ASTM A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).

8. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

9. AWS D1.1/D 1.1M, Structural Welding Code - Steel.

10. National Electrical Manufacturers Association (NEMA).

11. SSPC SP10, Near-White Blast Cleaning.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Division 05 specifications.

B. Section 09 90 00 – Painting.

C. Division 40 specifications.

D. Section 43 20 00 – Pumps – General.

E. Section 43 23 69 – Double Disc Pumps.

F. Section 46 00 00 – Equipment – General Provisions.

G. Section 46 77 20 – Liquid Polymer Preparation System

1.04 QUALIFICATIONS

A. Manufacturer’s Qualifications: Manufacturer shall have a minimum of five years’ experience producing substantially similar equipment to that specified in this Section and shall be able to document at least five installations in satisfactory operation for at least five years.

B. Welding Qualifications: Equipment manufacturer's shop welds and welding procedures and personnel shall be qualified and certified per AWS D1.1/D1.1M.

C. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer from a single belt filter press manufacturer.

2. Belt filter press manufacturer shall review and approve or prepare all Shop Drawings and submittals specified in this Section for all components furnished under this Section.

3. All components shall be fully suitable for specified service conditions and shall be integrated into overall assembly by belt filter press manufacturer.

D. Certifications:

1. Certification of Compliance:

a. Obtain certification of compliance with the Contract Documents from the belt filter press manufacturer on manufacturer letterhead; certification by manufacturer's representatives is not acceptable.

b. Certification shall be worded as follows:

"[Insert manufacturer's name] proposes to supply equipment included in Section 46 76 21 for Lee County FMB WRF Belt Press Replacement. We have examined the Contract Documents and have a clear understanding of the requirements insofar as they affect the proposed products. We certify that the products will operate satisfactorily under the conditions described in the Contract Documents and that the products meet the requirements of the Contract Documents:

[List exceptions, deviations, or changes necessary to accommodate the proposed products.]

We further certify that the products to be furnished shall conform to the standards listed in Section 46 76 21 of the Contract Documents.

[List exceptions, deviations, or changes necessary to accommodate the proposed products.]

_____ _____

Authorized Signature & Title Date"

E. Provide justification for exceptions, variations, deviations, or changes. Engineer will determine whether exceptions, deviations, or changes are acceptable. Exceptions, variations, deviations, or changes may result in rejection of products.

F. Compatibility of Programmable Logic Controllers (PLC) and Variable Frequency Drives (VFD): Attach the following to certification of compliance:

1. Letter from the equipment manufacturer stating that PLCs furnished by manufacturer, VFDs furnished by manufacturer, and belt filter press equipment provided under this Section are fully compatible and will successfully operate under operating load conditions and all other operating characteristics provided by control package specified and shown.

G. Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.

H. Acceptance of certification shall not relieve Contractor of responsibility for adequacy of all products.

I. Submittal of certification shall not relieve Contractor and Supplier from complying with submittal procedures in the Contract Documents.

1.05 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions.

1. Shop Drawings:

a. Drawings showing fabrication methods, assembly, layout at Site, accessories, installation details, and wiring diagrams. Include in layout Shop Drawings proposed primary and alternate polymer injection locations.

b. List of deviations from the Contract Documents.

c. Drawings and information for local control panels and instruments, including complete control panel details, wiring diagrams showing all electrical connections to motors and variable speed controls, logic diagrams, PLC data, and detailed specifications conforming to this Section and Division 40 specifications. This includes submittal of panel wiring drawings, hardware, circuit breakers, motor starters and VFDs (if included in control panel), and electrical devices furnished.

d. Product Data:

1) Manufacturer's literature, illustrations, specifications, and engineering data including: materials, dimensions, general arrangement, outline drawings, size, weight, parts lists, performance data, and motor horsepower.

2) Motor data, including type, size and model number; assembly drawings, rated size of motors with calculations supporting selected motor size; temperature rating; running light current, locked rotor current; and efficiency at 1/2, 3/4, and full load.

3) The weight of the heaviest item that would need to be removed from the press as part of routine maintenance.

e. Testing Plans: Prior to performing tests, submit and obtain Engineer's approval of test procedures for shop testing and field testing.

B. Informational Submittals:

1. Certificates:

2. Certification of compliance as specified in this Section, including letters on PLCs and VFDs from manufacturer.

3. Design Data: Structural computations demonstrating that the following complies with Specifications:

a. Belt filter press frame.

b. Belt filter press rollers.

4. Test Reports:

a. Shop Test Results: Provide prior to shipment from factory, including control panel tests.

b. Field Test Results, including field performance testing.

5. Submit manufacturer's instructions and recommendations for:

a. Transportation and storage.

b. Handling.

c. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.

d. Installation.

6. Manufacturer's Reports:

    a. Submit a written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.

7. Qualifications Data.

C. Closeout Submittals:

1. Operational and Maintenance Data:

    a. Submit complete operation and maintenance manuals, including copies of test reports, maintenance data, and schedules, descriptions of operation, and spare parts information.

    b. Furnish operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.

    c. Warranty documentation, conforming to requirements of this Section.

1.06 WARRANTY

A. Extended Warranty: Provide from equipment manufacturer an extended warranty for benefit of Owner. Warranty shall cover troubleshooting investigations, repair, and replacement of parts due to defective materials or workmanship for durations listed below. Provide certificate from belt press manufacturer defining conditions and terms of warranty as specified in this Section. All costs for extended warranty shall be included in the Contract Price. Belt filter press manufacturer's certificate of extended warranty shall include:

1. Warrant belt filter press frame and coating for three (3) years from the date of Substantial Completion, not to exceed forty-two (42) months from the date of delivery. At no additional cost to Owner, repair or replace defects or corrosion occurring during warranty period.

2. Warrant belt filter press rollers and coating to be free from manufacturing defects for three (3) years from date of Substantial Completion, not to exceed forty-two (42) months from the date of delivery. Neither rollers nor coating shall require preventive maintenance during warranty period. Warranty shall include all parts and labor and shall cover cost of repairing or replacing items that fail during warranty period, provided damage is not due to misuse or neglect by others.

3. Warrant belt filter press's complete bearing assembly for five (5) years from date of Substantial Completion, not to exceed sixty-six (66) months from the date of

delivery. Warranty shall include all parts and labor for repairing or replacing bearing assembly parts that fail during warranty period.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The belt filter press equipment shall be manufactured by:

1. Alfa Laval (Ashbrook Simon-Hartley), Klampress (KP) 3-Belt, 2.0M.

2. Or approved equal.

2.02 GENERAL REQUIREMENTS

A. The belt filter presses shall be horizontal, 3-belt, 8-roller units having a stacked configuration with an independent gravity zone located over top of the pressure zone. Tower style belt filter press equipment with vertical pressure zones and lower adjacent thickening zones will not be accepted.

B. Belt filter presses shall be designed to accept additional rollers in the pressure section to support a future conversion to a 12-roller design.

C. Constructed for continuous or intermittent operation in a humid and corrosive environment.

D. Employ woven polyester belts arranged to perform sludge conveying, pressing, and dewatering.

E. Of a continuous belt design with three dewatering zones including gravity drainage zone, followed by wedge zone, and an increasing-pressure drum and roller zone.

F. Pressure zone shall entrain sludge between two continuous, open-meshed belts with a system of perforated and solid rollers. Belt tension system shall act on the rollers exclusively to provide increasing pressure as sludge advances toward the equipment's discharge.

G. Belt filter press shall be complete with all necessary motors, gear drives, hydraulic system, control panel, alarm system, washwater booster pump, belts and belt wash system, and appurtenances.

H. Dewatered sludge shall then be removed from the belts with scrapers (doctor blades) and belts shall then be washed prior to receiving additional sludge.

I. Utilize chemical conditioning by one liquid organic polyelectrolyte chemical (polymer) readily available in bulk quantities. Conditioning with inorganic chemicals such as lime or ferric chloride is unacceptable.

J. Provide all appurtenant equipment and piping normally furnished as an integral component of belt filter press and required for proper operation of belt filter press, whether or not specifically required in the Specifications.

K. Design and performance criteria of unit specified establish minimum requirements. When installed and operating, equipment shall meet or exceed specified minimum performance requirements.

L. Equipment shall be completely factory assembled and tested, unless otherwise specified in this Section. Equipment main frame assembly shall require only bolting to floor at the Site and connection of external piping and electrical wiring. Flocculation devices, belts, gearboxes, and other equipment that may be damaged during shipping if mounted on main frame shall be shipped loose and installed following delivery to Site. All electrical components located on the machine shall be pre-wired at the factory.

M. Assembly Relative to Maintenance:

1. Routine maintenance shall be possible without taking equipment out of service.

2. Belts shall be replaceable without requiring disassembly of belt filter press.

3. Parts requiring routine maintenance shall be readily accessible from outside the belt filter press. Side panels, when furnished, shall be removable for access to belt filter press components and shall be securely attached to frame.

4. Upper gravity thickening belt drive and motor and lower dewatering belt drives and motors shall be located on the long side of the press opposite the access stairs and platform.

5. Hydraulic pump/manifold gauges, electrical box, and washwater feed connection shall be located on the long side of the press closest to the access stairs and platform.

2.03 PERFORMANCE AND DESIGN CRITERIA

A. The feed sludge properties are as follows:

Parameter	Value	Unit
Sludge Type	Non-thickened, aerated WAS	-
Temperature	70	degrees F
pH	6.5 to 7.5	-

Feed Sludge Minimum (5th Percentile) Dry Solids Concentration	0.5	% wt.
Feed Sludge Average Dry Solids Concentration	1.0	% wt.
Feed Sludge Maximum (99th Percentile) Dry Solids Concentration	1.7	% wt.

B. The belt filter press equipment shall be capable of operation for the conditions of service described herein.

Parameter	Value	Unit
No. of Belt Filter Press Units	2	ea.
Unit Effective Belt Width	2.0	meters
Minimum Dewatered Cake Solids Concentration	16	% wt.
Minimum Dewatering Process Capture Efficiency at Average Feed Sludge Dry Solids Concentration (1.0%)	95	%
Minimum Dewatering Process Capture Efficiency at Feed Sludge Dry Solids Concentration < 0.7%	90	%
Conditioning Agent	Polydyne SE-1496 Emulsion Polymer	-
Maximum Polymer Dose [1]	21	active lbs. / dry ton
Design Unit Hydraulic Loading Rate	400	gpm
Minimum Unit Solids Loading Rate	1,200	dry lb. / hour
Maximum Wet (Operating) Unit Weight	30,580	lbs.
Minimum Sludge Inlet Pipe Connection Diameter	6	inches
Minimum Effective Gravity Drainage Section Thickening Area	88	SF
Minimum Effective Increasing Pressure (Wedge) Section Dewatering Area	62	SF
Minimum Effective Shear Pressure Zone Dewatering Area	127	SF

1 To be confirmed with jar testing during start up.

C. The belt filter press equipment shall suit the existing footprint and overhead clearance available, shall be compatible with reuse of existing filtrate sump, and shall be limited dimensionally to the following:

Parameter	Value	Unit
Maximum Unit Frame Length	15.3	Ft.
Maximum Unit Frame Width	8.3	Ft.

Maximum Unit Overall Length	20.5	Ft.
Maximum Unit Overall Width	11.5	Ft.
Maximum Unit Overall Height	9.4	Ft.

D. To accommodate roller removal the overall dimensions of the belt filter press unit shall be such that the installation of the press provides the minimum clearance on one side of each press of 7'6" or as otherwise indicated on the Drawings.

2.04 MATERIALS OF CONSTRUCTION

A. All structural steel shall conform to the ASTM Standard Specification for Structural Steel, Designation A36/A36M.

B. All iron castings shall conform to the ASTM Standard Specifications for Gray Iron Castings, Designation A48, and shall be of a class suitable for the purpose intended.

C. Other materials shall conform to the ASTM Specifications where such specifications exist and the use of such materials shall be based on continuous and successful use under similar conditions of service.

D. All electrical components shall be U.L. listed where such listing exists and all electrical control panels shall be assembled in U.L. approved facilities.

E. All structural carbon steel plates and shapes shall have a minimum thickness of 1/4 inch and shall be hot dip galvanized in accordance with ASTM A-123.

F. Unless specified otherwise herein, all metals in contact with polymer or sludge, and all other components specified to be stainless steel, shall be type 316L stainless steel.

G. Materials of construction shall conform to the following minimum requirements unless otherwise specified:

Component	Material of Construction
Bearing housings	Nylon coated, cast iron
Belt support grids/bars	Type 316L stainless steel with UHMWPE wiper bars
Belt wash housing	14 ga. type 316L stainless steel
Belt wash spray tube and nozzles	Type 316L stainless steel
Belt wash piping / washwater piping	Sch. 80 PVC
Chicanes	Galvanized steel support rods, galvanized cast iron holders, and UHMW polyethylene blades
Feed and discharge chutes	10 ga. type 316L stainless steel

Sludge containment barriers	14 ga. type 316 stainless steel
Discharge (doctor) blades	Type 316 stainless steel support frame and UHMW polyethylene blades
Drain trays	14 ga. type 316 stainless steel
Drain tray piping	Sch. 40 PVC
Frame	Hot-dipped galvanized ASTM A123 coating grade 100, A36 steel
Hardware and fasteners	Type 316 stainless steel
Hydraulic cylinder body Hydraulic cylinder rod	FRP tube with glass filled nylon head Solid type 316 stainless steel with hard surface treatment
Polymer mixer housing Polymer mixer counterweight Polymer mixer injection ring Polymer splitter manifold	Cast type 316L stainless steel Cast iron, galvanized UHMW polyethylene UHMW polyethylene
Rollers (solid)	Carbon steel, 1/2-inch wall, with 1” forged flange, thermoplastic nylon coated, 25 mils minimum
Drive rollers (coated)	Carbon steel, 1/2-inch wall, with 1” forged flange with Buna-N rubber coating, 1/4 inch
Rollers (perforated)	1/4 –inch wall, type 316 stainless steel
Roller shafts	Forged steel ASTM 572 Grade 50, perforated roller shall have 8620
Wedge plate	Carbon steel, nylon coated

H. Coatings

1. Coating systems for components, including thermoplastic nylon and Buna-N, shall be manufacturer’s standard and suitable for the application.

2. All hot dip galvanizing shall be applied in accordance with ASTM-A123. Zinc flame spray shall not be considered an acceptable substitute to this specification.

3. Paint system for drive unit shall be as follows:

   a. Primer: Minimum 2 mils DFT, vinyl copolymer resin.

   b. Finish: Minimum 5 mils DFT, acrylic emulsion.

2.05 SLUDGE/POLYMER MIXER

A. Each belt filter press shall be provided with a sludge conditioning system, designed to efficiently mix polymer with the sludge and to adequately condition the sludge, for optimum dewatering.

B. The static mixer shall be a 4” x 6” unit constructed of stainless steel.

C. The sludge conditioning system shall be mounted upstream of the press and shall consist of an in line, non-clog, venturi type static mixer with a variable orifice and a four port vortex polymer injection ring, counterweight arm, flow splitting manifold, clear flexible tubing, and fittings for connecting injection ring to manifold. The belt filter press manufacturer shall be required to provide, to the engineer, a proper layout for the system. The sludge conditioning system shall be capable of providing the following performance:

1. The polymer and sludge must be instantly mixed (less than 1.0 seconds at 60 GPM).

2. Mixing energy must be independently adjustable during operation.

3. Flocculation time must be independently adjustable, by the displacement of flanged pipe sections, with the mixer. Provide on each belt filter press sludge feed pipe three alternate polymer injection locations. Polymer injection point shall be adjustable by removing flanged pipe spool piece at each alternate injection point and installing polymer/sludge mixer. The Drawings show two locations based on achieving a 15 or 30 second flocculation time at average flowrate prior to discharge to belt filter press. Belt filter presses manufacturer’s submittal shall provide manufacturer’s recommended layout for system with primary and two alternative locations shown. Locations shall be in the horizontal plane or the vertical plane provided that flow is in the up direction. Locations shall allow for polymer mixer to remain flooded at all times. Contractor shall provide flanged spool piece to facilitate disassembly at each of the two alternate locations and provide sludge pipe coupling at each of the primary and alternate locations.

D. The sludge conditioning system shall meet the following mechanical specifications:

1. The in-line mixer shall have a flanged, cast housing, an adjustable orifice plate with shaft and O-ring seal connected to an externally mounted lever and counterweight and a removable side plate for inspection and cleaning.

2. The open throat area shall be fully adjustable downward and shall open automatically to prevent clogging.

3. The position of the counterweight on the externally mounted orifice plate lever shall be fully adjustable, within a 360-degree circle, to allow for adjustment of the mixing energy, regardless of the mounting angle, while the unit is in operation.

4. The polymer mixer shall be designed specifically for its intended use. The use of static mixers with stationary baffles, modified check valves, mixers requiring electrical motors and controls, or tanks with mechanical mixers shall not be acceptable.

5. The polymer mixer end connections shall be flanged and 6-inch diameter to match feed piping size. The mixer throat section should be nominal 4-inches.

6. Each polymer injection ring shall inject polymer at a minimum of eight points located 45 degrees apart around circumference of ring.

7. The mixer shall be installed in the horizontal plane or otherwise maintained fully flooded.

2.06 FRAME

A. The structural main frame shall be fabricated of steel members conforming to AISC Standard Specifications for Structural Steel, into a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection.

B. The frame shall have a minimum safety factor of 5 and maximum deflection of 0.025 inches under maximum loading. The moment of inertia of the structural members shall be adequately chosen to provide the safety factor and deflection rate specified herein.

C. Maximum load on the frame shall be based on the summation of forces applied to the frame from roller mass forces, weight of the rollers including the sludge and belts and belt tension forces. Belt tension forces shall include, but not be limited to, a belt tension of 50 pli per belt plus the tension produced by the driving torque of the motor at nameplate horsepower. Certified calculations shall be submitted to substantiate that this requirement has been met.

D. The framework shall be of welded and/or bolted construction. All welding shall conform to the American Welding Society Structural Welding Code.

E. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts. Permanent lifting lugs shall be provided as necessary to allow installation and removal of the belt filter press.

F. The construction shall allow easy access and visual inspection of all internal components.

2.07 GRAVITY DRAINAGE SECTION

A. Each belt filter press shall be furnished with an independent gravity drainage section to accept flocculated sludge from the sludge conditioning system and allow free water in the conditioned sludge to readily separate from the solids and drain to the collection pan.

B. The gravity drainage section shall be furnished with a sludge feed chute and an inlet distributor to evenly distribute the conditioned sludge over the effective width of the moving filter belt. The independent gravity drainage section shall be designed so that it can be operated as a pre-thickening device prior to dewatering.

C. The conditioned sludge shall be contained on the belt with adjustable containment barriers equipped with replaceable rubber seals to prevent leakage. Rubber seals shall be designed to be attached to the containment barriers, with a friction fit, to allow for easy replacement without the use of tools.

D. The filter belt, while in the gravity drainage section, shall be supported by a steel grid fitted with high-density polyethylene wiper bars. The wiper bars shall be spaced at a maximum of 2.5 inches and shall have a minimum nominal wear thickness of one-half inch, to minimize the frequency of replacement. The wiper bars shall be arranged in a chevron pattern, with the apex toward the sludge inlet, to reduce the possibility of belt creasing. The belt support grid shall be a minimum of 2 inches wider than the belt on each side and so designed to reduce belt wear.

E. The gravity drainage section shall be furnished with chicanes (plows) to adequately furrow the conditioned sludge to facilitate drainage. Each row of chicanes shall be provided with a single lifting handle, designed to remove the entire row of chicanes at least 6 inches from the belt, out of the sludge flow, to facilitate cleaning. Chicanes shall be designed to be individually adjustable laterally and shall pivot to allow them to pass over obstructions on the belt. The minimum of number of chicanes shall be 68, and the minimum number of rows shall be 8.

F. The manufacturer shall be required to demonstrate that each individual chicane shall be capable of allowing a one-inch vertical obstruction on the belt to pass under them without damage to the equipment.

G. The gravity drainage zone shall include an adjustable angle ramp assembly. The adjustable ramp shall be provided adjacent to the discharge end of the gravity drainage section which causes the thickened sludge to ascend the ramp prior to discharge. The ramp shall be fitted with a replaceable doctor blade. The ramp shall extend across the width of the belt adjacent to the discharge end of the unit and be set at a sufficient height and angle so as to create an optimum backward rolling action of the sludge. The rolling action shall impart a shearing action to the sludge, which further relieves trapped water from between the sludge particles, to enhance and assure optimum thickening.

H. The ramp assembly shall incorporate the following features:

1. The ramp shall be provided with an actuator which includes a manual crank which, when turned, effects the incline of the ramp with respect to the filter belt.

2. The ramp adjustment shall be capable of providing inclination angles of between 10 degrees and 45 degrees relative to the filter belt during operation.

3. The ramp shall be designed so the location of the leading edge of the doctor blade with respect to the belt remains the same regardless of the angle of inclination at which the ramp is set.

4. The ramp assembly shall be capable of being easily and quickly lifted away from the belt and out of the sludge path to facilitate cleaning during operation.

5. The angle of inclination of the ramp shall be capable of being adjusted by one person while the unit is in operation and without the use of tools.

I. The gravity drainage section shall incorporate independent belt drive, tracking, and tensioning features which are suitable for the intended service.

J. The independent thickening belt drive motor shall be controlled using a VFD.

2.08 PRESSURE SECTION

A. Each belt filter press shall be furnished with a pressure section following the gravity drainage section. The pressure section shall consist of two stages.

B. Increasing pressure (wedge) section

1. The first stage of the pressure section shall be the increasing pressure (wedge) zone, where the upper and lower belts gradually converge, creating a belt/sludge sandwich. In the wedge zone the sludge cake is prepared for the shear pressure zone by generating continuously increasing pressure on the sludge as it travels through the zone.

2. For process flexibility, the amount of pressure exerted on the sludge and the rate at which the increasing pressure is applied shall be independently adjustable while the machine is in operation utilizing an adjustable steel wedge plate located between the belts, pressing down on the sludge. These adjustments shall be capable of being performed without causing undue wear on the belts or other components and without causing the belts to be moved from their normal path between rollers. The sludge inlet height at the entrance to the wedge plate shall be adjustable between one and three inches.

3. The belt in the increasing pressure zone shall be supported in the same manner as supported in the gravity drainage section.

C. Shear Pressure Section

1. The second stage of the pressure section shall be the shear pressure zone consisting of a minimum of eight pressure rollers arranged to provide a serpentine pattern of belt travel.

2. Pressure may be achieved by any of, or a combination of, the following:

a. High belt tension.

b. Successively decreasing roller diameters.

c. Separate high-tension belt that presses against the two belts containing the sludge cake to increase pressure on cake.

d. Adjustable pressure rollers that compress the sludge cake.

3. Each pressure dewatering zone belt shall be driven by a dedicated drive, consisting of gearbox, shaft, and motor. The drive motors shall be controlled using a variable speed drive.

D. The first roller in the increasing pressure zone shall be a perforated roller. The rollers shall be supported by bearings mounted on the end shafts.

E. The effective dewatering area in the shear pressure zone shall be defined as the area of curved grid and rollers in contact with the belts, meaning full width of the belt.

2.09 ROLLERS

A. All solid rollers shall be constructed using one-piece forge shafts and end plates. The forged stub shaft unit shall eliminate all welding of the roller shafts in the region of highest stress where the shafts join with the end plates.

B. The roller shall be machined so that the total indicated runout of the shell relative to the journals is 0.010 inch maximum. Total surface machining is required to provide a smooth surface for the coating of thermoplastic nylon or to prepare the roller for cladding.

C. The first roller in the pressure section shall be a perforated roller designed to allow water to escape out both ends. It shall be constructed with a solid through shaft and at least five (5) radial vanes to support the perforated shell.

D. Drive rollers shall be coated up to the point of insertion into the bearings by a 1/4-inch minimum thickness of Buna-N rubber. Perforated rollers shall be type 316 stainless steel. Solid rollers shall be coated with a 30-mil minimum thickness of thermoplastic nylon or clad with type 316 stainless steel.

E. All solid roller shells shall have a minimum wall thickness of 1/2 inch. Heavier walls shall be used where required to meet the maximum stress and deflection limits. The roller bearing journals shall be turned to 75 mm to accept direct mounted 75 mm bore bearings. The minimum thickness of the forged flange that forms the end plates shall be one (1) inch.

F. The perforated roller shall have punched holes of 1 1/4 inch diameter minimum to prevent bridging of solid material. The punched shell shall be rolled with the smooth side out. The shell shall be a minimum 1/4-inch thick.

G. The rollers shall be analyzed using finite element stress analyses. Certified calculations, showing the maximum stress to be less than 1/5 the yield strength of the material and the maximum deflection at mid span to be less than 0.050 inch shall be submitted as specified herein. The standard load case for the pressure rollers shall be a distributed load in the belt contact area equivalent to 50-pli belt tension, weight loading, and drive torque. The standard load case for the other rollers shall be a distributed load in the belt contact area equivalent to 50-pli belt tension and weight loading.

2.10 BEARINGS

A. All rollers shall be supported by greaseable type, high-capacity design roller bearings, in sealed, splash proof, horizontal split case pillow block housings. The bearings shall be direct mounted on the shaft with a shrink fit backed by a retaining snap ring.

B. Bearings supporting the steering rollers shall be non-self-aligning cylindrical roller bearings in pivot mounted pillow block housings.

C. All other rollers shall be supported by self-aligning spherical roller bearings with metallic cages mounted in fixed pillow block housings.

D. Bearings supporting all the rollers except the steering rollers shall be double row spherical bearings.

E. Bearings supporting the steering rollers shall be single row cylindrical roller bearings.

F. Bearing housings shall include two mounting bolts and four cap bolts. The outer side of the housing shall be solid, without end caps or filler plugs. The housings shall be designed with an integrally cast water trough which, when shrouded by a shaft mounted water flinger, shall divert water from the bearing seal area. The housings shall be cleaned and coated with nylon to a thickness of 8-12 mil.

G. The bearing seal in the pillow block housing shall be of nonmetallic construction with a carrier/flinger, which rotates with the roller shaft. A static sealing arrangement between the carrier/flinger and the shaft shall be a triple rubber seal, constructed in a manner that prevents relative rotation between the seal and the shaft. A dynamic sealing

arrangement between the carrier/flinger and the bearing housing shall consist of a primary dynamic contact seal of ozone resistant rubber which shall seal by rotational contact with a machined housing surface. A secondary dynamic seal shall be a labyrinth seal between the carrier/flinger and the bearing housing which utilizes a nonmetallic retaining ring to hold the seal assembly in position within the housing.

H. Bearing lubrication shall be performed through stainless steel grease fittings mounted on each bearing housing. All bearings shall be outboard (externally mounted) and shall be greaseable while the unit is in operation.

2.11 BELT WASH SYSTEM

A. Each belt filter press shall be equipped with individual belt wash stations for the independent gravity belt and both the upper and lower dewatering belts. Each station shall consist of a minimum 1.5” spray pipe, fitted with spray nozzles, contained within a fabricated housing which encapsulates a section of each belt. The housing and nozzle assembly shall be readily removable.

B. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another at the belt surface. Individual spray nozzles shall be replaceable.

C. The housing shall be sealed against the belt with rubber seals. The spacing between the upper and lower housing shall be adjustable to insure continuous contact between the seals and belt. The seals shall be replaceable without disassembly of the wash station.

D. Each belt wash station shall be furnished with a drain valve having an external handwheel to which is mounted on a stainless steel cleaning brush located inside the spray pipe. One full turn of the handwheel shall cause the brush bristles to enter each spray nozzle, and dislodge any solid particles which have accumulated, open the valve, and allow the solids particles to be flushed into the drainage system.

E. Belt wash stations shall be as manufactured by:

1. Appleton Manufacturing.

2. Menasha Corporation.

3. Or approved equal.

F. Each belt wash station shall be positioned such that the washing is performed after the cake has been discharged from the belt. The belt wash station shall extend over the full width of the filter belt by a minimum of two inches. The belt shall be cleaned by the belt wash with no blinding. The belt wash system shall be suitable for use with reuse water / plant effluent water containing a chlorine residual supplied at a minimum pressure of 85 psig and shall be designed to operate at a flow of up to 120 gpm.

G. Each belt filter press shall be provided with a 1 1/2-inch female NPT connection for belt wash water.

H. Washwater Pumping Equipment

1. Washwater pumps shall be a centrifugal, horizontal, frame mounted, end suction pump,

2. Pumps shall be:

a. Goulds Series A-C 2000.

b. Equivalent as manufactured by Aurora Pump.

c. Or approved equal.

3. The casing shall be of the end suction design with tangential discharge outlet. Suction and discharge connections shall be flat-faced flange connections. Flange connections shall be ANSI 125 lbs. rated.

4. Pump suction and discharge connections shall be 2-inch diameter minimum.

5. The casing bore shall be large enough to allow "back pullout" of the impeller without disturbing the casing or suction and discharge piping.

6. Impeller shall be enclosed, dynamically balanced, and keyed to shaft.

7. Shaft sealing system shall utilize elastomeric bellows type mechanical seal.

8. Pump materials of construction shall be as follows:

Component	Material of Construction
Frame	Steel
Casing	Cast iron, ASTM A48
Wear rings	Bronze alloy
Stuffing box	Cast iron
Impeller	Bronze alloy
Shaft sleeve	Bronze alloy
Impeller nut and washer	Type 316 stainless steel
Gland	Zinc alloy
Mechanical seal	Type 316 stainless steel

Seal cage	Teflon
Shaft	Steel, AISI C1045
Close-coupled adapter	Cast iron

9. Washwater pump design criteria are as follows:

Parameter	Value	Unit
Washwater Source	Reuse water	-
Maximum Chlorine Residual of Washwater Source	3.0	mg/L
Approximate Available System (Pump Suction) Pressure [1]	30	psig
No. of Units per Belt Filter Press	1	ea.
Minimum Unit Washwater Pump Flowrate	120	gpm
Minimum Washwater Delivery Pressure at the Belt Filter Press Connection	85	psig
Pump Total Dynamic Head [2]	160	ft.
Maximum Unit Motor Power	5	hp
Motor Enclosure	TEFC	-
Motor Power	460 3 60	V Ph Hz
Motor Speed	1,750	RPM
Motor Control	Constant	-
Minimum Suction Connection Size	2	inches
Minimum Discharge Connection Size	2	inches
Minimum Pump Efficiency at Duty Speed	68	%

1 As measured in the existing 6-inch diameter wall-mounted reuse pipe, having a centerline EL. of approx. 22.75 feet.
2 Sizing to be verified by belt filter press manufacturer.

10. Motor shall be non-overloading throughout the entire full speed pump curve.

11. All controls and equipment necessary to provide a complete and operating system shall be provided for the pumps by the belt press manufacturer, including the controls from the machine control panel as specified hereinafter.

12. Contractor shall provide and install a concrete equipment pad, as detailed on the Drawings.

13. Contractor shall provide PVC suction and discharge piping, true-union PVC isolation ball valves, PVC flanged connections to the pump, and supports.

14. Belt filter press manufacturer shall provide a low pressure switch on the discharge side of the pump, Ashcroft Type 400B or approved equal.

15. Provide high flow strainer on suction side of pump.

16. Manufacturer shall provide electric solenoid valve and incorporate into the auto start/stop sequence and the controls to prevent the booster pump motor from spinning when shut off.

17. Contractor shall provide and install local motor disconnect switch.

2.12 BELT ALIGNMENT SYSTEM

A. Each belt shall be provided with an automatic belt alignment system to assure proper alignment of both belts at all times. Belt alignment shall be accomplished using a self-contained system that does not require an external power source, other than electrical power.

B. The belt alignment system shall be provided with sensing devices designed with a counter-weighted arm fitted with a ceramic plate, which rides on the edge of the belts to detect their position. The arm shall operate a pilot valve, which in turn affects the position of a hydraulic actuator connected to a pivoted belt alignment roller. The pivoting action of the belt alignment roller shall cause this roller to skew from its transverse position to guide the belts centrally along their path.

C. The alignment systems shall function as a continuous automatic belt guidance system and shall be an integral part of the press. The alignment system shall operate with smooth and slow motions resulting in a minimum of belt travel from side to side. The use of electrical servos or systems which utilize devices that maintain alignment by a large snap action type alternating movement of the alignment roller shall not be considered acceptable to this specification.

D. Backup limit switches for the belt alignment system shall be provided on the machine with sufficient contacts to de energize all drives and sound an alarm in case of belt over travel.

2.13 BELT TENSIONING SYSTEM

A. Each belt shall be provided with a belt tensioning system. The belt tensioning system shall be hydraulically actuated. The design of the tensioning system shall be such that adjustments in tension shall result in immediate changes in dewatering pressure.

B. The belt tensioning system shall be furnished with a control station located on the press so that shutoff of belt tension is possible. Actual belt tension, shall be maintained automatically despite process changes or belt stretching and not require additional adjustment by the operator to maintain the setpoint.

C. The belt tensioning system shall be designed to accommodate maximum belt stretching during the useful life of the belt.

D. The tensioning system shall have two hydraulic cylinders for each belt, directly connected to a rigid tensioning yoke, to provide absolute parallel tension across the entire width of the belt. The tension force shall be constant over the full range of the cylinder.

E. Manual tensioning systems or pneumatic bellows systems, which do not automatically maintain a pre-set pressure on the sludge despite process changes, are not acceptable.

F. Sensing devices shall be furnished for each belt with sufficient electrical contacts to de energize all drives and sound an alarm in the event of failure of the belt or the tensioning system.

2.14 HYDRAULIC POWER UNIT

A. Each belt filter press system shall be provided with a dedicated hydraulic power system to provide pressurized oil for the steering and tensioning. The unit shall consist of a minimum one-gallon reservoir; variable-displacement pressure compensated hydraulic oil pump and drive motor, hydraulic oil filter, pressure gauges, piping, valves and cylinders to make a complete operational system.

B. The pump, motor, reservoir, oil filter, and valves shall be mounted directly to the belt press frame to minimize excess piping runs, fittings and hoses.

C. All hydraulic lines shall be properly sized for the pressure and flow of the unit. Pressurized hydraulic lines shall be 316ss tubing and shall be rigidly supported on the structural frame of the press. Flexible lines to cylinders, low-pressure connections to the reservoir, etc. shall be hose of the material and construction appropriate to the application.

D. The hydraulic reservoir shall be made of high-density polyethylene (HDPE) and shall be translucent to allow visual inspection of the oil level.

E. The hydraulic oil pump motor shall be as follows:

Parameter	Value	Unit
No. of Pump Units per Belt Filter Press	1	ea.
Minimum Motor Power	1	HP

Enclosure	TEFC	-
Motor Speed	1,200	RPM
NEMA Design	B	-

F. Maximum system pressure shall be set equal to the highest pressure required to obtain the desired operating belt tension. The maximum system operating pressure shall be 1,000 psi.

G. Hydraulic system controls shall be grouped for easy access and ease of operation. There shall be means provided to retract the belt tension cylinders for service. The valves, fittings, manifold, and associated parts shall be of non-corroding materials such as FRP, glass filled Nylon, and type 316 stainless steel.

H. The oil pressure gauge(s), one for each pair of belt tension cylinders, shall indicate oil pressure in PSI. Low-pressure switch (es) shall be provided to sense the absence of belt tension pressure.

I. Hydraulic cylinders shall have a non-corrosive body and type 316 stainless steel hardware and cylinder rod. The cylinder rod shall be solid stainless with a hardened polished seal contact surface. Chrome or nickel-plated rods are not acceptable.

2.15 BELT DRIVE

A. Input power to the drive roller shaft shall be supplied through a variable frequency drive unit. Speed shall be controlled through cyclical variation in motor current, which is operator set at the control panel. The drive roller speed reduction shall be obtained through a helical gear reducer. Motors shall be high-efficiency inverter duty.

B. Belt press (pressure section) drive motor shall be as follows:

Parameter	Value	Unit
No. of Drive Units per Belt Filter Press	1	ea.
Maximum Unit Horsepower	3	hp
Power	460 3 60	VAC Ph Hz
Rated Motor Speed	1,740	RPM
NEMA Design	B	-
Insulation Class	H	-
Enclosure	TEFC	-

Service Factor	1.15	-
Motor Duty	Severe	

C. Gravity zone drive motor shall be as follows:

Parameter	Value	Unit
No. of Drive Units per Belt Filter Press	1	ea.
Maximum Unit Horsepower	2	hp
Power	460 3 60	VAC Ph Hz
Rated Motor Speed	1,800	RPM
NEMA Design	B	-
Insulation Class	H	-
Enclosure	TEFC	-
Service Factor	1.15	-
Motor Duty	Severe	

2.16 DEWATERING BELTS

A. Each belt filter press shall incorporate the use of three dewatering belts.

B. Belts shall be fabricated of monofilament polyester and shall have type 316 stainless steel seams. The mesh design shall be selected for optimum dewatering of the sludge to be processed and provide for a minimum 2,000-hour belt life when operated in accordance with the manufacturer's instructions.

C. Belt selection shall be based on the manufacturer's experience obtained from testing the sludge during start-up of the belt filter press(es) and at other installations dewatering similar sludges with similar polyelectrolyte conditioning chemicals.

D. Each belt and connecting seam shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt shall be subjected. The seam shall be designed to fail before the belt.

E. Belts shall be designed for ease of replacement with a minimum of belt filter down time. Belt replacement shall be such that disassembly of the equipment is not required.

2.17 DISCHARGE (DOCTOR) BLADES

A. Discharge blades shall be provided to scrape dewatered sludge from the belt at the final discharge rollers. The blades shall be readily removable.

B. Operation of doctor blades shall minimize wear on the belt seam.

C. Doctor blades shall have adjustable springs or counterweights to maintain pressure against the belts

D. All springs and hardware shall be type 316 stainless steel.

E. Provide with lifting device to allow for movement of blades away from belts for cleaning without requiring belt filter press shutdown.

2.18 DRAINAGE PANS

A. Drainage pans shall be provided as necessary to contain filtrate from all dewatering areas within the belt filter press without splashing and to prevent rewetting of downstream cake.

B. All drainage piping shall be furnished, adequately sized for the intended service, and rigidly attached to the press frame.

C. Drainage piping shall terminate inside the structural frame at the bottom of the press. Drain connection shall be self-venting to prevent overflow.

D. Drainage pans shall be located so that the moving belts do not come into contact with the pans under any condition.

2.19 CAKE DISCHARGE CHUTE

A. The belt filter press shall be furnished with a custom discharge chute to direct cake solids to the existing belt conveyor system.

2.20 CONTROLS

A. Control panels, including components, shall comply with the requirements of Section 40 61 00, Instruments and Control Programming Requirements.

B. Programming shall be performed using the standards set by the Lee County Utilities.

C. Each belt filter press shall be provided with a power control panel (BFP-CP-1 and BFP-CP-2) that will contain the necessary starters, variable frequency drives (VFDs), control devices and equipment for powering and controlling the dewatering process as

described herein. Each filter press shall also be provided with a local control panel (BFP-LCP-1 and BFP-LCP-2) that shall be mounted above the belt press operation platform that contains a digital electronic operator interface terminal (OIT) to allow full remote operation in both Auto and Manual mode while visually observing the press operation. All hard-wired controls for each press shall be located at the power control panel.

D. The power control panel shall accept a 460 VAC, 60 hertz, 3-phase power input. A main disconnect circuit breaker and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the power distribution and control systems. The power control panel shall provide a 120V circuit to power the associated local control panel.

E. IEC rated motor starters shall be provided for the hydraulic unit and washwater pump. A VFD shall be supplied for each belt drive. VFDs shall be as manufactured by Square D, or approved equal. Provide branch circuit breakers for each starter and VFD.

F. A control power transformer shall be included that will provide 120 VAC control power to the system. Provide 120V branch circuit breakers off the 120V supply line for a panel receptacle, panel lights, panel AC system, and panel control power UPS.

G. The control panel shall be a dead-front panel with no physical devices on the exterior cover. All physical devices and OIT shall be mounted on the inner dead-front panel.

H. Located on the inner dead-front of the control panel shall be a CONTROL POWER OFF/ON switch. When in the ON position, the CONTROL POWER ON pilot light will be illuminated and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de energized. Also located on the control panel shall be an EMERGENCY STOP pushbutton. It shall be an illuminated mushroom head style pushbutton that when depressed shall immediately de energize all moving equipment in the system. An alarm horn shall be included for audible alarm annunciation.

I. As a minimum, the following control pilot devices shall be located on the inner dead-front of the control panel to allow for complete automatic and manual operation of the press through hard wired controls:

1. HAND/OFF/AUTO MODE selector switch

2. AUTO START pushbutton

3. AUTO STOP pushbutton

4. SYSTEM RESET pushbutton

5. ALARM SILENCE pushbutton

6. LAMP TEST pushbutton
7. PRESS READY indicator
8. DEWATERING OFF/ON selector switch
9. WASHDOWN CYCLE ON indicator
10. WASHWATER PUMP START pushbutton
11. WASHWATER PUMP STOP pushbutton
12. WASHWATER PUMP RUNNING indicator
13. HYDRAULIC PUMP START pushbutton
14. HYDRAULIC PUMP STOP pushbutton
15. HYDRAULIC PUMP RUNNING indicator
16. BELT FILTER PRESS DRIVE START pushbutton
17. BELT FILTER PRESS DRIVE STOP pushbutton
18. BELT FILTER PRESS DRIVE RUNNING indicator
19. THICKENER BELT DRIVE START pushbutton
20. THICKENER BELT DRIVE STOP pushbutton
21. THICKENER BELT DRIVE RUNNING indicator
22. THICKENER BELT DRIVE SPEED controller (0-100%)
23. PRESS BELT DRIVE SPEED controller (0-100%)
24. SLUDGE PUMP START pushbutton
25. SLUDGE PUMP STOP pushbutton
26. SLUDGE PUMP RUNNING indicator
27. SLUDGE PUMP SPEED controller (0-100%)
28. POLYMER FEEDER START pushbutton
29. POLYMER FEEDER STOP pushbutton

30. POLYMER FEEDER RUNNING indicator

31. POLYMER FEEDER SPEED controller (0-100%)

32. LOW WASHWATER PRESSURE indicator

33. LOW HYDRAULIC PRESSURE indicator

34. BELT MISALIGNED indicator

35. BELT BROKEN indicator

36. HIGH SLUDGE LEVEL indicator

37. EMERGENCY STOP pushbutton

38. THICKENER BELT DRIVE FAIL indicator

39. PRESS BELT DRIVE FAIL indicator

40. CONTROL POWER ON/OFF switch

41. CONTROL POWER ON indicator

J. The local control panel OIT shall be mounted on the inner panel dead front. OIT shall display the same status and control devices as provided by the physical devices on the inner dead-front of the power control panel to allow automatic and manual operation of the press through an Ethernet link between the OIT and the PLC in the power control panel.

K. Faults

1. When any of the following fault conditions occur, in automatic or manual mode, the appropriate fault indicator shall be illuminated, the alarm horn shall sound, and the belt filter press and associated equipment shall be de energized.

a. EMERGENCY STOP

b. LOW WASHWATER PRESSURE

c. HYDRAULIC PRESSURE FAULT

d. BELT MISALIGNED

e. BELT BROKEN

f. THICKENER BELT DRIVE FAIL

g. PRESS BELT DRIVE FAIL

L. Each power control panel shall communicate with a dewatering system main control panel (BFP-MCP, furnished under Division 40 by the Integrator) over a CAT6 Ethernet link. The following I/O shall be provided by vendor and transmitted to BFP-MCP via this link as shown on contract drawings/P&IDs:

1. Washwater pump running and continuous runtime value (hrs and 10ths)
2. Thickener belt drive running and continuous runtime value (hrs and 10ths)
3. Dewatering belt drive running and continuous runtime value (hrs and 10ths)
4. Hydraulic pump running and continuous runtime value (hrs and 10ths)
5. Washwater pump starter overload
6. Thickener belt drive VFD fault
7. Dewatering belt drive VFD fault
8. Hydraulic pump starter overload
9. Start signal for selected sludge feed pump
10. Speed setting for selected sludge feed pump
11. Start signal for selected polymer feeder
12. Speed setting for selected polymer feeder
13. Low water pressure alarm
14. Sludge feed flow and sludge feed daily flow total (resets each day)
15. Emergency stop alarm (any E-stop activated)
16. Dewatering belt misaligned alarm
17. Dewatering belt broken alarm
18. Thickener feed high level alarm
19. Low Hydraulic Pressure alarm
20. Panel internal temperature high alarm

M. Controls Description

1. Auto Mode

    a. The press may be operated in the automatic mode by placing the HAND/OFF/AUTO selector switch in the AUTO position. The operator will press the AUTO START pushbutton. At this time, the hydraulic pump, washwater pump and washwater valve will be energized and a belt tensioning time delay will start.

    b. After the belt tensioning timer times out, both belt drives will be energized and a belt pre wet time delay will start. After the pre wet timer times out, the conveyor will be energized, the PRESS READY pilot light will be illuminated and, if the DEWATERING OFF/ON selector switch is not in the ON position, switch it to ON and the sludge and polymer pumps will be energized and pop-up shall enable to enter the speed for the pumps to run at OR last value entered by the Operator.

    c. Pressing the AUTO STOP pushbutton will de energize the sludge and polymer pumps, illuminate the WASHDOWN ON pilot light and start a wash down time delay. After the wash down timer times out, the belt drive, hydraulic pump, washwater valve and washwater pump will be de energized.

2. Manual Mode

    a. To operate the press in the manual mode (with or without actually dewatering sludge) at the BFP-CP, the operator will place the HAND/OFF/AUTO selector switch in the HAND position. The operator will start the washwater pump by pressing the WASHWATER PUMP START pushbutton; start the hydraulic pump by pressing the HYDRAULIC PUMP START pushbutton. Anytime the washwater pump is running, the washwater valve shall be energized. Manual mode shall also be achievable at the BFP-LP at the top of the presses using the HMI manual mode selector switches on the HMI displays.

    b. To operate the press in manual mode at the BFP-CP to actually dewater sludge, if the PLC system is operational, the start/stop polymer and sludge feed pump pushbuttons on the BFP-CP can be used in conjunction with the manual controls of the press (command signals for the polymer and sludge pumps sent via Ethernet to the MCP). The same can be achievable at the BFP-LP if the Ethernet links are operational.

    c. To operate the press in manual mode at the BFP-CP to actually dewater sludge and the PLC and/or Ethernet links are out of service, the polymer and sludge pump start/stop manual control shall be through the physical pushbuttons on the MCP or locally at the polymer control panel and/or the sludge pump VFDs.

d. The operator should not proceed until the belts have been fully tensioned. No interlock is provided to prevent the operator from starting the belt drive in the manual mode. Pressing the BELT DRIVE START pushbuttons will energize the belt drives and after a pre-wet time delay will illuminate the PRESS READY pilot light. At this time, the operator will start the sludge pump by pressing the SLUDGE PUMP START pushbutton and start the polymer pump by pressing the POLYMER PUMP START pushbutton and manually start the conveyor via the conveyor control panel (C-CP).

e. Pressing the respective STOP pushbutton in the reverse order stated above will stop the system, stopping with the sludge and polymer pump first, then the belt drives, hydraulic pump and washwater pump.

N. Programmable Logic Controller (PLC): Each power control panel shall include a PLC to provide control logic for automatic mode operation and to perform runtime and flow total calculations. All logic functions for the system shall be performed by an industrial grade programmable logic controller (PLC) located in the control panel. PLC shall be Allen Bradley CompactLogix, latest processor and utilizing ladder logic programming. The CPU shall have 4K minimum RAM for user instructions. The unit shall have battery backed RAM and EEPROM backup. PLC shall be mounted behind the dead front panel door. Discrete inputs to the PLC shall be fused. Refer to specification section 40 61 00 for additional PLC requirements.

2.21 CONTROL PANEL COMPONENTS

A. Enclosures: Control panel enclosures shall be fabricated of 316 stainless steel and shall be suitable for NEMA 4X service. The power control panels shall be free-standing panels on support legs. The local control panels shall be suitable for support rack mounting. The panel exterior shall be coated with a phosphatized baked enamel white coating. Panel doors for the power control panes shall be designed for dead-front access and fitted with lockable, three-point door latches that maintain the NEMA 4X rating when fully engaged. Door for the local control panel shall include quick-release latches. Enclosures shall be manufactured by Hoffman Manufacturing, Steeline, or equal.

B. Wiring: All power and control wiring shall be 600 volt, type MTW insulation stranded copper and shall be sized for the required load, 14 AWG minimum for discrete signals and power; #16 twisted pair for analog wiring. Color coding shall be as noted in Section 40 61 00.

C. Circuit Breakers: The circuit breaker for the main breaker and branch circuit breakers shall be thermal magnetic molded case units. The main circuit breaker shall be as manufactured by Square D for 480V service and shall be operable through the dead front panel door.. Branch circuit breakers shall be as manufactured by Square D for 120V (QOU1 series) service or approved equal. Branch circuit breakers shall be located

behind the dead front panel door (dead front door must be opened to access the branch circuit breakers).

D. Motor Starters: Motor starters shall be mounted behind the dead front panel and be full voltage, non-reversing, IEC style across the line units. Coils shall be 120 VAC. The starters shall be as manufactured by Square D., or approved equal.

E. Selector Switches: All selector switches shall be mounted on the dead front panel door and be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Selector switches shall be as manufactured by Square D Type SK, or approved equal.

F. Pushbuttons: All pushbuttons shall be mounted on the dead front panel door and be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Pushbuttons shall be as manufactured by Square D Type SK, or approved equal.

G. Pilot Lights: Pilot lights shall be mounted on the dead front panel door and be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC transformer type with LED lamps. Pilot lights shall be as manufactured by Square D Type SK, or approved equal.

H. Relays: Control, timing, and isolation relays shall be mounted behind the dead front door and be DIN rail mounting type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a test button and LED indicator. Relays shall be as manufactured by Square D or Phoenix Contact .

I. Corrosion Protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts, and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

J. Panel Seal-Offs: All conduits entering the panel shall be sealed at the conduit entry point with a removable, expandable conduit seal material to prohibit outside air from entering the panel.

K. Terminal Blocks: Terminal blocks shall be high density, spring cage clamp style, with 600-volt rating. Terminal blocks shall be as manufactured by Square D or Phoenix Contact. Terminals shall be as noted in Section 40 61 00.

L. Variable Frequency Drives (VFDs): The VFDs shall be mounted behind the dead front door and be UL listed and shall be Square D Altivar 660 or Altivar 320 Process Drive series. No equal.

M. Operator Interface Terminal (OIT): The OIT on each local control panel shall be a 15" color display touch screen, capable of being configured for use with Citect software. The OIT shall communicate with the PLC in the power control panel through a network switch in the local control panel over a copper CAT6 Ethernet link. OIT's shall be as manufactured by C-more or Automation Direct. The OIT shall be mounted behind the panel door with a clear window on the panel door that allows viewing of the OIT without opening the panel.

N. Nameplates: Each panel shall include a panel nameplate and each dead-front panel mounted device shall include legend nameplates to describe the function of the device. All interior panel components mounted behind the dead front door shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back. The tags shall be black background with white letters and match the nomenclature indicated on the as-built wiring diagrams.

O. Uninterrupted Power Supply (UPS): Provide a UPS in both the power control panels and the local control panels. The 120V control logic, PLC CPU and I/O modules, network communications, OIT, and field instrument loop power supply shall all operate on 120V power from a UPS securely mounted inside the panels (loose installation at bottom of panel not acceptable). The power control panel UPS shall be mounted behind the dead front door. The UPS shall be APC SMT1000 with AP9640 Ethernet card with outputs to the PLC to indicate battery life low, running on battery status, UPS fault. Panel shall incorporate a true UPS bypass switch inside the panel that allows operators to send line power to the UPS directly to the load side circuits, completely bypassing the UPS for maintenance purposes.

P. Surge Suppression: Provide a surge arrestor installed on the line side of the main breaker in accordance with manufacturer's instructions. Provide surge suppression devices on all signal and power leads on all circuits that have any part of the control or power circuit that extends past the limits of the power control panel. Provide surge suppression on all analog signals at the instrument end in the field in addition to the panel end. Surge devices shall match the components used by the County throughout the WRF facility:

1. Erico SES40 series for 480V power; or approved equal.
2. EDCO HSP for 120V power; or approved equal.
3. Erico UTB110SP for 120V signals; or approved equal.
4. Allen Bradley 4983-DD24 for 4-20mA signals, panel end; or approved equal.
5. Emerson EDCO SLAC-22036-LC for powered instrument field end; or approved equal.
6. Phoenix Contact S-PT1-2PE-24DC for unpowered instrument field end; or approved equal.

Q. Ethernet Interface: The VFDs, UPS's, OIT's, and PLC in the power and local control panels shall communicate over a copper Ethernet PoE link connected through a network switch. The conduit between panels shall be furnished and supplied under Division 26.

R. Network Switch: Ethernet interface for all network components shall be through a local area managed network switch, as manufactured by Allen Bradley Stratix, mounted within the local control panel and the power control panel. The switch in the power control panel shall be mounted behind the dead front panel door. The network switch shall have the number of CAT6 as needed to connect all required devices with at least one spare port. The network switch shall provide communications with County-assigned IP addresses for the PLC, OIT, UPS, and VFDs. Cable between the network switch and connected components shall be furnished under this section and be industrial grade CAT6 cable and ST connectors for all cable other than the VFDs. Cable connection to the VFDs shall include LAPP Group PN 2170060 Connectors to protect against interference from 480V power within the VFD.

S. As-built Drawings: A laminated "As Built" copy of the panel wiring diagrams shall be provided and placed in the panel print pocket. Panel drawings shall be developed using AutoCad®. The drawings shall have a complete Bill of Materials, panel exterior and interior layouts, and show all electrical wiring. As-built drawings shall be submitted with the O&M materials on electronic media in both AutoCad® (.dwg) and searchable Adobe Acrobat® (.pdf).

T. Air Conditioning

1. Provide solid-state cabinet coolers or air conditioning units on each power control panel.

2. Increase panel sizes as needed to accommodate cooling units.

3. Enclosure rating: NEMA Type 4X.

4. Closed-loop design to separate sealed internal panel air from outside air to maintain the panel NEMA 4X rating. The unit shall be of stainless steel construction with exterior shields and special coatings applied to coils and copper lines exposed to ambient air to protect the unit from corrosive ambient conditions.

5. Power supply: 120 VAC.

6. Provide a sensor to alarm on high panel internal temperature

7. Manufacturers: The following or approved equal:

a. Kooltronic, GuardianDP Series.

b. ICEqube, Blade series or IECEx/ATEX for Zone 1 & 2.

c. Hoffmann Thermoelectric Unit.

d. Or approved equal.

2.22 SPARE PARTS

A. Belt filter press manufacturer shall provide the following spare parts:

1. Two complete sets of cloth belts. Provide belts following successful start up to allow evaluation of performance of installed belts.

2. Four complete sets of doctor blades.

3. Two complete sets of bearings and bearing seal rings of each size and type.

4. One complete set of wash water spray nozzles.

5. One complete set of edge seals for dewatering zones.

6. One complete set of drive unit components for one belt filter press, including motors, speed reducers, drive belts, chains, sprockets, and related items for each type and size of drive unit provided.

B. Furnish supply of all greases and lubricants required for start-up, field testing, and first year of operation. Products shall be as recommended by the manufacturer

C. Furnish maintenance repair kit for belts and repairable wear items as recommended by equipment manufacturer.

D. Furnish and deliver spare parts, consumables, and special tools carefully packed in sturdy containers with clear indelible identification markings. Properly store spare parts, consumables, and special tools until transferred to Owner.

E. Provide list of additional recommended spare parts for operating period of one year. List shall describe each part, quantity recommended, and unit price of the part.

F. Special Tools: Furnish two sets of special tools required for normal operation and maintenance.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not

proceed with the Work until unsatisfactory conditions have been corrected. Verify that structures, pipes, and equipment are compatible.

3.02 INSTALLATION

A. Install products in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents.

B. Anchorages and Base Plates:

1. Provide anchorages in new or existing concrete, as applicable, per equipment manufacturer's recommendations and the Contract Documents.

2. Provide concrete bases up to one inch below equipment baseplate or support leg/pedestal as applicable and as shown on the Contract Drawings. Base with equipment mounted thereon shall then be accurately shimmed to grade and spaces between filled with non-shrink grout per Section 03 30 05, Concrete and Grout. After grout has reached its initial set, exposed edges shall be neatly cut back 1/2-inch.

C. General:

1. Perform all drilling and fitting required for installation. Set products accurately in location, alignment, and elevation, plumb, true, and free of rack.

2. Fit exposed connections accurately together to form tight hairline joints.

3. For contact surfaces between aluminum and dissimilar surfaces, use a coat of bituminous paint or other approved insulating material.

4. Provide utility connections per the Contract Documents.

5. Align and adjust equipment including shafting, motors, belts, drives, chutes, and drains.

6. Provide appropriate mounting brackets for field instruments, and coordinate location of sensors and transmitters.

7. Prior to energizing electric motor drive equipment, rotate drive motor by an external source to demonstrate free operation of all mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.

8. Field painting shall conform to Section 09 90 00, Painting.

9. Comply with Section 01 73 00, Execution of the Work and Section 01 75 00, Checkout and Startup Procedures.

3.03 SHOP TESTING

A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.

3.04 FIELD TESTING

A. Preliminary and final field tests shall be performed in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

B. Preliminary Field Tests: Run 2-hour no load test on each press. The test shall consist of the following:

1. Check starting and running amperage. Run for five (5) minutes.

2. If units operate vibration free and quietly with normal amperage, test is acceptable.

3.05 PROCESS PERFORMANCE TESTING

A. Equipment shall dewater sludge produced by Owner's operations at the Site. Sludge pumped to the belt filter presses will not vary significantly from sludge having the characteristics described in this specification.

B. Acceptance test will be scheduled jointly by Contractor and Owner and will be conducted for eight continuous hours per day for a minimum of four consecutive days. All testing will be subject to supervision by Owner and Engineer.

C. Testing will be on weekdays and will consist of one day for polymer dosage and operational optimization and three days (test runs) of intensive testing, which will be used by Engineer for evaluating equipment performance. A continuous eight-hour test run will be conducted each day of intensive testing. Working hours for process performance testing will correspond to normal day shift at the Site.

D. Samples of sludge feed, sludge cake, wash water, and filtrate shall be taken at end of each hour of eight-hour test runs. Supplier may request that two additional sets of samples be taken at any time during the last two hours of test run. Average results of samples taken during each test run will be used for representing performance during test run.

E. Test information required for each test run is as follows:

1. Test run number.

2. Sludge feed rate in gpm.

3. Percent dry solids of feed sludge.

4. Percent dry solids of sludge cake.

5. Percent water removed.

6. Percent solids capture.

7. Filtrate dry solids in mg/L.

8. Washwater flow rate in gpm.

9. Washwater dry solids in mg/L.

10. Filtrate discharge rate in gpm.

11. Polymer feed rate in gpm.

12. Polymer type, activity, and solution feed concentration. Polymer used shall be the Owner's existing Polydyne SE-1496.

13. Polymer consumption in active pounds of polymer per dry ton of feed sludge. Maximum polymer consumption shall be capped at 21 active lbs./DT.

14. Flow rate of filtrate and washwater discharged from belt filter press to be determined by method acceptable to Engineer.

F. Third-party testing laboratory, paid for by Contractor, will be responsible for collecting, marking, and delivering samples to laboratory for testing. Percent solids in sludge feed and cake samples will be determined as total residue dried at 103 to 105 degrees C in accordance with Standard Methods for Examination of Water and Wastewater. Testing Laboratory personnel will assist Contractor during polymer optimization period by performing tests for sludge, wash water, and filtrate solids on hourly samples. Contractor shall have continuous access to results of laboratory tests conducted on samples during intensive testing as necessary to determine need for adjustments to polymer or sludge feed, or to equipment. Results on samples taken during final three hours of a test run may not be available until the following day. Contractor may, for its own use and at its option, obtain split samples during test run and utilize services of commercial laboratory acceptable to Owner for obtaining additional test results. Engineer and Contractor will have access to the test results prepared by Testing Laboratory within three working days of end of intensive testing.

G. Contractor shall use the average feed sludge consistency during run for reporting. Contractor shall construct curves representing feed sludge percent dry solids versus cake percent dry solids, and feed sludge percent dry solids versus polymer dosage for each throughput rate. Average values of percent dry solids and polymer dosage for each test run shall be used to plot curves.

H. Rates of unconditioned sludge feed to belt filter press, polymer added to feed sludge, and wash water flow shall be measured and recorded during the test when samples are taken. Rate of filtrate discharged from belt filter press shall be determined as accepted by Engineer and recorded during the test runs. Total filtrate flow rate includes filtrate from sludge and wash water flow rate.

I. Standpipes or overflow weirs are not allowed in wash water and filtrate drainage sump. Drains shall run free and clear.

J. Recycling filtrate to sludge polymer conditioner is not allowed during testing.

K. Upon completion of testing, Engineer will evaluate test results relative to belt filter press throughput rate, polymer usage, solids capture, and sludge cake dry solids, and determination whether conformance of each belt filter press with specified process performance has been achieved. Engineer's determination will be based on average performance of each belt filter press during the intensive testing. Average process performance for each belt filter press will be estimated on basis of total quantities of water and solids processed by each belt filter press during intensive testing. If Engineer determines that dewatering equipment meets specified performance requirements, equipment performance will be acceptable and Contractor and Owner will be notified accordingly.

L. Satisfactory completion of process performance testing does not release Contractor from obligations under the Contract.

M. Compliance with specified performance requirements shall be achieved for equipment to be acceptable.

N. Invalid Test Runs:

1. An invalid test run, as determined by the Engineer, is defined as a test run in which a belt filter press does meet the performance requirements. Should an invalid test run occur, the data associated with that test run shall be excluded from the results provided that the remaining 2 of the 3 total test days provide acceptable and valid data.

O. Retest:

1. If there are two or more test days' worth of invalid data, the performance test will be deemed to have failed and the Contractor shall modify the system and repeat the test event. Modifications and retest event shall be completed by Contractor at no additional cost the Owner.

2. The Contractor shall be entirely responsible for the cost related to such modifications (e.g., engineering and construction, retesting, laboratory analysis).

3. Contractor and belt filter press Manufacturer shall complete all modifications and re-testing within thirty days of being notified of results of first performance test.

P. Process Non-performance:

1. If the re-test event is again deemed a failed test, as determined by the Engineer, the equipment shall be considered non-performing. Analysis and investigations shall be undertaken by the Contractor and the Manufacturer to determine the cause of such noncompliance; at Contractor's expense. Contractor shall prepare and submit a remedial action plan that presents options to the Owner.

   a. One option shall be the completion of a third performance test. The Owner shall allow additional time for Contractor and Supplier to modify and re-test equipment. The third performance test, if authorized by Owner, and any subsequent performance tests shall be at the cost of the Owner.

2. If the cause of such noncompliance is faulty equipment or negligence on the part of the Contractor or Manufacturer, and the specified feed solids throughput is not achieved on one or more belt filter presses, after modifications and re-testing, belt filter press equipment will not be accepted. If attempts to modify and re-test, system are not successful, remove and replace the belt filter presses with units provided by an alternate Supplier that has proven capable (by testing with Owner's process sludge prior to selection) of meeting specified performance, at no additional cost to Owner.

3.06 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions to perform the following:

1. Supervise unloading and installation of equipment.

2. Instruct Contractor in installing equipment.

3. Inspect and adjust equipment after installation, setting, and leveling by Contractor to ensure proper operation and approve the installation.

4. With Contractor, perform startup and calibration.

5. Instruct Owner's personnel in operating and maintaining the equipment.

6. With Contractor, perform field testing of equipment.

B. Field services shall include the following site visits. All requirements are minimums. Any additional time required to achieve successful installation, operation, and performance

shall be at the expense of the Contractor.

Service	Number of Trips	Number of Days/Trip	Number of Hours/Day
Unloading and Supervision	1	1	4
Installation	1	2	8
Checkout, Calibration, and Startup	1	5	8
Performance Testing	1	5	8
Instruction of Owner's Personnel	1	2	4

END OF SECTION

SECTION 46 77 20
LIQUID POLYMER PREPARATION SYSTEM

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Furnish and install two (2) complete liquid polymer preparation systems, including neat polymer feed pump, controls, skid, integral piping, valves, fitting, pipe supports, special equipment and appurtenances in accordance with these specifications, including all incidental work necessary to make it complete, satisfactory and ready for operation, as specified herein and as indicated on the Drawings.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

C. Before submitting shop drawings, the CONTRACTOR shall verify spatial requirements to ensure that the equipment supplied will fit in the space allotted on the Drawings.

D. The liquid polymer preparation system shall be designed for use with the plant reclaimed water system.

E. The OWNER's existing polymer product which is in use as of the writing of this Specification is SNF Polydyne Clarifloc SE-1496. The Supplier shall verify the County's current polymer product during submittal development and confirm that the performance requirements can be met based on the current polymer product used at the time of the submittal.

F. The CONTRACTOR shall have unit responsibility for coordination of all structures, controls, piping, and appurtenances with all interrelated equipment as may be specified elsewhere in these documents to provide a complete and operable system.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittals and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

a. Submit data completely describing product, including detailed scope of supply, detailed bill of materials and annotated specification sheets of all components.

b. Submit detailed specifications and shop drawings with both shaded isometric and orthogonal views of the proposed system, including dimensions and weights.

c. Submit wiring, control schematics, and control logic diagrams for all electrical and control components furnished.

d. Motor data sheets.

2. O&M Manuals

3. Warranty documentation.

B. Field Tests:

1. Submit proposed polymer system testing protocol for approval by ENGINEER.

2. Submit a written report giving the results of the required field tests.

1.03 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years from the date of acceptance by the County for the Work associated with the equipment specified herein.

B. Any equipment which does not meet the performance requirements specified herein shall be repaired to the County's satisfaction or replaced with equipment that does meet the performance requirements of the specification.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The liquid polymer preparation system shall be:

1. VeloBlend Model VM-10P-1800-E, as manufactured by VeloDyne.

2. Or approved equal.

2.02 PERFORMANCE REQUIREMENTS

A. The system shall be designed to fully activate neat emulsion polymers and provide homogenous liquid polymer feed solutions to downstream points without additional polymer solution pumping.

Parameter	Value
No. of Polymer Units	2 (1 duty unit per each operational press)
Belt Filter Press Feedstock Solids Concentration (%)	0.5 – 1.0
Polymer Type	Emulsion
Polymer Activity (% active)	35 - 40
Solution Concentration Range (% by volume)	0.1 - 1.0
Solution Concentration Range (% active)	0.2 - 0.5
Polymer Dose (lbs. active polymer/hour)	12 - 20
Neat Polymer Flowrate Range (gph)	0.5 - 10.0
Dilution Water Flowrate Range (gph)	180 – 1,800
Neat Polymer Feed Pump Style	Progressive Cavity
Suction Lift (ft.)	3
Max. Pressure Drop Across Polymer Preparation Skid (psig) [1]	40
Polymer Feed Pump Turndown Ratio	20:1
Electrical Feed Power	480 VAC/3 phase/60 Hz
Dilution Water Source	Reuse water
Dilution Water Chlorine Residual (mg/L)	0.5 to 3.0
Approx. Available Dilution Water Supply Pressure (psig) [2]	30

1 Maximum pressure drop value to be confirmed by manufacturer.
2 Manufacturer shall confirm the need for a dilution water booster pump.

2.03 MATERIALS OF CONSTRUCTION

A. The polymer system components shall be constructed of materials of construction as scheduled.

Parameter	Value
Skid	Type 316 stainless steel
Hardware	Type 18-8 stainless steel
Inlet and outlet fittings	Type 316 stainless steel
Pipe and pipe fittings	Schedule 80 PVC
Pipe supports	Stainless steel

Parameter	Value
Tubing and tube fittings	Polyethylene, polypropylene, stainless steel, and Viton
Water solenoid valve	Brass
Pressure gauges	Stainless steel
Pressure switch connections	Brass
Rotameter flow meter	Acrylic, stainless steel, PVC, or polypropylene
Calibration chamber	PVC
Water control valve and seat	Stainless steel
Mixing chamber	Stainless steel
Impeller	Type 316 stainless steel
Impeller shaft seal	Viton, stainless steel, ceramic, carbon
Pressure relief valve	Brass, stainless steel, or PVC
Metering pump wetted parts	Stainless steel and Viton
Metering pump shaft seals	Viton, stainless steel, ceramic, carbon
Control enclosure	FRP

2.04 SKID

A. The skid and frame assembly shall be constructed of 3/16" angle or structural stainless steel tubing.

B. The back plate supporting the control panel shall be a minimum 12-gauge thickness.

C. Vertical frame members shall be gusseted to the base.

D. Piping and valves shall be mounted with rigid pipe clamps.

E. The skid shall be designed for fork-lifting and shall have holes for mounting to concrete pad.

F. All piping shall be rigidly supported.

G. The skid shall have an integral stainless steel drip pan located under the neat polymer metering pump.

H. The skid shall include the following connections:

1. 1.5” FNPT water inlet connection.

2. 1” FNPT neat polymer inlet connection.

3. 1.5” FNPT solution discharge connection.

2.05 POLYMER ACTIVATION AND BLENDING CHAMBER

A. Polymer activation and blending shall utilize a multi-stage, multi-zone, hydro-mechanical technology.

1. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber.

2. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush.

3. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.

B. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

C. An alternative hydro-dynamic, non-mechanical blending device will be acceptable provided that all other specified requirements are met and that the technology is capable of providing control over mixing energy in order to provide the versatility required to handle all emulsion and dispersion type polymers that may be used now and in the future. In order to meet this requirement, the following shall be provided:

1. Integral, multi-stage, stainless steel dilution water booster pump shall be provided to eliminate reliance on system pressure for its mixing energy.

a. The booster pump system shall be capable of producing 100 psi differential pressure across the hydro-dynamic mixing chamber’s water-jet producing orifice which is then controllable down to a minimum of 50 psi differential pressure in order to provide control over mixing energy.

2. Integral pressure regulating valve mounted down-stream of the booster pump to provide control over mixing energy

3. Pressure gauge upstream of the pressure regulating valve to monitor available system pressure.

2.06 DILUTION WATER CONTROL

A. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range as specified herein.

B. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.

C. The unit shall have a NEMA 4X electric solenoid valve for on/off control of total dilution water flow.

D. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 9 and 60 psig. The dilution water loss of flow sensor shall be a NEMA 4X, industrial duty differential pressure switch.

E. The pressure switch shall be as manufactured by Ashcroft, or approved equal.

F. Provide a 2-1/2" liquid filled pressure gauge to monitor dilution water inlet pressure.

G. The dilution water system shall have the ability to perform a flush cycle at the end of a run cycle, which sends dilution water downstream of the booster pump to the injection point. This will allow for removing any clogs in the dilute polymer line to the injection point.

H. The dilution water piping on the suction side of the booster pump shall include a 40 mesh wye strainer.

I. Dilution Water Booster Pump

1. The system's frame shall be designed for the integral dilution water booster pump.

2. The dilution water booster pump shall be sized based on the anticipated dilution water supply pressure, the anticipated downstream backpressure, and the pressure drop across the liquid polymer preparation system. The dilution water booster pump shall be mounted to the liquid polymer preparation skid and shall be powered and controlled from the liquid polymer preparation system local control panel. The dilution water pump shall have stainless steel wetted components and be supplied with a TENV or TEFC electric motor. The motor starter shall be located in the liquid polymer preparation system local control panel.

2.07 NEAT-POLYMER FEED PUMP

A. The liquid polymer preparation system shall be supplied with a neat polymer-metering pump integrally mounted on the system skid.

B. Progressive cavity pump shall be as manufactured by Seepex, or approved equal.

C. The metering pump shall have a range as specified herein.

D. The pump shall be positive displacement, progressive cavity type.

E. The pump shall be configured for a suction lift application. To prevent loss of prime, provide pump with seal kit.

F. The shaft seal shall be an adjustable packing type.

G. The pump shall be driven by a maximum 0.5 hp, 0–90VDC electric motor.

H. The speed of the pump shall be controlled by an SCR motor controller mounted in the control panel.

2.08 NEAT POLYMER CHECK VALVE

A. The liquid polymer feed system shall be supplied with a neat polymer check valve designed to isolate the neat polymer from the dilution water upstream of the mixing chamber.

B. The valve shall be designed with an open, unobstructed path to the valve seat.

C. The valve shall be readily accessible for cleaning and maintenance.

D. The check valve shall not be installed within the mixing chamber assembly or require mixing chamber disassembly for maintenance and servicing.

2.09 CALIBRATION COLUMN

A. A calibration chamber shall be provided on the neat polymer inlet piping to the liquid polymer feed system for use in calibrating the polymer feed pump.

B. The chamber shall be sized to give adequate capacity for a minimum 60 second draw down test at maximum pump capacity. The scale shall give direct readings in GPH without the need for calculations.

C. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets.

D. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.

2.10 FLOW SENSOR

A. Provide a thermal type polymer loss of flow sensor. The flow sensor shall include a stainless-steel plumbing assembly with a stainless-steel full port ball valve for draining during cleaning.

2.11 SOLUTION DISCHARGE ASSEMBLY

A. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure.

B. Provide an in-line swing check valve on the solution discharge.

2.12 ELECTRICAL AND CONTROL REQUIREMENTS

A. Each liquid polymer preparation system shall operate from a polymer feeder control panel, one for each feeder (PP-CP-1 and PP-CP-2) that shall power and control the individual components of each feeder.

B. All interconnecting power and control wiring necessary for a complete installation shall be the responsibility of the equipment manufacturer and/or the CONTRACTOR.

C. The control panel shall include the following at a minimum:

1. Single point power connection from a 480 VAC, single phase, power source for the entire system.

2. Main disconnect switch for the incoming power with operating handle that shall be pad-lockable in the OFF position.

3. Motor starters and SCR controllers as required for all motors furnished.

4. Controls for all liquid polymer preparation system equipment.

D. All conduit, couplings, fittings, and fasteners furnished by the equipment manufacturer shall be PVC-coated rigid aluminum and liquid tight, PVC-coated, flexible metal conduit.

2.13 CONTROL PANEL

A. The control panel shall be a skid mounted NEMA 4X stainless steel enclosure with a fused disconnect main power ON-OFF switch and pilot light to indicate a power ON operating condition. The control panel shall consist of all switches, relays, indicator lights, digital displays, and other auxiliary devices as required to provide the functional capabilities described herein. The control panel, and its components, shall be industrial duty fully suitable for the application environment. The control panel shall be furnished with a numbered terminal block, with legend, suitable for connection of 14 AWG wire for remote signal capability. Electrical equipment in the control panel shall conform to the applicable NEMA and NEC standards.

B. The control panel shall include an e-stop mushroom pushbutton.

C. The control panel shall be a dead-front panel with all physical devices mounted on the inner dead-front panel door.

D. The control panel shall be provided with a LOCAL-OFF-REMOTE selector switch.

1. When the LOCAL-OFF-REMOTE selector switch is in the LOCAL position, the unit shall operate based on RUN/STOP and SPEED settings at the control panel. The speed input shall be a 4-20 mA analog pacing signal from the control panel's speed potentiometer.

2. When the LOCAL-OFF-REMOTE selector switch is in the OFF position, the unit shall not operate.

3. When the LOCAL-OFF-REMOTE selector switch is in the REMOTE position the unit shall operate based on RUN/STOP and SPEED input received from the dewatering system main control panel (BFP-MCP) with the speed command being a 4-20 mA analog pacing signal.

E. The dilution water loss sensor shall place the polymer pump on standby if the dilution water flow has been interrupted for any reason and shall automatically restart the polymer pump when the water flow is restored. An integral timer shall monitor loss of dilution water flow and energize the contacts to provide an alarm after 15 seconds of continuous loss. The controller shall indicate loss of water alarm.

F. The liquid polymer preparation system shall be supplied with a sensor to indicate loss of polymer to the neat polymer feed pump. The sensor shall be of the thermal type. The sensor shall place the polymer pump on standby if loss of polymer flow is detected. Loss of polymer flow shall require a manual system restart.

G. The polymer system control panel shall include a relay to facilitate a flush cycle at the end of a run cycle, as described under paragraph 2.06 G.

H. The polymer system control panel shall have the following I/O signals to interface with the dewatering system BFP-MCP:

1. System run status digital input to the BFP-MCP.

2. System general alarm status digital input to the BFP-MCP.

3. System LOR switch IN REMOTE status digital input to the BFP-MCP.

4. System start/stop command digital output from the BFP-MCP.

5. Sludge feed pump flow paced analog output signal from the BFP-MCP.

6. Polymer feed pump speed feedback analog input signal to the BFP-MCP.

I. Polymer control panel shall have the following indicating lights and devices mounted on the dead-front face of the local control panel enclosure:

1. System LOCAL-OFF-REMOTE selector switch.

2. Neat polymer feed pump speed indication.

3. Neat polymer feed pump run status indication.

4. Neat polymer feed pump fault status indication – generated from pump.

5. Loss of polymer flow alarm.

6. Dilution water Low Pressure alarm.

7. E-stop pushbutton.

8. Power On indicator.

9. Manual speed potentiometer.

2.14 CONTROL PANEL COMPONENTS

A. Enclosures: Control panel enclosures shall be fabricated of 316 stainless steel and shall be suitable for NEMA 4X service. The panel exterior shall be coated with a phosphatized baked enamel white coating. Panel door shall have quick-release latches that maintain the NEMA 4X rating when fully engaged. Enclosures shall be manufactured by Hoffman Manufacturing, Steeline, or equal.

B. Wiring: All power and control wiring shall be 600 volt, type MTW insulation stranded copper and shall be sized for the required load, 14 AWG minimum for discrete signals and power; #16 twisted pair for analog wiring. Color coding shall be as noted in Section 40 61 00.

C. Circuit Breakers: The circuit breaker for the main disconnect and branch circuit breakers shall be thermal magnetic molded case units. The main circuit breaker shall be Allen Bradley type 1404 or equal. Branch circuit breakers for 120V control power shall be as manufactured by Square D for 120V (QOU1 series) service or equivalent supplied by Allen Bradley.

D. Selector Switches: All selector switches shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Selector switches shall be Allen Bradley Type 800H or equal.

E. Pushbuttons: All pushbuttons shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Pushbuttons shall be Allen Bradley Type 800H or equal.

F. Pilot Lights: Pilot lights shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC transformer type with LED lamps. Pilot lights shall be Allen Bradley Type 800H or equal.

G. Relays: Control, timing, and isolation relays shall be DIN rail mounting type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a test button and LED indicator. Relays shall be as manufactured by Phoenix Contact or Allen Bradley.

H. Corrosion Protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts, and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

I. Panel Seal-Offs: All conduits entering the panel shall be sealed at the conduit entry point with a removable, expandable conduit seal material to prohibit outside air from entering the panel.

J. Terminal Blocks: Terminal blocks shall be high density, spring cage clamp style, with 600-volt rating. Terminal blocks shall be as manufactured by Allen Bradley or Phoenix Contact. Terminals shall be as noted in Section 40 61 00.

K. Nameplates: Each panel shall include a panel nameplate and each front panel mounted device shall include legend nameplates to describe the function of the device. All interior panel components shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back. The tags shall be black background with white letters and match the nomenclature indicated on the as-built wiring diagrams.

L. Surge Suppression: Provide a surge arrestor installed on the line side of the main breaker in accordance with manufacturer's instructions. Provide surge suppression on all analog signals. Surge devices shall match the components used by the County throughout the WRF facility:

1. Erico SES40 series for 480V power; or approved equal.
2. EDCO HSP for 120V power; or approved equal.
3. Erico UTB110SP for 120V signals; or approved equal.
4. Allen Bradley 4983-DD24 for 4-20mA signals; or approved equal.

M. As-built Drawings: A laminated "As Built" copy of the panel wiring diagrams shall be provided and placed in the panel print pocket. Panel drawings shall be developed using AutoCad®. The drawings shall have a complete Bill of Materials, panel exterior and interior layouts, and show all electrical wiring. As-built drawings shall be submitted with

the O&M materials on electronic media in both AutoCad® (.dwg) and searchable Adobe Acrobat® (.pdf).

2.15 NAMEPLATES

A. Each panel shall include a panel nameplate and each front panel mounted device shall include legend nameplates to describe the function of the device. All interior panel components shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back. The tags shall be black background with white letters and match the nomenclature indicated on the as-built wiring diagrams.

2.16 SHOP TESTING

A. Prior to shipment the system shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and connections whisker-free.

B. The complete system shall be fully factory tested prior to shipment. Testing shall include:

1. Setting and verification of all instrumentation and sensors.

2. Pressure testing all plumbing systems for a minimum of one hour at 100 psig.

3. Verification of system design flow rates.

4. Each pump casing shall be hydrostatically tested to twice the discharge head or 1-1/2 times the shutoff head, whichever is greater.

5. Complete functional simulation of operation.

2.17 SPARE PARTS

A. Provide the following spare parts:

1. One (1) progressive cavity pump stator.

2. One (1) progressive cavity pump shaft seal.

3. One (1) banding clamp tool for replacement of the progressive cavity metering. pump pin joint banding clamps.

4. One (1) neat polymer check valve.

B. Provide one set of any special, nonstandard tools.

C. Provide a one-year supply of lubricants.

D. Provide a minimum of (12) absorbent pads designed for oil and sized to fit within the drip pan.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Liquid polymer preparation equipment shall be installed in accordance with the manufacturer's written instructions and recommendations.

3.02 DELIVERY AND STORAGE

A. Equipment shall be delivered according to manufacturer’s recommendations. Equipment shall be delivered in crates of construction that allows for fork-lifting.

B. The crate shall include a shock sensor to warn of equipment mishandling during shipment.

C. Short- and long-term storage of all equipment shall be in accordance with manufacturer’s recommendations.

D. Deliver materials to the Site to ensure uninterrupted progress of the Work.

E. CONTRACTOR shall deliver anchor bolts and anchorage devices in ample time to prevent delay of that Work.

F. Inspect boxes, crates and packages upon delivery to the Site. Notify ENGINEER of loss or damage to equipment or components. Replace losses and repair damage to new condition, in accordance with manufacturer’s instructions.

G. Store materials to permit easy access for inspection and identification. Keep material off the ground, using pallets, platforms, or other supports. Protect equipment including packaged materials from corrosion and deterioration.

3.03 FIELD TESTING

A. Field testing shall be in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

B. The manufacturer and CONTRACTOR shall demonstrate to the ENGINEER that the polymer system meets the functional requirements intended and that all components of the system are properly adjusted and calibrated and operate reliably.

C. After the system is cleaned, a complete system hydrostatic and operational test shall be completed with potable water. The CONTRACTOR shall check the functioning of all

system components including instruments and controls. The CONTRACTOR shall repair or replace all malfunctioning or unsatisfactory components identified during testing, start-up, and through the guarantee period.

D. The CONTRACTOR shall provide a sufficient quantity of polymer for a 48-hour performance test period after hydrostatic and operational tests specified above are completed and approved. The type and make of polymer shall be as approved by the OWNER. Scheduling of the performance tests shall be approved and witnessed by the ENGINEER and OWNER.

3.04 START-UP

A. Jar testing shall be performed during start up to determine the most efficient emulsion polymer for the application.

3.05 PERFORMANCE TESTING

A. Performance testing shall be conducted during startup using emulsion polymer.

B. Calibration curves for polymer metering pump and dilution water flow settings shall be prepared by the Manufacturer's authorized field representative under actual field operating conditions.

C. Final acceptance of the equipment will be made after the polymer system has been demonstrated in the field to meet the performance requirements stated in this specification under all normal operating conditions and verification that the motors are not overloaded in normal operating conditions.

D. The polymer system, including pump and mixing chamber, shall be checked for abnormal noise and vibration while the system is running throughout the normal range of motor speeds. Abnormal noise or excessive vibration will constitute failure of the system.

E. Demonstrate that each unit is able to detect loss of water flow and place the polymer pump and mix chamber on standby, then restart it automatically when flow is restored.

F. Demonstrate that each unit is able to detect loss of polymer flow and energize contacts indicating alarm after 15 seconds of continuous loss.

G. Demonstrate capability of all systems to operate in Local and Remote modes as specified herein.

H. Demonstrate that each unit is capable of providing the specified flow rates of neat polymer feed and dilution water by collecting volumetric samples in graduated cylinders or other suitable vessels.

I. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

3.06 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation	1	1
Field and Performance Testing and Startup	1	1
Training	1	2

END OF SECTION