WATER – SEWER DISTRICT

REPLACEMENT OF PROCESS AIR BLOWERS

SOUTH COUNTY WATER RECLAMATION FACILITY

TECHNICAL SPECIFICATIONS
ISSUED FOR CONSTRUCTION

November 2013

HOLE MONTES
ENGINEERS · PLANNERS · SURVEYORS

HM Project No. 2013.039

COLLIER COUNTY WATER-SEWER DISTRICT

SOUTH COUNTY WATER RECLAMATION FACILITY
REPLACEMENT OF PROCESS AIR BLOWERS

DIVISION 1 – GENERAL REQUIREMENTS

DIVISION 2 – SITEWORK

DIVISION 3 – CONCRETE

DIVISION 9 – FINISHES

SECTION 01110

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

General description of the Work required under this Contract.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of this Contract comprises construction at the Collier County - South County Water Reclamation Facility (SCWRF). The Contractor shall refer to the Contract Documents for a more complete description of the Work.

B. Refer to Section 01120 for information and requirements regarding the required sequence of Contract Work.

C. The Contract Work can be summarized to include furnishing labor, materials, equipment, services and incidentals for the following items:

1. Remove six existing centrifugal blowers including concrete pads.
2. Install six new turbo blowers.
3. Revise process air piping to connect the new turbo blowers.
4. Electrical system modifications required to accommodate the new turbo blowers.
5. SCADA system modifications required to accommodate the new turbo blowers.
6. Structural modifications to the existing structure required to accommodate the new turbo blowers.
7. Installation of temporary dust control enclosures during structural demolition and concrete grinding, and removal after demolition grinding work is complete. Refer to Section 01160 for information and requirements.
8. Miscellaneous demolition activities and facility improvements as described in the Contact Documents.
9. Painting, restoration and final clean-up.
10. Functional testing and performance testing of each new blower and its associated controls.
11. Manufacturer's extended warranty on the new blowers.

D. The Contract Work also includes unloading, storing and installation of Owner Furnished material which will include an electric harmonic filter for each blower and, for the Phase 1 Contract only, new flow meters and flow conditioner inserts.

E. The Contract Work will be executed in different phases and stages so that adequate total blower capacity is available for the treatment process. The available total blower capacity during construction will include some of the existing centrifugal blowers. Accordingly, the removal of these existing blowers and the associated demolition as well as installation of the new turbo blowers must be coordinated. Refer to Section 011120 for additional information and requirements.

F. The Contractor shall organize, coordinate, schedule and execute the various phases and/or stages of the Contract Work so as to be in strict compliance with the following:

1. Special Project Requirements as noted on Contract Drawing Sheet 2,and
2. Section 01120, Work Sequence, with special attention to the different phases.
3. Section 01140 with special attention to the requirements for written shut-down plans.

G. The Contract Work includes temporary measures as may be required to shut-off or control the flow of process air from the existing and new blowers affecting execution of the Work. Before proceeding with such temporary measures, the Contractor shall submit details for approval. Refer to the Contract Drawings and Section 01140 for additional information and requirements.

H. The Contractor shall provide factory certified start-up of the new equipment.

I. Execution of the Work will require coordination and planning with the SCWRF Manager and the County's Project Manager. The Work shall be executed in a manner and schedule that does not interfere with the on-going normal operations of the SCWRF.

1.04 SITE ACCESS

The Contractor shall use the Wildflower Way gate for all entering and departing construction traffic. The Contractor shall coordinate and regulate all site access/egress with the SCWRF Manager and the County Project Manager.

1.05 CONTRACT METHOD

Construct the Work under a single contract. Certain materials as described in the Contract Documents may be furnished by the Owner for unloading, storing, installation, start-up and testing assistance by the Contractor. The Contractor shall provide coordination and technical support associated with Owner furnished material.

1.06 WORK BY OTHERS

During the construction period for this project, the Owner (either with his own forces or under a separate contract) will be performing other work that will require the cooperation of the Contractor in scheduling and his coordination to avoid conflicts. This coordination shall include submitting weekly schedules and cooperating with other contractors.

END OF SECTION

SECTION 01120

SEQUENCE OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

The project includes constraints regarding construction sequence.

1.02 CONSTRUCTION SEQUENCING

A. The overall project will be accomplished in three sequential contract phases. Each phase will be procured through a separate construction contract independent of the other two contracts. The completion of each contract phase may be followed by some period of time before the Owner begins procurement of the next contract phase.

B. The following construction constraints and work sequences are not intended to be a complete or exhaustive list, and the descriptions provided are general in nature. The Contractor is responsible for identifying all work activities that could affect any operational aspect of the SCWRF and for providing the Owner and Engineer sufficient prior notice. Refer to Sections 01110, 01140 and 01150 and 01160 for additional information and requirements. The following work sequences are intended to be general in nature and not inclusive of all steps or details. The Contractor can submit alternative work sequences to the Engineer for review.

C. The Contract Work for the three separate construction contracts (one contract for each phase) require specific planning and coordination to avoid interruptions to the treatment capability of the SCWRF.

1. <u>Replacement of Process Air Blowers – Phase 1 Contract</u>

a. Phase 1 will provide two new turbo blowers in the North Blower Room.

b. The removal of the two existing blowers and installation of the two new turbo blowers will be accomplished in two stages, Stages A and B. The Work in Stage A shall consist of replacement of Blower 8 (one 250 hp) with a new 250 hp turbo blower with Master Control Unit and include all piping, start-up, testing and training on the new Turbo Blower 8. Stage A work shall include Turbo Blower 8 testing and County training and verification that all SCADA systems have been modified as required to accommodate the use of the existing blowers and the one new turbo blower. (During Stage A construction, the installed blower capacity will be three existing 250 hp blowers and four existing 125 hp blowers for approximately 21,500 scfm.)

c. Stage B work cannot commence until the preceding paragraph's work is complete and the new blower has been operating successfully and to the Owner's and the Engineer's satisfaction for fourteen continuous days.

d. Stage B shall be replacement of Blower 7 (one 250 hp) with a new 250 hp turbo blower and include all piping, start-up, testing and training on the new Turbo Blower 7. Stage B work shall include Turbo Blower 7 testing and verification that all SCADA systems have been modified as required to accommodate the use of the existing blowers and the two new turbo blowers. (During Stage B, installed blower capacity is two existing 250 hp blowers and one new 250 hp turbo blower and four existing 125 hp units for approximately 21,000 scfm.)

2. Replacement of Process Air Blowers – Phase 2 Contract

a. Phase 2 shall be replacement of Blowers 5 and 6 (two existing 125 hp) including all piping, start-up, testing and training on the new Turbo Blowers 5 and 6. Phase 2 work shall include Turbo Blowers 5 and 6 testing and training and verification that all SCADA systems have been modified as required to accommodate the use of the existing blowers and the new turbo blowers. (During Phase 2, the installed blower capacity is two existing 250 hp blowers and two new 250 hp turbo blowers and two existing 125 hp blowers for approximately 21,000 scfm.)

b. After completion of all other work in Phase 2, the entire floor area of the North Blower Room shall receive surface preparation and a high performance coating.

3. Replacement of Process Air Blowers – Phase 3 Contract

a. Phase 3 will provide two new turbo blowers in the South Blower Room.

b. The removal of the existing blowers and installation of the two new turbo blowers can be accomplished simultaneously. (During Phase 3, the installed blower capacity is four 250 hp turbo blowers and two 125 hp existing centrifugal blowers for approximately 20,000 scfm.)

c. After completion of all other work in Phase 3, the entire floor area of the South Blower Room shall receive surface preparation and a high performance coating.

4. General

Refer to Sections 01110, 01140 and 16850 for additional information and requirements regarding sequence of Contract Work.

D. Temporary enclosures, covers, walls and seals are required in order to provide dust control during structural demolition and concrete grinding. Refer to the Contract Drawings and Section 01160.

E. The Contractor shall coordinate and schedule execution of the Contract Work with delivery of the Owner Furnished material. Refer to Section 01110 for a list of Owner Furnished material.

PART 2 – PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01130

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Payment for the various items in the Schedule of Payment as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.

B. The Contractor's attention is called to the fact that the quotations for the various items of Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of Work has not been established by the Schedule of Payment items or this Section, it shall include the cost for that Work in some other applicable bid item, so that its proposal for the project does reflect its total price for completing the Work in its entirety.

1.02 PAYMENT ITEMS

A. The Contractor shall submit a Schedule of Payment Values for review with the return of the executed Agreement to the Owner. The schedule shall contain the installed value of the component parts of Work broken down into labor and material categories for the purpose of making progress payments during the construction period.

B. The schedule shall be given in sufficient detail for proper identification of Work accomplished. The Schedule of Payment Values shall coincide with the activities of work detailed in the construction progress schedule and the construction network analysis in order to accurately relate construction progress to the requested payment. Each item shall include its proportional share of all costs including the Contractor's overhead, contingencies and profit. The sum of all scheduled items shall equal the total value of the Contract.

C. If the Contractor anticipates the need for payment for materials stored on the project site, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Payment Values. Similar procedures shall be employed for undelivered specifically manufactured equipment and materials as specified herein.

D. Payment will not be made for materials stored off-site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01135

ALLOWANCE FUND

PART 1 – GENERAL

1.01 SECTION INCLUDES

1.02 CONTRACT ALLOWANCE

A. The Contractor shall include in its Contract Price an allowance equal to Allowance Fund shown in the bid schedule for additional work required due to unforeseen conditions.

B. The price negotiated (between Contractor and Owner) for any work falling under this category shall be compensation in full for all labor, materials and equipment necessary.

C. The provisions for the Allowance Fund are not a guarantee the Contractor will be paid any portion or the full amount of such Allowance Fund.

1.03 ALLOWANCE FUND

A. Refer to the Bid Schedule for the Allowance Fund amount.

B. Allowance for Owner's use as directed for unforeseen work and costs associated with modifications to the existing electrical, SCADA, piping and structural systems.

END OF SECTION

SECTION 01140

MAINTENANCE OF UTILITY OPERATIONS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The existing plant will be maintained in continuous operation by the Owner 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, chlorination and disposal of the full effluent flow throughout the construction period.

B. Work shall be scheduled and conducted by the Contractor so as not to impede any treatment process, reduce the quality of the plant effluent or cause odor or other nuisance except as explicitly permitted hereinafter. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the plant and collection system operating requirements, and the constraints and construction requirements as outlined in this Section. No discharge of raw or inadequately treated wastewater shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of raw or inadequately treated wastewater associated with the Contractor's work.

C. The General Contractor shall be responsible for coordinating the general construction and the schedules of electrical, HVAC, plumbing and related trades and for ensuring that permanent or temporary power and controls are available for all existing, proposed, and temporary facilities that are required to be on line at any given time.

D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without 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 shall be consecutive calendar days.

1.02 GENERAL CONSTRAINTS

A. 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. Several items of work require connections of new piping and/or utilities to existing piping, utilities, or modifications to existing piping, utilities or facilities. The County will not allow shutdowns of the South County Water Reclamation Facility, any of its processes, or its collection system (in part or in its entirety) to facilitate these connections and/or modifications without prior written approval. The Contractor shall submit a written plan to the Owner and Engineer describing the process shut-down and a detailed schedule along with all planned resources. The plan for each process shut-down must be submitted at least ten working days prior to the scheduled shut-down. The Contractor shall be responsible for, and include in its contract bid amount, all costs associated with necessary work to isolate the existing piping, utilities or facilities to complete the required connections and/or modifications. Necessary work required by the Contractor shall include, but shall not be

limited to, temporary bypass pumping and piping, wet taps, line stops, line plugs, and temporary bulkheads.

B. The Contractor shall review all bidding documents and shall be responsible to determine all such connections or modifications, and the scope and cost of all temporary measures required to isolate the work area without the need for a shutdown of the affected facility, process area, piping or utility.

C. The Contractor shall furnish any temporary work, facilities, roads, walks, protection of existing structures, piping, pipe stops, blind flanges, valves, equipment, electrical work, power supply, controls, etc. that may be required to maintain continuous and dependable operation of the entire SCWRF facilities at no extra cost to the Owner.

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

E. 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 and the Engineer. Such work shall progress continuously to completion on a 24-hours per day, seven work days per week basis.

F. The Contractor shall provide the services of emergency repair crews on call 24-hours per day at no additional cost to the Owner.

1.03 GENERAL OPERATING REQUIREMENTS, CONSTRAINTS, AND CONSTRUCTION REQUIREMENTS

A. **The Contractor shall not operate any valve, flow control device, electrical device, instrument or control system associated with the existing facility.** If such operation is required for prosecution of the Work, the Contractor shall notify the Owner. Only the Owner's representatives or staff shall operate such devices.

B. Access to Plant Site, Roadways, and Parking Areas

1. An unobstructed traffic route through the Gate on Wildflower Way shall be maintained at all times for the Owner's operations personnel and maintenance equipment. The General Contractor shall be responsible for providing access to and for preparing and maintaining approved parking areas.

2. An unobstructed traffic route around the plant site shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Vehicular access to the treatment units and buildings for Owner personnel shall be maintained at all times by the Contractor.

3. When vehicles are leaving the site, a wash down pit shall be provided and utilized to remove all mud and other contaminants before entering a public roadway.

4. The Contractor shall provide temporary measures to protect the existing pavement by filling over with earthen material or supplying other measures acceptable to the Engineer, and he shall repair any damage to existing paved surfaces that occurs during the construction period. Any areas disturbed along the shoulders of the access road and interior roads and elsewhere inside and outside of the plant shall be repaired, graded, seeded, etc. as necessary to match pre-existing conditions.
5. The General Contractor shall not undertake the restoration/construction of new roadway (paved, gravel, or asphalt overlay) shown on the Contract Drawings, until all other work on the plant improvements has been completed.

6. It shall be the responsibility of the General Contractor to obtain any permits required from the Florida Department of Transportation and pay all associated fees.

C. Personnel Access

1. Treatment plant personnel shall have access to all areas which remain in operation throughout the construction period. The Contractor shall locate stored material, dispose of construction debris and trash, provide temporary walkways, provide temporary lighting, and other such work as directed by the Engineer to maintain personnel access to areas in operation. Access and adequate parking areas for plant personnel must be maintained throughout construction.

D. Plumbing Facilities

1. Unless otherwise allowed by the Engineer, sanitary facilities in the existing structures shall be operational at all times for plant operating personnel. All other building plumbing systems such as roof and floor drains, pumping, etc., shall be maintained for all structures.

E. Building Cooling and Ventilating

1. Building air conditioning, cooling and ventilating for the existing plant structures shall be in service for the entire construction period. Additional temporary air conditioning, cooling and ventilation shall be provided as required to maintain facilities under construction adequately cooled and vented. The temperatures to be maintained in any areas occupied by plant operating personnel such as offices, lunchrooms, locker rooms, bathrooms, etc., shall be no more than 76 degrees Fahrenheit.

F. Power, Light and Communications Systems (General)

1. Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which remain in operation. 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 Owner may allow outages under conditions determined by the Owner by making use of the existing and/or the proposed engine-generator at the plant. All costs associated with operation of the engine-generators shall be paid by the Contractor. The Contractor shall coordinate shutdowns required by subcontractors to minimize the total number of shutdowns required to complete construction. Owner's phone service to the plant shall be maintained in continuous operation during construction.

G. Draining Process Pipes and Conduits (General)

1. 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 the appropriate process flow train.

H. Potable Water System

1. 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 Plant Superintendent and shall be limited to not more than two (2) hours. Existing fire hydrants within the plant site shall be operational at all times, unless otherwise approved by the Owner.

I. Non-potable Water System – Plant Service Water Only

1. The existing non-potable plant service 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. Temporary non-potable plant service for the water systems shall be provided by the Contractor as necessary to insure continuous, uninterrupted service of these critical systems. The Contractor shall furnish any required temporary non-potable plant service water systems at no additional cost to the Owner. The Contractor may require temporary support or relocation or demolition of existing non-potable plant service water facilities to proceed with construction. The Contractor shall provide all temporary supports, relocation of existing piping, or demolition of existing non-potable plant service water piping including placement with temporary or permanent non-potable water piping as required at no additional cost to the Owner.

J. Sump Pumps and Sumps

1. 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.

K. Seal Water and Service Water Piping

1. A supply of service and seal water and the necessary connections to existing equipment shall be maintained during construction. Interim piping shall be provided as required.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION (not used)

END OF SECTION

SECTION 01150

PROTECTION OF EXISTING FACILITIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

Requirements for protection of existing facilities and completed construction

1.02 GENERAL

A. **The Contractor shall not operate any valve, flow control device, electrical device, instrument or control system associated with the existing facility.** If such operation is required for prosecution of the Work, the Contractor shall notify the Owner. Only the Owner's representatives or staff shall operate such devices.

B. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents.

C. The Contractor shall verify the exact locations and depths of all utilities shown and the Contractor shall make exploratory hand excavations of all utilities that may interfere with the Work. All such exploratory hand excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's Work. When such exploratory excavations show the utility location as shown to be in error, the Contractor shall so notify the Engineer.

D. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.03 RIGHTS-OF-WAY

A. The Contractor shall not do any Work that would affect any oil, gas, sewer or water pipeline, any telephone, telegraph or electric transmission line, any fence or any other structure nor shall the Contractor enter upon the rights-of-way involved until notified by the Engineer that the Owner has secured authority therefor from the proper party. After authority has been obtained, the Contractor shall give said party due notice of its intention to begin Work.

B. When two or more contracts are being executed at one time on the same or adjacent land in such manner that Work on one contract may interfere with that of another, the Owner shall determine the sequence and order of the Work.

C. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other

reasonable privilege may be granted by the Owner to the Contractor so desiring, to the extent, amount, in the manner, and at the times permitted.

D. No such decision as to the method or time of conducting the Work or the use of territory shall be made the basis of any claim for delay or damage.

E. The Owner's Right of Access is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property.

1.05 PROTECTION OF SURVEY STREET OR ROADWAY MARKERS

The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. It shall be the Contractor's responsibility to notify the Owner of the time and location that Work will be done. Such notification shall be sufficiently in advance of construction so that there will be no delay due to waiting for survey points to be satisfactorily referenced for restoration.

1.06 EXISTING UTILITIES AND IMPROVEMENTS

A. Maintaining in Service: All oil and gasoline pipelines, power, and telephone or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, wire or cable.

B. The Contractor shall protect all underground utilities and other improvements which may be impaired during construction operations. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

C. Where the proper completion of the Work requires the temporary or permanent removal, or relocation of an existing utility or other improvement which is shown, the Contractor shall contact the utility owner and proceed as specified in Section 01160 – Alteration of Existing Facilities.

D. Unrecorded Underground Utilities or Improvements

1. Plans show features of topography and underground utilities, but do not purport to show in complete detail all such lines or obstructions.

2. Existing utilities shown on Drawings are based upon available records. Data regarding existing utilities is presented for Contractor's convenience only, and shall not be used as a basis for claims of extra compensation.

3. Examine available records and make exploratory excavations whenever necessary to determine locations of existing pipes, valves, or other underground improvements.
4. Take prudent precautions not to damage unrecorded underground utilities and improvements.
5. If unrecorded underground utilities or other improvements are encountered, immediately notify the Engineer and inform the Engineer of the conditions encountered. Include written report of conditions encountered with Progress Schedule covering period in which unrecorded underground utilities or improvements were encountered. Provide unscheduled impact on CPM schedule for each occurrence. If unrecorded underground utilities or improvements conflict with Work, changes shall be made under the terms of the Agreement. Changes to the Work shall be as approved by the Owner.
6. The Contractor shall contact the affected utility owner and proceed as specified in Section 01160 – Alteration of Existing Facilities.

1.07 TREES WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. The Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or owner.

B. All existing trees and shrubs which are damaged during construction shall be repaired or replaced by the Contractor as specified in Section 01160 – Alteration of Existing Facilities.

1.08 NOTIFICATION BY THE CONTRACTOR

Prior to any excavation in the vicinity of any existing underground facilities including all water, sewer, storm drain, gas, petroleum products or other pipelines; all buried electric power, communications or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can locate their facilities or be present during such work if they so desire.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION (not used)

END OF SECTION

SECTION 01160

ALTERATION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements and procedures for alterations and restoration.

1.02 SITE AND BUILDINGS

A. Site Visit

1. Prior to submission of Bids, the Contractor shall have visited the site and thoroughly acquainted himself with the exact nature of the work indicated on the Drawings and the Specifications requirements. Failure to comply with the aforementioned requirements shall not constitute a basis for claims for additional compensation.

B. Measurements and Notice

1. Prior to ordering any materials or doing any work, the Contractor shall verify all measurements, dimensions and other conditions of each building scheduled for work as may be necessary or required in connection with his work. The Contractor shall be responsible for the correctness of same. Provide three working days notice to the Owner prior to commencing cutting or alterations.

C. Dust Control

1. Refer to Article 3.01 in this Section.

1.03 SUBMITTALS

A. General: as specified in Section 01330 – Submittals.

B. In addition, submit the following:

1. Written request for authorization to perform cutting or alteration.

a. Submit written request in advance of cutting, restoration, or alteration which affects:

(1) Structural integrity of any element of Project.

(2) Integrity of weather-exposed or moisture-resistant element.

(3) Efficiency, maintenance, or safety of any operational element.

(4) Visual qualities of sight-exposed elements.

(5) Work of Owner or separate contractor.

b. Include in request:

(1) Identification of Project.

(2) Location and description of affected work.

(3) Necessity for cutting, restoration, or alteration.

(4) Description of proposed work, and products to be used.

(5) Alternatives to cutting, restoration, or alteration.

(6) Effect on work of Owner or separate contractor.

(7) Written permission of affected separate contractor.

(8) Date and time that work will be executed.

2. Shop drawings for fabricated items to be used in alterations and restoration.

3. Product data for items and materials to be used in alterations and restoration.

4. Request for substitution as specified in Section 01600 – Material and Equipment

1.04 SHORING, UNDERPINNING AND BRACING

A. When necessary and required, the Contractor shall provide underpinning and temporary shoring and bracings, all in accordance with code requirements, and as approved by the Engineer. The underpinning, shoring and bracing shall be based on calculations and drawings provided by a Florida licensed P.E. Submit calculations and drawings for the Engineer for review prior to commencing work.

B. Shoring and bracing shall be of such form and so installed as to safely support the work and interfere as little as possible with the progress of the work. Suitable means shall be provided to adjust any settlement in the shorings supports. Temporary shoring shall consist of sound timbers or rolled shapes of required dimensions which shall be removed after necessity for same ceases to exist. All work removed or damaged through installation of temporary shoring or through improper shoring shall be replaced or repaired after the shoring is removed, at no additional cost to the Owner.

1.05 WORK PREPARATION AND TEMPORARY ACCESS

A. The Contractor, before commencing work, shall prepare and submit for approval a progress schedule in accordance with the requirements of Sections 01310 and 01330 in order to coordinate the work of all trades and to insure completion on or before the completion date. The Owner and the Engineer reserve the right to revise or modify such schedules as required to expedite each phase of work and to coordinate such work with the partial use of the building for purposes as directed.

B. No facility such as toilets, corridors, etc., shall be barricaded or access restricted without providing other temporary or interim means of access. It is further required that no work specified hereinafter shall disturb or interfere with the operation of the existing mechanical installation until proposed new work has been completed or

satisfactorily installed. Exception may be made to this requirement only by written approval from the Owner and Engineer.

C. Detailed sequence of availability of areas within the present buildings where work is to be performed shall be in accordance with Section 01140, Maintenance of Utility Operations, but may be modified by the Contractor, upon authorization by the Owner and Engineer as the work progresses.

D. Existing built-in equipment to remain in the final work, but requiring temporary removal for the installation of new construction, alterations, repairs and/or renovations, shall be disconnected by the Contractor and removed to temporary storage areas designated by the Owner. Resetting of existing equipment under this heading shall be performed by the Contractor including connecting to electric service lines.

E. The Contractor shall furnish and install all temporary fire exists, fire extinguishers, hose and safety devices as may be required by authorities having jurisdiction.

F. Work within existing buildings to be performed, once started, shall be completed as quickly as practicable and each trade shall determine before work is started that all required materials are at hand or readily obtainable to avoid delays.

G. Shutdowns of existing services within existing buildings which may be occupied during construction will be permitted only upon written approval by the Owner subject to at least three weeks notice in writing to the Owner in each case. Shutdowns will be limited to times which will result in the least interference with normal operations.

1.06 EXISTING UTILITIES AND IMPROVEMENTS

A. General

1. Ascertain the actual location of existing utilities and improvements that will be encountered.

2. Protect existing utilities and improvements.

3. Supervise and observe excavation operations.

B. Public Utilities and Franchise Utilities (Utilities)

1. General: Do not interrupt service of any utility without notification and approval of applicable utility.

2. Work in Public Right-of-Way and Utility Easements: The Contractor shall inform affected utilities as specified in Section 01150 – Protection of Existing Facilities.

3. Work on Owner's Property

a. Notify the Engineer prior to performing excavations in areas where existing utilities may by encountered.

b. Do not perform excavations until underground utilities have been located by utilities having property in the area to be excavated.

4. Relocation of Utility Property

a. If is necessary to relocate the property of any utility, the utility property will be relocated by the applicable utility unless otherwise shown or specified.

b. If utility property is shown or specified to be relocated by the Contractor, relocate utility property in accordance with the written instructions or recommendations of the applicable utility.

c. Notify Engineer and applicable utility a sufficient time in advance of relocation for the following:

(1) Measures to be taken which prevent, or minimize, interruption of service.

(2) Scheduling of personnel to perform, observe, or perform and observe relocation.

d. Provide access to applicable utility personnel, vehicles, and equipment required to perform, observe, or perform and observe relocation of utility property.

5. Repair of Utility Property

a. If service of utility is interrupted or property of utility is damaged without notification and approval of applicable utility, immediately notify Engineer, Owner, and affected utility.

b. Service interruption and property damage shall be corrected and repaired by affected utility, unless otherwise approved by Engineer and affected utility.

c. Repairs by Contractor shall be done in accordance with instructions of the affected utility. All repairs shall be subject to inspection and approved by an authorized representative of the utility before being concealed by backfill or other work.

d. Repairs and fines related to unscheduled interruptions, or damage shall be paid by the Contractor with no additional cost to the Owner.

C. Owner's Utilities, Process Piping, and Improvements

1. General

a. Do not interrupt service of Owner's existing utilities, process piping, or other improvements without ten working days prior notification and written approval of the Owner and the Engineer.

b. Interruptions of Owner's utilities, process piping, and other improvements shall be minimized and shall meet the requirements of Sections 01110, 01120 and 01140.

2. Repair of Owner's Utilities and Improvements

a. If Owner's utilities, process piping, or other improvements are interrupted or damaged without notification and approval, immediately notify Engineer and Owner.

b. Unscheduled service interruption damage shall be repaired as follows:

(1) Contractor shall take immediate actions to shut off flows, shut off pumps, shut off equipment, and contain spills as applicable to the event.

(2) Engineer shall direct Contractor to make repairs, assist Owner in making repairs, or provide access to event site for Owner to make repairs.

c. Repair work by Contractor shall meet the requirements of the Owner.

d. Repairs and fines related to unscheduled interruptions, or damage shall be paid by the Contractor with no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 PRODUCTS FOR ALTERATIONS AND RESTORATION

A. Type and Quality of Existing Products: Determine by inspecting and testing existing products where necessary, referring to existing work as a standard.

B. Products for Restoration: Products identical to, or equal to, products used in existing work when new.

C. Products for Alterations: As specified in individual product specification Sections applicable to products.

PART 3 – EXECUTION

3.01 DUST-PROOF PARTITIONS/DUST CONTROL

A. The Contractor shall furnish and erect necessary temporary dust-tight partitions and enclosures where concrete demolition or grinding is required in order to protect existing equipment, newly installed equipment and existing structures. Partitions and enclosures shall be sturdy, stable and self-supporting.

B. Partitions and enclosures shall be constructed of wood studs with plywood or polyethylene sheeting. Partitions and enclosurers shall extend from a closure plate

at the floor to either the building ceiling or a temporary ceiling. The Contractor shall furnish and install one door in each enclosure complete with hardware. Such enclosures will be required in all areas of concrete demolition and grinding work and for protection of existing equipment and newly installed equipment.

C. Contractor shall provide an adequate ventilation system for workers and for dust removal. Contractor shall provide adequate lighting as required for the demolition work.

D. Contractor shall remove the temporary partition(s) and enclosure(s) upon completion of the demolition and concrete grinding in each area.

3.02 EXAMINATION

A. Inspect existing conditions, including elements subject to damage or movement during alteration, restoration, or alteration and restoration.

B. Remove debris and abandoned items from areas of alteration and renovation work and from concealed spaces.

C. Verify that demolition is complete.

D. Verify that areas are ready for installation of new work.

E. Beginning of restoration work or alteration work means acceptance of existing conditions.

3.03 PREPARATION

A. Provide supports to assure structural integrity of surroundings. If supports are provided for structural members, details and calculations must be prepared by a Florida licensed P.E. and submitted for review prior to commencing installation of such supports.

B. Close openings in exterior surfaces so that existing work and salvage items are protected from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

C. Maintain excavations free of water.

D. Provide barriers, covers, and other protection required to prevent structural elements, equipment, piping, conduit, paving, finishes, and other adjacent improvements from being damaged.

E. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.

F. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete.

G. Remove and cut work so that damage is minimized. Remove and cut work to provide a means of restoring products and finishes as follows:

1. If products, finishes, or products and finishes are specified, restore work to specified condition.

2. If products, finishes, or products and finishes are not specified, restore work to original condition.

H. Remove surface finishes and prepare surfaces to provide for proper installation of new work and finishes.

3.04 PLUGGING OPENINGS

Plug openings in wall, floors, and ceilings resulting from removal of existing equipment, piping, and conduit. Plug openings in a manner that will result in a structurally suitable seal and a neat and presentable appearance.

3.05 CUTTING PIPE AND CONDUIT

A. Where new piping is to be connected to existing piping, cut existing piping square. Properly prepare ends of pipe for connection indicated on the drawings. Repair damage to lining and coating of existing piping resulting from cutting.

B. Where existing piping or conduit is to be removed or abandoned in place, cut existing piping or conduit square or disconnect piping or conduit at an existing joint. Seal exposed ends of abandoned connections with plugs, caps, or blind flanges suited for material, type, and service of pipe or conduit.

3.06 WASTEWATER DEWATERING

A. Cut, disconnect, and remove existing wastewater, sludge, grit, and drain pipelines and tanks as required to complete the work.

B. Contain and dispose of wastewater, grit and sludge from tanks and pipelines cut or disconnected during construction. Containment shall meet regulatory requirements. Provide temporary pumps and piping required to pump wastewater and sludge to an on-site wastewater basin or sanitary sewer as designated by the Engineer.

3.07 REPAIR OF STRUCTURAL STEEL

A. Where existing structural steel members are removed or modified, repair remaining steel members which are damaged by construction activities or corrosion.

B. Prepare surfaces of repaired members and coat repaired members as specified in Section 09850 - Paints and Coatings.

3.08 DOORS, PASSAGEWAYS, AND WINDOWS

A. Dress jambs, sills, and heads of new doors, passageways, windows, or other openings cut into existing walls and slabs. Dress jambs, sills, and heads of new

doors, passageways, windows, or other openings with new masonry, concrete, or metal.

B. Finish jambs, sills, and heads so that only finished edges and surface are exposed. Provide a smooth finished appearance.

3.09 TRANSITIONS

A. Where new work abuts or aligns with existing, perform a smooth and even transition. Patch work to match existing adjacent work in texture and appearance.

B. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

C. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer for transition from existing surface to new surface.

3.10 REPAIR OF DAMAGED SURFACES

A. Repair surfaces of walls or floors which are exposed by removals or demolition and which have holes, scars, chipped, or other damage revealed by removal or demolition. Unless noted otherwise, repair concrete with Sikatop 122 or approved equal.

B. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

C. Repair substrate prior to patching finish.

D. Provide exposed surface of repair to match texture of adjacent surface.

3.11 FINISHES

A. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.

B. Finish patches to product uniform finish and texture over entire area.

C. When finish cannot be matched, refinish entire surface to nearest intersections.

D. Finish surfaces as specified in individual Product Sections.

3.12 PAVEMENT RESTORATION

A. Restore pavement removed, cut, or damaged during construction.

B. If edges of pavement surface remaining are jagged or broken, saw cut surface course so that the pavement edge is clean, sound, and vertical.

C. Restore pavement as follows:

1. If pavement restoration detail is shown on the Drawings, restore pavement as shown in detail.

2. If no restoration details are shown on the Drawings, replace pavement with similar materials and of equal thickness to match existing undisturbed pavement.

3. Restoration of payment to comply with Collier County DOT Standards and Utilities Standards Manual, latest editions with revisions.

D. Following restoration or pavement cuts, overlay pavement.

1. If extent of overlay is shown on the Drawings, provide overlay as shown on Drawings.

2. If extent of overlay is not shown on the Drawings, provide continuous surface course overlay over all of the pavement cuts with 10' minimum overlap of existing pavement at each end of overlay.

3. Restoration of payment to comply with Collier County DOT Standards and Utilities Standards Manual, latest editions with revisions.

3.13 SIDEWALK RESTORATION

A. Restore sidewalks removed, cut, or damaged during construction.

B. Saw cut sidewalk at existing joint. If there are no existing joints, saw cut sidewalk perpendicular to the side of the sidewalk. Saw cut sidewalk so that the sidewalk edge is clean, sound, and vertical.

C. Replace sidewalk with similar materials and of equal thickness to match existing undisturbed sidewalk.

D. Sidewalk restoration shall comply with Collier County DOT Standards and Utilities Standards Manual, latest editions with revisions.

3.14 REPLACEMENT AND REPAIR OF TREES AND SHRUBS

A. Replace damaged trees and shrubs if damaged trees and shrubs if damaged plants cannot be repaired without destroying the value of the plants as screening or landscaping.

B. Replacement of Trees and Shrubs

1. Replacement plants for native varieties shall be same variety as plants removed.

2. Replacement plants for exotic varieties shall be native varieties.

3. Replacement plants shall be equal in size to plants removed or 1.5 times total diameter of removed plants if replacement plants are smaller than plants removed.

C. Repair of Trees and Shrubs.

1. Preserve symmetry of trees and shrubs.

2. Do not leave stubs, splits, or torn branches.

3. Make clean cuts close to trunk or large branch.

4. Coat cuts over 1-1/2" in diameter with asphaltic emulsion material.

3.15 WEATHER PROTECTION

A. Where exterior walls or roofs are being altered, or disturbed for any adjacent alteration, the Contractor shall provide temporary weather protection in those areas to keep interior of buildings absolutely dry and unaffected by the weather. The Contractor will be held responsible for any damage caused by improper protection against weather.

B. Where existing exterior walls or roofs are disturbed due to alterations, disturbances shall be kept to a minimum and walls or roofs shall be repaired and patched in such a manner that the buildings will be absolutely watertight and meet the conditions of the existing roofing flashing and waterproofing bonds and guarantees.

3.16 CUTTING, PATCHING, REPAIRING, AND REFINISHING – GENERAL

A. The Contractor shall be responsible for cutting all openings in walls, floors and ceilings (indicated to remain) to accommodate alteration work under his Contract in accordance with the requirements of the General Conditions, Supplemental Conditions, and as hereinafter specified. Rough patching and all finish patching shall be by the Contractor.

1. Where new openings are to occur in existing exterior and interior concrete and masonry bearing walls and structural concrete floor, the Contractor will be required to notify the Owner and Engineer in writing at least five full work days prior to commencing the cutting and shall obtain approval prior to cutting operations. The Engineer will determine whether such openings affect the structural stability or load bearing capacities of walls and floors.

2. All holes and openings to be cut in existing walls, floors and ceilings of any nature shall be geometrically correct and no larger than necessary to accommodate the new work.

3. No cutting of finished or structural work may be done without the approval of the Engineer.

B. Major demolition and removal work such as demolition of buildings and structures, complete or nearly complete removal of floors, walls and ceilings indicated on the Drawings, shall be performed by the Contractor. The Contractor shall also be responsible for all finish patching operations of holes and openings in existing floors, walls, ceilings and roofs to accommodate the alteration work under the Plumbing, HVAC and Electrical Sections as well as that required for the Contractor's work hereinafter specified.

C. The Contractor shall provide sleeves, forms and inserts for installation as required by the Contract Documents.

3.17 EXISTING EQUIPMENT AND FURNISHINGS

A. Existing built-in equipment to remain in the final work and requiring temporary removal shall be as specified under this Section.

B. Existing appliances and portable equipment such as desks, chairs, tables, etc., shall remain the property of the Owner and will be removed from rooms and spaces to be altered by the Contractor prior to construction and alteration operations, and stored where directed by the Owner.

C. All unsalvageable equipment shall become the property of the Contractor in accordance with the requirements of Section 02220 and shall be removed from each building and away from the site. Equipment to be retained, or relocated, shall be as shown on the Drawings or as specified.

3.18 SCHEDULE OF INTERIOR FINISHES FOR EXISTING BUILDINGS

A. Unless otherwise specified, all materials required for the work in the existing buildings shall be new, and where required shall match existing adjacent finishes.

B. As indicated on the Drawings, specified or otherwise required to complete the work, the Contractor shall cut new openings and block up existing openings in floors, walls, partitions and ceilings; remove existing floors; remove, relocate existing and/or install new windows, doors, frames, transoms, access doors, partition sash and trim.

C. The Contractor shall remove window sash, frame, sill, stool and trim at exterior door openings to be blocked up; remove door, frame and trim and, unless otherwise hereinafter specified or indicated on the Drawings to be blocked up with other materials, window and door openings shall be blocked up with brick and/or masonry block.

1. At door, sash and other openings in interior partitions and wall to be closed, block up such openings with same materials and construction as adjacent, unless otherwise indicated on the Drawings. Plaster and finishes applied at blocked up openings shall finish even and straight, flush with and of the same texture or other surface characteristics of existing adjacent finishes.

D. Existing finishes or subfloor surfaces which are scheduled to receive new floor finishes shall be repaired, patched with concrete, asphalt latex type emulsion and underlayment as required to suit existing surfaces or the new floor surfacing material to be applied.

E. Concrete and floors disturbed by alterations shall be patched to finish even, straight and flush with adjacent surfaces.

F. Where new ceramic tile flooring or base is to be installed over present concrete floors or base, and where a cove exists at the floor, the Contractor shall cut away part of the cove by grinding or other approved means to the extent required for installation of the new flooring or base.

G. Existing partitions to be removed shall be removed for their entire height.

H. Where existing bases and other trim are removed and grounds are exposed and will not be covered by new finishing materials such as resilient base, new trim, or wall covering, grounds shall be removed and wall surfaces patched with plaster to finished even, straight and flush with adjacent existing plaster surfaces. Where existing plaster ceilings are scheduled to be removed, the ceilings shall be replaced with new metal furring, lathing and plaster finish or acoustical ceilings or other ceiling system as indicated on the Drawings.

I. Where partitions or walls are removed and existing ceiling on each side of the partition or wall is to remain, the gap shall be patched; a vertical break shall be provided if the ceilings are at different levels. Where the ceiling on one side is to remain and a new ceiling is scheduled for the area on the other side, the new ceiling shall be constructed so that the new and existing finished ceiling areas will be at the same level.

J. Existing floors, walls and ceilings shall be cut as required for removal of existing services and for installation of new plumbing, heating, ventilating and air conditioning, and electrical work and related piping, duct work, conduits, fixtures and equipment.

K. In addition to work specifically called for in Contract Documents, all finishes disturbed in the performance of any alterations or new work by the Contractor shall be patched or repaired to match existing surfaces or finishes.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 PRECONSTRUCTION MEETING

A. A preconstruction meeting will be held after Award of Contract, but prior to starting work at the site. The Engineer shall prepare and distribute the meeting agenda and shall preside at the meeting. The Engineer shall record and distribute minutes of the proceedings and decisions.

B. Attendance:

1. Owner

2. Engineer

3. Contractor

4. Major subcontractors

C. Minimum Agenda:

1. Tentative construction and submittal schedules

2. Critical work sequencing

3. Designation of responsible personnel

4. Processing of Field Decisions and Change Orders

5. Adequacy of distribution of Contract Documents

6. Submittal of Shop Drawings and samples

7. Procedures for maintaining record documents

8. Use of site and Owner's requirements

9. Major equipment deliveries and priorities

10. Safety and first aid procedures

11. Security procedures

12. Housekeeping procedures

13. Processing of Partial Payment Requests

14. General regard for community relations

1.02 PROGRESS MEETING

A. Progress meetings will be held biweekly at the South County Water Reclamation Facility during the performance of the field work of this Contract. Additional meetings may be called as progress of work dictates.

B. Engineer will prepare and distribute agenda, preside at meetings and record minutes of proceedings and decisions. Engineer will distribute copies of minutes to participants.

C. Attendance:

1. Owner

2. Engineer

3. Contractor

4. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda

D. Minimum Agenda:

1. Review and approve minutes of previous meetings.

2. Review progress of Work since last meeting.

3. Review proposed 30-60 day construction schedule.

4. Note and identify problems which impede planned progress.

5. Develop corrective measures and procedures to regain planned schedule.

6. Revise construction schedule as indicated and plan progress during next work period.

7. Maintaining of quality and work standards.

8. Complete other current business.

9. Schedule next progress meeting.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION (not used)

END OF SECTION

SECTION 01315

COORDINATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements and procedures for structural, mechanical and electrical coordination to ensure proper selection, installation, fit and operation of all mechanical, electrical and control devices as well as building components.

1.02 COORDINATOR

Contractor shall employ an individual or a firm, technically qualified and experienced in field coordination for the type of work required for this Project for the duration of the Work.

1.03 SUBMITTALS

A. General: As specified in Section 01330 – Submittals.

B. Submit name, address, and telephone number of Coordinator and, if a firm, the name of its principal officer, to Engineer for approval.

C. Submit necessary coordination drawings and schedules prior to submitting shop drawings, product data, and samples.

1.04 COORDINATION REQUIRED

A. Coordinate submittals for structural, architectural, mechanical and electrical products.

B. Conduct conferences with Subcontractors and others concerned with the Work, to establish and maintain coordination and schedules, and to resolve coordination matters in dispute.

C. Participate in progress meetings. Report on progress of Work to be adjusted under coordination requirements, and any required changes in schedules. Transmit official minutes of meetings and reports to concerned parties.

1.05 DOCUMENTS FOR COORDINATION

A. Prepare necessary coordination drawings to organize installation of products for efficient use of available space, to meet requirements of Work sequence, for proper sequence of installation, and to identify potential conflicts.

B. Prepare a master schedule to identify responsibilities under each section of Divisions 1 through 16 of the Specifications for activities that directly relate to

mechanical and electrical coordination, including submittals and temporary utilities.

C. Maintain documents for the duration of the Work, recording changes due to site restrictions, modifications or adjustments.

D. After Engineer review of original and revised documents, reproduce and distribute copies to concerned parties.

1.06 COORDINATION OF SUBMITTALS

A. Coordinate shop drawings, product data, and samples.

1. Check field dimensions and clearances and relationship to available space and anchors.
2. Check compatibility of products with products furnished or installed under other sections.
3. Check electrical characteristics, and operational control requirements.
4. Check motor voltages, speed, and control characteristics.
5. Coordinate controls, interlocks, power wiring, control wiring, and instrument wiring.
6. Coordinate wiring and control diagrams.
7. Review the effect of any changes on work of other sections.

B. Verify and coordinate maintenance of Record Documents.

1.07 COORDINATION OF SUBSTITUTIONS AND MODIFICATIONS

A. Submit requests for substitutions as specified in Section 01600 – Materials and Equipment.

B. Review proposals and requests from subcontractors.

C. Verify compatibility of substitutes with other products. Identify modifications required to make other products compatible with substitutes.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.01 OBSERVATION OF WORK

A. Observe Work for structural, architectural, mechanical and electrical coordination.

B. Maintain a list of observed deficiencies and defects and promptly report observed deficiencies and defects to appropriate parties.

3.02 EQUIPMENT START-UP

A. Verify utilities, connections and controls are complete and equipment is in operable condition prior to equipment start-up.

B. Observe start-up of equipment and demonstrations to Owner.

C. Coordinate adjustments or modifications required to provide equipment and systems that operate properly, both mechanically and electrically.

3.03 INSPECTION AND ACCEPTANCE OF EQUIPMENT

Prior to inspection, verify that equipment and systems are tested and operating properly.

END OF SECTION

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements and procedures for submittals.

1.02 SCHEDULE

A. Transmit submittals in accordance with approved Progress Schedule, and in such sequence to avoid delay in the Work or work of other contracts.

B. Do not fabricate products or begin work that requires submittals until return of submittal with Engineer acceptance.

C. Identify the appropriate specification sections and parts on each submittal.

1.03 CONTRACTOR REVIEW

A. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.

B. Contractor's submittal review shall include coordination as described in Section 01315.

C. Sign each sheet of shop drawings and product data, and each sample; label to certify compliance with requirements of Contract Documents. **Notify Engineer of any deviations from requirements of Contract Documents in writing at time of submittal.**

D. Identify the relevant specification sections and parts on each submittal.

1.04 SUBMITTAL REQUIREMENTS

A. Apply Contractor's stamp, signed certifying to review and approval, verification of products, field dimensions and field construction criteria, and coordination of information with requirements of Work and Contract Documents.

B. Number each submittal sequentially beginning with *001*. Each submittal shall describe only one product or equipment. Re-submittals shall use the same number identifier with a letter suffix; e.g. *001A*. Submittals shall identify the relevant Specifications Section(s).

C. Coordinate submittals into logical groupings to facilitate interrelation of the several items:

1. Finishes that involve Engineer selection of colors, textures, or patterns.

2. Associated items that require correlation for efficient function or for installation.

D. Submit under transmittal letter. Identify Project by title and number.

E. If any submittal requires more than three reviews (normally an original and two re-submittals), the Engineer may charge the Contractor for additional review time based on his actual incurred time and expenses. These charges shall be summarized for the Contractor and deducted from the Contractor's next pay request.

F. The Contractor may expect most submittals to be reviewed within 21 calendar days following receipt of the submittal. Certain submittals such as Owner color selection or instrumentation may require a longer review time.

G. The submission of submittals by email will be required subject to the strict compliance requirements noted below. Before the first electronic submittal, the Contractor must meet with the Engineer to review the format and protocols for such submittals.

1. Any digital file submittal or re-submittal must be complete in every respect. Partial re-submittals will not be allowed. Any digital file submittal must include only one piece of material or equipment.

2. Each digital submittal on a piece of equipment or a process/control system shall include an index or table of contents and the digital file shall be organized and presented in a logical manner and in accordance with the index or table of contents.

3. Digital transmission of construction schedule, O&M data, electrical and instrumentation submittals must include three hard copies of the complete submittal.

H. In the event that digital transmission of submittals is generally not used or allowed by the Owner or Engineer due to non-compliance with the preceding requirements, then email shall not be used for transmission of the following submittals: (a) any submittal over one page in length and (f) any submittal in color.

1.05 NUMBER OF COPIES

A. Minimum Number of Copies: Submit minimum number of copies as follows:

Submittal	To Engineer	Returned to Contractor
Schedule of Submittals	5 copies	1 copy

Progress Schedules	5 copies	1 copy
Shop Drawings, Product Data & Manufacturer's Affidavit of Compliance	8 copies	3 copies
Test Reports and Samples	3 copies	1 copy
Certificates of Compliance	3 copies	--
Operation and Maintenance Data	(See Section 01830)	(See Section 01830)
Request for Substitution	5 copies	1 copy
Requests for authorization, requests for information, and other similar requests	2 copies	1 copy

B. Additional Copies: If additional copies of shop drawings, product data, or shop drawings and product data are required by the Contractor, submit up to two additional copies to Engineer.

1.06 SCHEDULE OF SUBMITTALS

A. Submit copies of Preliminary Schedule of Submittals prior to the Preconstruction Conference.

B. Within 10 days after Preconstruction Conference, submit the revised copies of Schedule of Submittals

1.07 PROGRESS SCHEDULES

Submit progress schedules in accordance with Contract documents

1.08 SHOP DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with Project name and number. Transmittal letter shall reference item as listed on Submittal Schedule.

B. Identify each element of drawings by reference to sheet number and specification section of Contract Documents.

C. Identify field dimensions; show relation to adjacent or critical features or Work or products.

D. Submit outline of manufacturer's representative services with Shop Drawings. Outline of manufacturer's representative services shall include man-hours or man-days of service to be provided for each of the following:

1. Minimum man-hours or man-days of service to be provided for installation inspection, assistance, and certification.
2. Minimum man-hours or man-days of service to be provided for functional testing and start-up.
3. Minimum man-hours or man-days of service to be provided for training Owner's operation and maintenance personnel.
4. Outline of manufacturer's representative services shall identify services and minimum man-hours, or minimum man-days, to be provided by factory representative and by equipment supplier, or distributor.

E. Provide a Spare Parts List including both the spare parts recommended by the equipment manufacturer for the first year of service and any spare parts specified in the individual specification sections.

1.09 PRODUCT DATA

A. Submit only pages that are pertinent. Mark or highlight each copy of standard printed data to identify pertinent products. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.

1.10 SAMPLES

A. Submit full range of manufacturer's standard finishes except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Owner selection.

B. Submit samples to illustrate functional characteristics of products, including parts and attachments.

C. Approved samples that may be used in the Work are indicated in the Specification section.

D. Label each sample with identification required for transmittal letter.

E. Provide field samples of finishes at Project, at location acceptable to Engineer, as required by individual Specifications section. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

F. Accepted samples shall establish the standards by which the completed Work will be judged.

1.11 TEST REPORTS

Submit test reports as specified in Section 01430 – Materials Testing

1.12 CERTIFICATES OF COMPLIANCE

A. Submit Manufacturer's Affidavits of Compliance as specified in Section 01600 – Materials and Equipment.

B. Submit Manufacturer's Certificate of Compliance as specified in Section 01750 – Testing and Start Up.

1.13 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data as specified in Section 01830 – Operation and Maintenance Data.

1.14 LUBRICATION TEST

Submit results of lubricant testing as specified in Section 01600 – Materials and Equipment.

1.15 SUBSTITUTIONS

Submit requests for substitutions as specified in section 01600 – Materials and Equipment.

1.16 REQUESTS

If there are any questions about interpretations of plans, specifications or Contract Documents, the Contractor may submit a written request for information or a request for clarification to the Engineer.

1.17 RESUBMITTAL

A. Make resubmittals under procedures specified for initial submittals; identify changes made since previous submittal.

B. Identify resubmittal as a resubmittal and reference previous submittal.

C. Identify changes made since previous submittal.

1.18 DISTRIBUTION

A. Distribute reproductions of shop drawings, copies of product data, samples, substitutions and other submittals which bear Engineer's review stamp, to job site file, Record Documents file, subcontractors, suppliers, and other entities requiring information.

B. Instruct recipients to promptly report any inability to comply with provisions.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01410

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements and procedures for obtaining permits and complying with permits.

1.02 PERMITS

A. Contractor will obtain County, State and Federal permits not obtained by County, including but not limited to building permits, South Florida Water Management District dewatering permits, right-of-way permits, burning permits, tree removal permits, excavation permits, demolition permits and Florida Dept. of Environmental Protection NPDES Stormwater Pollution Prevention Plan.

B. The Contractor must file a minimum of 48 hours prior to start of construction a Notice of Intent with the DEP.

C. Contractor shall schedule and document all inspections and re-inspections (if needed) required by permitting agencies.

D. County will obtain the DEP and Department of Health Water/Sewer Construction Permit, and County utilities and engineering approvals.

E. Documents:

1. County will furnish signed and sealed sets of Contract Documents for permit applications.
2. County will furnish copies of permits obtained by County and required to be posted on the job site. Copies of permits will be forwarded to Contractor prior to start of construction.
3. Contractor shall furnish copies of permits obtained by the Contractor. Forward copies of permits to the County prior to commencement of work requiring permits.

1.03 CODES AND ORDINANCES

A. Codes applicable to this project include, but are not necessarily limited to, the following:

1. Standard building codes as applicable.
2. Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

3. Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

4. Accessibility Requirements Manual, Department of Community Affairs, Florida Board of Building Codes and Standards.

5. The Americans with Disabilities Act (ADA) 1990 36 CFR Part 1191 Architectural and Transportation Barriers Compliance Requirements.

6. NFPA 101 Life Safety Code, Latest Edition.

7. Standard Fire Prevention Code, Latest Edition.

8. State Fire Marshal's Uniform Fire Safety Rules.

B. All materials and workmanship shall confirm to local city or county ordinances.

C. If there is a conflict in regulations, codes, or regulations and codes, the more stringent requirements shall govern.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.01 VERIFICATION AND CONFORMANCE

A. Conform to all requirements of all permits.

END OF SECTION

SECTION 01420

REFERENCE STANDARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

Description of reference standards and requirements relative to reference standards.

1.02 QUALITY CONTROL

For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

1.03 REFERENCE PUBLICATIONS

A. The date of reference publications shall be the latest in effect at the time of the award of Contract.

B. Reporting and resolving discrepancies relative to reference publications shall be as specified in the General Conditions and Division 1 of the specifications.

C. Document precedence shall be as specified in the General Conditions.

1.04 SCHEDULE OF STANDARDS ORGANIZATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AAN	American Association of Nurserymen, Inc.
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturer's Association
AHDGA	American Hot Dip Galvanizers Association
AI	Asphalt Institute

AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APHA	American Public Health Association
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASMM	Architectural Sheet Metal Manual
ASTM	American Society for Testing and Materials
AWPA	American Wood-Preservers' Association
AWPI	American Wood Preservers Institute
AWWA	American Water Works Association
AWS	American Welding Society
BHMA	Builders Hardware Manufacturer's Association
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute

DEP	Florida Department of Environmental Protection
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FS	Federal Specification General Services Administration Specification and Consumer Information Distribution Section (WFSIS)
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IMIAC	International Masonry Industry All-Weather Council
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
MBMA	Metal Building Manufacturer's Association
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
NRCA	National Roofing Contractor's Association

OSHA	Occupational Safety and Health Administration, Federal Department of Labor
PCA	Portland Cement Association
SBC	Standard Building Code
SDI	Steel Door Institute
SJI	Steel Joist Institute
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
UL	Underwriter's Laboratories, Inc.
WEF	Water Environment Federation

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01430

MATERIALS TESTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements and procedures for testing laboratory services.

1.02 REFERENCES

A. General: as specified in Section 01420 - Reference Standards.

B. ANSI/ASTM Standards

1. ANSI/ASTM D3740 Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
2. ANSI/ASTM E329 Practice for Inspection and Testing Agencies for Concrete, Steel, Bituminous Materials as Used in Construction

1.03 SELECTION AND PAYMENT

A. The Contractor shall employ services of one or more independent testing laboratories to perform specified inspection and testing.

B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.04 QUALITY ASSURANCE

A. Standards: Comply with requirements of ANSI/ASTM E329 and ANSI/ASTM D3740.

B. Laboratory: Authorized to operate in State in which Project is located.

C. Laboratory Staff: Maintain a full time Registered Professional Engineer on staff to review services.

D. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.

1.05 LABORATORY RESPONSIBILITIES

A. Test samples submitted by Contractor.

B. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.

C. Perform specified inspection, sampling, and testing of Products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or Products.

F. Perform additional inspections and tests required by Engineer.

G. Attend preconstruction conferences and progress meetings as appropriate.

1.06 LABORATORY REPORTS

A. After each inspection and test, the laboratory shall promptly submit three (3) copies of laboratory report to Engineer, Contractor and County.

B. Report shall include:

1. Date issued,
2. Project title and number,
3. Name of inspector or technician,
4. Date and time of sampling or inspection,
5. Identification of product and Specifications section,
6. Location in the Project,
7. Type of inspection or test,
8. Date of test,
9. Results of tests,
10. Conformance with Contract Documents.

C. When requested by Engineer, provide interpretation of test results.

1.08 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop the Work.

1.09 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory, at designated location, adequate samples of proposed materials that require testing, along with proposed design data as required.

B. Cooperate with laboratory personnel, and provide access to the Work.

C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of Products to be tested, to facilitate tests and inspections, storage and curing of test samples.

D. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

E. Payment for testing and laboratory services.

1.10 SCHEDULE OF INSPECTIONS AND TESTS

As specified in individual Product Specification sections

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01450

QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements to ensure that the products and installation meet industry standards, manufacturers requirements and government regulations and ordinances.

1.02 GENERAL QUALITY CONTROL

A. The Contractor shall maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Public Inspection: The Contractor shall inform the Engineer and local authorities, such as building and plumbing inspectors, Fire Marshall, OSHA inspectors, and others, in order that they may approve all required work and witness all required tests for foundations, piping, plumbing, fire protection systems, pressure vessels, safety systems, electrical systems and other systems requiring regulatory authority inspections to obtain all required permits and certificates.

C. Site Inspection: The Contractor shall verify all dimensions in the field and shall continuously check field conditions during construction.

D. Sampling and Testing: The Engineer reserves the right to take samples and make independent tests to verify that the Work meets the requirements of the specifications.

1.03 RIGHT OF REJECTION

A. Engineer shall have the right, at all times and places, to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after installation. If the Engineer or its representative, through an oversight or otherwise, has accepted materials or Work which is defective or which is contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be subsequently rejected.

B. The Contractor shall promptly remove rejected articles or materials from the site of the Work after notification of rejection.

PART 2 – PRODUCTS

2.01 MANUFACTURERS' CERTIFICATES

Submit manufacturer's certificate that product meets or exceeds specified requirements as specified in Section 01600 – Material and Equipment and Section 01750 – Testing and Startup.

2.02 MATERIALS TESTING

The Contractor shall employ the services of an independent, testing laboratory to perform inspections, tests, and other services as specified in Section 01430 – Materials Testing. The Contractor's responsibilities are described in Section 01430.

PART 3 – EXECUTION

3.01 MANUFACTURERS' INSTRUCTIONS

Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

3.02 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Comply with all local, state and federal regulations and ordinances.

C. Perform work by persons qualified to produce workmanship of specified quality.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration and rocking.

3.03 MANUFACTURERS' FIELD SERVICES

A. When specified in the individual product section, require manufacturer or manufacturer's representative to provide qualified personnel to observe field conditions; conditions of surfaces and installation; quality of workmanship; start-up, testing, adjustment, and balance of equipment as applicable; and to make appropriate recommendations.

B. The extent of the manufacturer's field services shall be as specified in the individual product specification sections.

END OF SECTION

SECTION 01470

COLOR AUDIO-VIDEO PRECONSTRUCTION RECORD

PART 1 - GENERAL

1.01 SCOPE

Prior to commencing work, the Contractor shall take a continuous color audio-video digital DVD recording of Project site to serve as a record of pre-construction conditions.

1.02 APPROVAL

No construction shall begin prior to review and approval by Engineer of the DVD recording covering construction area. The Engineer shall have authority to reject all or any portion of the recording not conforming to specifications and order that it be done again at no additional charge. The Contractor shall reschedule unacceptable coverage within five days after being notified. The Engineer shall designate those areas, if any, to be omitted from or added to the audio-video coverage. Recordings shall not be made more than 60 days prior to construction in any area. All DVDs and written records shall become property of the County. Prior to video recording, there will be a meeting between Engineer, Contractor and electrographer.

1.03 PROFESSIONAL ELECTROGRAPHERS

Engage the services of a professional electrographer. The color audio-video recording shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of preconstruction color audio-video documentation. The electrographer shall furnish to Engineer a list of names and addresses of two references that electrographer has performed color audio-video recording for projects of a similar nature.

PART 2 - PRODUCTS

2.01 AUDIO-VIDEO DVDs

Audio-video DVDs shall be new as manufactured by Maxell or equal. Reprocessed disks will not be acceptable. The Contractor shall submit two copies of each DVD recording for review and approval.

2.02 EQUIPMENT

A. Furnish all equipment, accessories, materials and labor to perform this service. The total audio-video system shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or any other form of imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity and be free from distortion and interruptions.

B. The color video camera used in the recording system shall have a horizontal resolution of 300 lines at center, a luminance signal to noise ratio of 45 dB and a minimum illumination requirement of 25 foot-candles.

PART 3 - EXECUTION

3.01 SCHEDULING

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

3.02 RECORDED INFORMATION – AUDIO

Each recording shall begin with current date, project name and Owner and followed by general location, i.e., viewing side and direction of progress. Audio track shall consist of an original live recording. Recording shall contain the narrative commentary of electrographer, recorded simultaneously with his fixed elevation video record of the zone of influence of construction.

3.03 RECORDED INFORMATION - VIDEO

All video recordings must, by electronic means, display continuously and simultaneously generated with the actual taping transparent digital information to include the date and time of recording, and station numbers as shown on the Drawings. Date information shall contain the month, day and year. Time information shall contain the hour, minutes and seconds. Additional information shall be displayed periodically. Such information shall include but not be limited to project name, contract number, name of street or structure, direction of travel and view. This transparent information shall appear on the extreme upper left hand third of the screen.

3.04 AREA OF COVERAGE

A. Recorded coverage shall include all surface features located within the zone of construction supported by appropriate audio coverage. Such coverage shall include special attention to existing driveways, sidewalks, curbs, pavements, structures, exposed piping, electrical and control devices, landscaping, culverts, fences, signs and headwalls within the area covered.

B. When a conventional wheeled vehicle is appropriate for use, distance from the camera lens to the ground shall not be less than twelve feet. Rate of speed in the general direction of travel of the vehicle used during recording shall not exceed 15 feet per minute. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object. Tape coverage may be required in areas not accessible by vehicles. Such coverage shall be obtained by walking or special conveyance approved by the Engineer.

END OF SECTION

SECTION 01510

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for temporary utilities.

1.02 TEMPORARY SERVICES

A. Each temporary service shall meet the requirements of the utility having authority over the temporary service. Provide metering and isolation to meet requirements of utility authority over temporary service.

B. Obtain permission of utility having authority over temporary service prior to connecting temporary service.

C. Remove temporary services after temporary services are no longer needed for construction operations, site security, field offices, or testing. Restore to pre-construction condition.

1.03 APPLICATION AND PAYMENT FOR TEMPORARY SERVICES

A. Make applications and arrangements and pay all fees and charges for temporary electrical, potable water, non-potable water, sanitary and telephone services.

B. Provide and pay for temporary generators, pumps, wiring, switches, piping, connections, meters, and appurtenances for temporary utilities.

C. The following permanent utility services and services relative to temporary utilities shall be provided by the Owner.

1. Electricity for facilities that are occupied and operated by the Owner.
2. Potable water for facilities that are occupied and operated by the Owner.
3. Telephone service for facilities that are occupied and operated by the Owner.

1.04 ELECTRICITY, LIGHTING

A. For facilities connected to permanent electrical services, the Contractor shall pay the Owner by deductive cost Change Order for all electrical power used in new facilities until facility is accepted, occupied, and operated by the Owner.

B. Provide temporary electrical service, or services, for the following:

1. Power tools for construction operations.
2. Construction lighting.

3. Security lighting.
4. Field offices and sheds.
5. Testing specified in individual Sections.

C. Provide construction lighting as required for the following:

1. Prosecution of Work;
2. Observation of Work by Engineer, Owner, and regulatory authorities;
3. Access to facilities occupied by Owner within project site.

D. Wiring for Temporary Electrical Services

1. Properly install and maintain wiring for temporary lighting and power.
2. Provide separate circuits for temporary lighting and for temporary power.
3. Provide branch wiring and distribution boxes located to allow service and lighting by means of construction-type power cords.
4. Securely fasten wiring and electrical devices.
5. Temporary lighting and power facilities shall meet the requirements of OSHA Safety and Health Standards for Construction.

1.05 WATER

A. Provide temporary water services for the following:

1. Potable water or non-potable water for construction operations.
2. Potable water for consumption by Contractor's and subcontractors' personnel.
3. Potable water for field offices.
4. Potable water or non-potable water for fire protection on the construction site.

B. Piping for Temporary Water Services

1. Provide pipe, fittings, valves, and hydrants for temporary water service, or services.
2. Provide temporary pumps, storage tanks, and controls if available water volume, pressure, or volume and pressure are not sufficient for construction operations.
3. Extend branch piping with outlets located so that water is available by use of hoses.
4. Securely anchor and support temporary water piping.
5. Provide warning signs at each temporary non-potable water outlet.

1.06 SANITARY FACILITIES

A. Provide sanitary facilities (fixed toilets or portable chemical toilets) for Contractor's and subcontractor personnel.

B. Sanitary Facilities for Contractor's and Subcontractor Personnel shall meet the requirements of OSHA Safety and Health Standards for Construction.

C. Seclude sanitary facilities from public observation as follows:

1. Locate sanitary facilities so that sanitary facilities cannot be observed by public, or

2. Provide screening around sanitary facilities so that public cannot observe sanitary facilities.

D. Maintain sanitary facilities so that sanitary facilities are clean and dry at all times.

E. Enforce use of sanitary facilities. Do not commit nuisances on the project site.

1.07 HEAT, VENTILATION, AND AIR CONDITIONING

A. Provide temporary heat, ventilation, and air conditioning for the following:

1. Construction operations.

2. Protection, drying, and curing of materials and finishes.

3. Field offices and sheds.

B. Temporary heat and ventilation for construction operations shall meet the requirements of OSHA Safety and Health Standards for Construction.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01520

OCCUPANCY

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for site occupancy.

1.02 CONTRACTOR USE OF PROJECT SITE

A. Contractor's use of project site shall be limited to the Contractor's construction operations, including on-site storage of materials, and field offices.

B. The Contractor shall prepare shop drawing submittal showing the location of trailers, utilities, storage parking, and staging area. No occupancy of the existing facility will be allowed until this submittal has been approved by the Engineer.

C. The Contractor shall not operate any valve, flow control device, electrical device, instrument or control system associated with the existing facility. If such operation is required for prosecution of the Work, the Contractor shall notify the Owner. Only the Owner's representatives or staff shall operate such devices.

D. Residential occupancy on the project site by the Contractor's or subcontractor's employees, including owners and supervisors, is not permitted.

1.03 OWNER USE OF PROJECT SITE

A. Owner may utilize all or part of the existing facilities during the entire construction period for the conduct of the Owner's normal operations.

B. Schedule and coordinate the Work to minimize interference between construction operations and Owner's operation and maintenance of facilities in service.

1.04 OPERATION AND MAINTENANCE OF TREATMENT FACILITIES

A. Operation

1. Owner shall operate the treatment facilities that are in service as part of the treatment process.

2. Contractor shall operate or assist in the operation of new facilities and modified facilities during testing and prior to Owner’s acceptance of new facilities and modified facilities.

B. Maintenance

1. Owner shall maintain existing facilities that have not been removed from service for modification or demolition.

2. Owner shall maintain new facilities and modified facilities that have been accepted following Substantial Completion certification of these facilities by the Engineer.

3. New or modified facilities shall be placed in service prior to acceptance if required to meet regulatory requirements for treatment quality. New or modified facilities may be placed in service prior to acceptance if required to complete Work on schedule. **If new facilities or modified facilities are in service prior to acceptance of new or modified facilities, Contractor shall maintain new or modified facilities until such facilities are accepted for Substantial Completion. Contractor shall provide maintenance and operation at no additional cost to the Owner.**

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01525

FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for field offices, storage areas, and sheds.

1.02 REQUIREMENTS FOR FIELD OFFICES AND SHEDS

A. Installation of field offices and required utilities shall be completed prior to commencement of site work and prior to submission of first payment application for site work.

B. Engineer's Field Office and Parking:

1. One office as specified in this Section;
2. Minimum of two parking spaces adjacent to Engineer's office.

C. Contractor's Field Office and Parking:

1. Minimum of one office for Contractor’s field superintendent and staff as specified in this Section;
2. Minimum of two parking spaces adjacent to Contractor's field office.

D. Meeting Area and Parking:

1. Minimum of one meeting area as specified in this Section;
2. Minimum of two additional parking spaces adjacent to meeting area.

E. Storage Areas and Sheds: As required to hold and protect the following:

1. Products and materials to be incorporated into new Work;
2. Construction equipment and materials.

1.03 USE OF EXISTING AND PERMANENT FACILITIES

Do not use existing or permanent facilities for field offices or for storage.

1.04 CONTRACTOR'S AND ENGINEER'S FIELD OFFICES

A. Schedule for Contractor’s and Engineer's Field Offices:

1. Offices for Contractor and Engineer shall be complete before Contractor starts construction work on project site.
2. Offices including temporary utilities and services, shall remain until new and renovated facilities are complete, tested, and accepted.
3. Subcontractors' offices may be installed and removed to meet the requirements of the construction schedule.

B. Location of field offices: Coordinate location of field offices and sheds with SCWRF staff and submit proposed location in submittal to Engineer. Install the offices as approved in the submittal.

C. Access to field offices:

1. Office and parking shall be accessible by passenger vehicle.

2. Provide steps and landing at each exterior entrance which is more than eight inches above grade. Steps and landings shall meet the requirements of the Life Safety Code.

D. Occupancy of Engineer's Field Office:

1. Provide one field office for use of Contractor and Engineer.

2. Engineer's field office shall be separate from subcontractors' field office, or offices.

1.05 STORAGE AREAS AND SHEDS

A. General: Provide storage areas for the following:

1. Products and materials to be incorporated into new Work;

2. Construction equipment and materials.

B. Location of Storage Areas and Sheds:

1. Site Not Occupied by Owner: The Contractor shall select storage areas only where authorized by the Owner.

2. Site Partially Occupied by Owner

a. If specific areas are designated as storage areas, use the designated storage areas.

b. If specific areas are not designated as storage areas, the Contractor may use areas within the project site that are not occupied by the Owner and do not interfere with the following:

(1) Owner's operations

(2) Access to Owner occupied facilities

(3) Work by other Contractors.

C. Additional Storage Areas: Provide additional off-site storage area if available on-site storage area is not adequate for the Contractor, or subcontractors needs.

D. Storage Area Access:

1. Access to storage areas by Owner and Engineer shall meet the requirements of Section 01600 – Material and Equipment.

2. Provide emergency access to stored equipment and materials.

PART 2 - PRODUCTS

2.01 CONDITION

Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.02 BUILDING REQUIREMENTS

A. Building Type for Field Offices and Sheds: Portable buildings, mobile buildings, or temporary buildings constructed on site.

B. Field Office and Shed Construction:

1. Field Offices and sheds shall be shall be wood frame, metal frame, or concrete block.
2. Field Offices and sheds shall be structurally sound, secure, and weather-tight.

C. Ceiling Height for Field Offices and Sheds: 7'-6" minimum.

D. Temperature Transmission Resistance of Floors, Walls, and Ceilings for Field Offices and Sheds: Compatible with occupancy and storage requirements.

E. Exterior Materials for Field Offices and Sheds: Weather resistant, finished.

F. Interior Materials for Field Offices:

1. Walls and Ceilings: Pre-finished or painted sheet type materials.
2. Floors: Vinyl tile or resilient sheeting.
3. Base Molding: Rubber, cove bases, or equal.

G. Interior Materials for Sheds: As required to provide specified conditions for storage of products.

H. Exterior Color for Field Offices and Sheds:

1. Non-objectionable to Owner and Engineer.
2. Non-objectionable to public, if visible from outside of project site.

I. Exterior Finish for Field Offices and Sheds:

1. Free from peeling or excessive fading.
2. Free of graffiti and other markings not required for identification or safety.

J. Interior Finish for Field Offices:

1. Clear finished paneling or painted sheet material.
2. Free from peeling or excessive fading.
3. Free of graffiti and other markings not required for identification or safety.

K. Interior Wall Finish for Sheds: Finished or unfinished with light color, which does not impair inspection and maintenance of stored products.

L. Door and Frame Material for Field Offices and Sheds: Sound metal, wood, or metal and wood doors and frames.

M. Door Hardware for Field Offices and Sheds:

1. Doors shall open and close smoothly.
2. Doors shall have functioning locksets.

N. Window Type for Field Offices: Awning, casement, double hung, or horizontal sliding with operating sash. Windows to have sound wood or metal frames. Window sash shall open and close smoothly and have operating locks. Glass shall be uncracked and unbroken.

O. Glazing Type for Field Office Windows:

1. Offices and Meeting Rooms: Clear.
2. Restrooms: Frosted, or clear with blinds.

P. Screens for Field Office Windows: Insect screens securely attached and without holes.

Q. Glazing for Shed Windows: Contractor's option.

R. Exterior Lighting for Field Offices: One light, 60 watt minimum, at each exterior entrance.

S. Interior Lighting for Field Offices, Including Meeting Area: 50 ft-candles minimum at desk-top height.

T. Exterior Lighting for Sheds: As required for security.

U. Interior lighting for Sheds: As required to permit inspection and maintenance of stored products.

2.03 ENVIRONMENTAL CONTROL

A. Heating, Cooling, and Ventilating for Offices and Meeting Area: Automatic equipment to maintain comfort conditions as follows:

1. Heating: 78 degrees F.
2. Cooling: 72 degrees F.

B. Heating, Cooling, and Ventilating for Storage Spaces: Heating, cooling, and ventilation as required to provide environment conditions specified in individual Specification Sections or as recommended by product manufacturer.

2.04 FIRE PROTECTION

A. Provide appropriate type fire extinguisher at each office, meeting area, and each storage area.

B. Provide additional fire protection, such as sprinkler systems, as required to protect stored products.

2.05 FIELD OFFICE – CONTRACTOR'S AREA

A. Floor Area for Contractor's Field Office:

1. Office for Contractor's Superintendent: 120 square feet, minimum, with 10' minimum width.

B. Minimum Furnishings and Equipment for Contractor's Field Office:

Quantity	Description
One	Office desk
One	Office chair
One	Four-drawer file cabinet
One	10" outdoor weather thermometer
One	Rain gauge

2.06 FIELD OFFICE – ENGINEER'S AREA

A. Size of Engineer's Field Office: 100 square feet, minimum, with 10' minimum width.

B. Locks and Keys for Engineer's Field Office: Provide new lock with two keys for each individually keyed exterior door.

C. Windows for Engineer's Field Office:

1. Quantity of Windows for Engineer's Field Office:

a. End Room: Three per room, minimum.

b. Side Rooms and Corner Rooms: Two per room, minimum.

2. Total Window Area for Engineer's Field Office: 10 percent of floor area, minimum.

3. Location of Windows for Engineer's Field Office: Locate to provide views of construction area.

D. Electrical Systems for Engineer's Field Office:

1. Electrical Distribution Panel for Engineer's Field Office: One, 100 amp minimum.

2. Wiring and devices to conform to National Electric Code.

3. Outlets for Engineer's Field Office:

a. Outlet Type: 110 volt duplex.

b. Quantity of Outlets: Four in each room, minimum.

E. Telephone Systems for Engineer's Field Office

1. Number of Dedicated Telephone Lines for Engineer's Field Office: One, minimum.

F. Provide one washroom with potable water, water closet and lavatory.

G. Water Heater: 30 gallon, minimum.

H. Wash Room Accessories:

1. One, paper towel dispenser, or roll paper towel holder.
2. One roll toilet paper holder.

I. Minimum Furnishings and Equipment for Engineer's Field Office:

Quantity	Description	Manufacturer
One	Double pedestal desk with three drawer one side and one supply drawer, one file drawer on opposite side, and 30"x60" minimum	Hon Metro Series stock model 3244, Vanguard LP 860, or equal
One	Metal frame, swivel office chair with arms	Hon W22 Executive Swivel, United Chair Co. S11, or equal
One	Metal frame office chair with arms	Hon Model W42, or equal
One	Four-drawer file cabinet, legal size, 52" high, with key lock	Hon 310 Series, Steelmaster, or equal
One	Three-shelf, metal bookcase, 42" high	Hon S42ABC, or equal minimum
One	Metal, waste basket	
One	Desk lamp with two 15 watt tubes	Dazor Model 1000, Flexarm No. 4444, or Equal

2.07 FIELD OFFICE MEETING AREA

A. Meeting Area Size:

1. Minimum Floor Area for Meeting Area: 100 square feet.
2. Minimum Width Dimension for Meeting Area: 10 feet.

B. Minimum Furnishings and Equipment for Meeting Area:

Quantity	Description	Manufacturer
One	Metal or wood, conference room table	6’ x 4’ top, minimum
Four	Metal frame office chairs with arms	Hon Model W42, or equal
One	Dry erase “white board”, 4’ x 6’, wall mount type, with aluminum frame, full length marker rail, two erasers, and two boxes of four color dry erase markers	Quartet, Catalog Number QRT 7537, or equal and Pentel, Catalog Number PEN MW6-4E, or equal
One	Electric, bottled water cooler which dispenses cold water and hot water	
One	Refrigerator, 6 cubic feet, minimum	
One	Medium industrial First Aid Kit, new fully equipped	ERB 3200, or equal

PART 3 - EXECUTION

3.01 PREPARATION

Fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

A. Installation of field offices and required utilities shall be completed prior to commencement of site work and prior to submission of first payment application for site work.

B. Meet local building requirements

C. Block and level portable buildings and mobile buildings

D. Temporary Buildings constructed on site shall be securely fixed to building foundations.

3.03 MAINTENANCE AND CLEANING

A. General:

1. Maintain and clean offices and sheds as specified in this Section.

B. Maintain parking area and approach walks free of mud and water.

C. Damaged Offices and Sheds: Repair damaged offices and sheds.

D. Non-functioning Equipment: Repair, or replace, office equipment that is not functioning or not functioning properly.

E. Supplies:

1. Provide office and janitorial supplies and service required for the functioning of field offices and field office equipment.
2. Provide the following supplies and service for the Engineer's Office:
    a. Light bulbs and tubes;
    b. Toilet paper;
    c. Towels for the Wash Room;
    d. Soap for the Wash Room;
    e. Paper cups for the Water Cooler.

F. Cleaning Exterior of Engineer's Field Office, Contractor's and Subcontractors' Field Offices, and Sheds: As required to keep field offices and sheds presentable and free of graffiti and other markings not required for identification or safety.

G. Janitorial Services for Engineer's Field Office and meeting area:

1. Routine: Twice weekly.
2. Windows: Monthly or as necessary
3. Additional: As required to keep office clean when job site or weather conditions produce excessive mud.

3.04 REMOVAL

A. Offices, sheds, and equipment shall remain property of the Contractor, unless otherwise specified.

B. Following completion, testing, and acceptance of new and renovated facilities, remove offices and sheds, including blocking, foundations, utility services, and debris.

C. Restore areas where offices, storage areas and sheds were located, or finish areas as shown on the Drawings, if characteristics of area are to be changed as part of the Work.

END OF SECTION

SECTION 01540

SECURITY

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for project site security

1.02 SITE SECURITY

A. Facilities Partially Occupied by Owner: Site security of partially occupied sites shall be joint responsibility of Contractor and Owner.

1. Contractor shall provide security for the following:
   a. Contractor's and subcontractors' staging areas and storage areas.
   b. Field offices and sheds.
   c. New facilities under construction.
   d. Existing facilities being renovated.

2. Owner shall provide security for the following:
   a. Facilities occupied by Owner.
   b. Site areas solely occupied by Owner.

3. Site Entrance

   a. Site access shall be through the entrance gate on Wildflower Way unless otherwise directed by the Owner.
   b. Contractor shall provide security for site entrance for Contractor's and subcontractors' use.

B. All field workers associated with execution of the Contract Work must obtain security badges from the Facilities Department of Collier County.

1. Each worker must go to the Facilities Department at the Government Center on Tamiami Trail East for fingerprinting, photographing and completion of security application. Workers that fail the security clearance requirements shall not be allowed on the project.

2. The Contractor shall be responsible for payment to the County of the fee associated with each security badge.

3. The Contractor is responsible for renewal of the security badges and for maintaining a current badge for each worker.

4. The Contractor shall retrieve the security badge from each worker no longer employed at the site and turn badge over to the County.

C. The Contractor shall be fully responsible for security of construction equipment, products, small tools, and other items related to the construction.

1.03 SECURITY PROGRAM

A. Protect Work from theft, vandalism, and unauthorized entry.

B. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.

1.04 ENTRY CONTROL

A. Restrict entrance of persons and vehicles into construction site.

B. Owner will control entrance of persons and vehicles related to Owner's operations.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

General requirements for materials and equipment and requirements for procurement, handling, and storage of materials and equipment.

1.02 GENERAL

A. Furnish and Install

1. Where the words “furnish”, “provide”, “supply”, “replace”, or “install” are used, whether singularly or in combination, they shall mean to furnish and install, unless specifically stated otherwise.

2. In the interest of brevity, the explicit direction “to furnish and install” has sometimes been omitted in specifying materials and/or equipment herein. Unless specifically noted otherwise, it shall be understood that all equipment and/or materials specified or shown on the Drawings shall be furnished and installed under the Contract as designated on the Drawings.

B. Concrete Foundations for Equipment

1. Each Contractor shall provide all concrete foundations shown, specified or required for all equipment furnished under their respective Contract.

2. Anchor bolts and templates for equipment foundations shall be furnished by the Contractor unless noted otherwise.

3. All concrete foundations for equipment shall be treated, by the respective Contractor, with an approved sealer to prevent oil from seeping into the concrete.

1.03 REFERENCES

A. General: Section 01420 - Reference Standards.

B. ANSI Standards

ANSI B46.1 Surface Texture

C. ASTM Standards

1. ASTM A48 Specification for Gray Iron Castings
2. ASTM A108 Specification for Steel Bars, Carbon, Cold-Finished Standard Quality

1.04 SUBMITTALS

A. General: As specified in Section 01330 - Submittals

B. Lubricant Test Report: as specified in this Section.

C. Substitutions: as specified in this Section.

D. Manufacturer Certificate of Completion: The Contractor shall obtain written certification from the equipment manufacturer, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with the Specifications and as indicated on the Drawings. Contractor shall have responsibility for coordination of all equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed equipment. The Contractor shall submit all such certificates to the Engineer with the shop drawings.

1.05 INFORMATION REGARDING BUY AMERICAN PROVISION

A. The Buy American Provision of Public Law 95-217 (Section 215 of Public Law 92-500 as amended) as implemented by EPA regulations and guidance, generally requires that preference be given to the use of domestic construction material in the performance of this Contract.

B. Products manufactured outside of the United States will not be considered acceptable for the Work unless the Manufacturer and the manufacturing facility (ies) are certified as ISO/9001 compliant. The ISO certification must come from a firm having itself been certified by the International Accreditation Forum.

C. Refer to part 2.02 of this Section.

1.06 QUALITY ASSURANCE

A. General: As specified in Section 01450 – Quality Control

B. Inspection, Field Adjustment, and Startup: Demonstrate that all equipment meets the specified performance requirement.

C. Tolerances: Tolerances and clearances shall be shown on the shop drawings. Adhere to approved tolerances and clearances. Machine work shall be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16 of an inch for members 30 feet or less in length, and not greater than 1/8 of an inch for members over 30 feet in length.

D. Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for all surfaces in sliding contact.
2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.
4. Contact surfaces of shafts and stems that pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

E. Manufacturer's Experience: Unless otherwise directed by the ENGINEER, all equipment furnished shall have a record of at least 5 years of successful, trouble-free operation in similar applications, from the same manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Products include material, equipment, and systems.

B. Comply with Specifications and referenced standards as minimum requirements.

C. All products shall be new and of the very best quality.

D. Components that are supplied in quantity within a Specification section shall be the same, and shall be interchangeable.

E. All parts of the equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation.

2.02 STAINLESS STEEL

A. All stainless steel fasteners shall be polished during the manufacturing process to provide a bright surface finish.

B. The submittal data on stainless steel fasteners manufactured outside the United States shall include documentation of alloy elemental analysis performed as routine and ongoing quality control measures associated with the manufacture of the specific products for this project.

2.03 PRODUCT OPTIONS

A. Products specified by reference standards or by descriptions only: Any product meeting these requirements can be submitted for approval.

B. Products specified by naming one or more manufacturers with a provision for substitutions: Submit a request for substitution for any manufacturer not specifically named.

C. Products specified by naming one or more manufacturers with no provision for substitutions: No substitutions will be allowed.

2.04 SUBSTITUTIONS

A. A request for substitution should be made enough time in advance of procurement to allow time for review by the Engineer. A substitution may not be accepted if it delays the project schedule.

B. Document each request for substitution with complete data substantiating compliance of proposed substitution with material or product specifications.

C. Request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.

2. Will provide the same warranty for substitution as for specified product.

3. Will coordinate installation and make other changes that may be required for Work to be complete in all respects.

4. Waives claims for additional costs that may subsequently become apparent.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents.

E. Engineer will determine acceptability of proposed substitution, and will notify Contractor of acceptance or rejection in writing within a reasonable time.

2.05 MANUFACTURERS' CERTIFICATIONS

A. Prior to delivery at project site, furnish an Affidavit of Compliance certified by the equipment manufacturer that the equipment and appurtenances furnished comply with all applicable provisions of applicable referenced standards and these Specifications.

B. Do not deliver equipment to job site until Affidavit of Compliance has been submitted and accepted by the Engineer.

2.06 NOISE AND VIBRATION

A. When in operation, no single piece of equipment shall exceed the OSHA noise level requirements for a one-hour exposure.

B. Equipment that transmits vibration to structures, piping, conduit, or other items connected to the equipment, shall be provided with restrained spring-type vibration isolators or pads per manufacturer 's written recommendations.

C. Equipment that can be damaged by vibration generated by the equipment or by vibration transmitted through piping or other connecting items, shall be provided with vibration damping per manufacturer 's written recommendations.

2.07 WELDING OF EQUIPMENT AND PIPE

A. Shop Welding: Unless otherwise specified or shown, shop welding shall conform to the following:

1. Applicable Standards of the American Welding Society and AWWA for the material and type of item being welded.

2. All composite fabricated steel assemblies, which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.

3. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

4. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

B. Field Welding: Field welding shall be as specified in individual specification sections. Qualification of welders shall be in accordance with the AWS standards. Prior to commencement of any field welding, the Contractor shall furnish the Engineer a copy of each welder's current certification for the alloy, position and type of welding to be performed.

2.08 PROTECTIVE COATINGS FOR EQUIPMENT

A. Equipment shall be painted or coated in accordance with Section 09850 – Painting unless otherwise approved by the Engineer. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

B. 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 and shall be satisfactory to the Engineer up to the time of the final acceptance.

C. Shop-painted items which suffered damage to the shop coating shall be touched up as specified in Section 09850 – Painting.

2.09 GEARS AND GEAR DRIVES

A. Unless otherwise specified, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum B-10 bearing life of 60,000 hours and a minimum efficiency of 94 percent. Gear reducer service factor shall be based on nominal motor horsepower and shall be:

1. 2.0 for drives incorporating flexible connections between the driven shaft and the gear reducer.

2. 2.5 for coupled drives with pinion gears incorporating a torsionally soft coupling between the motor and pinion shaft.

3. 2.75 for integral gearmotors with pinion gears where the pinion is rigidly affixed to the motor shaft.

B. For integral gearmotors with pinion gears, pinions shall not be of the shell type. The pinion gear shall be easily removable from the motor shaft in the field.

C. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. Casings shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train.

D. Each oil lubricated gear speed reducer or increaser shall be provided with an oil level sight glass and an oil flow indicator, arranged for easy reading. Oil level and drain location relative to the mounting arrangement shall be easily accessible. Provide oil coolers, or heat exchangers, with required appurtenances when necessary to maintain the proper oil temperature for the application.

E. Input and output shafts shall be designed for the service and load requirements of the equipment of which gear drives are a part. Gears shall be computer-matched for minimum tolerance variation. Each output shaft shall have seals that prevent lubricant leakage. Each oil lubricated gear dive output shaft shall have two positive seals.

F. Where gear drive input or output shafts connect to couplings or sprockets not supplied by the gear drive manufacturer, the gear drive manufacturer shall supply matching key taped to the shaft for shipment.

G. Ship gears and gear drives fully assembled for field installation.

2.10 DRIVE CHAINS

A. General

1. Power drive chains shall be commercial type roller chains and meet ANSI Standards.

2. Provide chain take-up or tightener that provides easy adjustment of chain tension.

3. Provide a minimum of one connecting or coupler link with each length of roller chain.

4. Chain and attachments shall be of the manufacturer's best standard material and suitable for the process fluid.

B. Sprockets

1. Sprockets shall be used in conjunction with all chain drives and chain-type material handling equipment.

2. Unless otherwise specified, sprockets material shall be as follows:

   a. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.

   b. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.

   c. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.

3. Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

4. Finish bored sprockets shall be furnished complete with key seat and setscrews.

5. Sprockets shall be of the split type or shall be furnished with taper-lock bushings as required.

6. Idler sprockets shall be furnished with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with setscrews may be provided in both sides of the hub.

2.11 V-BELT DRIVES

A. V-belts and sheaves shall be highest industrial grade and shall conform to ANSI and MPTA Standards.

B. Unless otherwise specified, sheaves shall be machined from gray cast iron.

C. Sheaves shall be statically balanced. In some applications where vibration is a potential problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 feet per minute may be required to be of special materials and construction.

D. Sheaves shall be furnished complete with taper-lock or QD bushings.

E. Finish bored sheaves shall be furnished complete with key seat and setscrews.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.12 DRIVE GUARDS

A. Power transmission, prime movers, machines, and moving machine parts shall be guarded to conform to the OSHA Safety and Health Standards (29CFR1910).

B. Where required for lubrication or maintenance, guards shall have hinged access doors.

C. All drive guards and fasteners shall be constructed of stainless steel.

2.13 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).

B. Fitting practice, mounting, lubrication, sealing, static rating, housing strength, and other factors shall be considered in bearing selection.

C. Grease-lubricated type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. Install stainless steel tubing and supports as necessary to extend grease fittings so that greasing can be done from platforms and walkways used by the Owner in routine operations.

E. Permanently lubricated bearings shall be factory-lubricated with the manufacturer's recommended lubricant.

F. Except where otherwise specified or shown, bearings shall have a minimum B-10 life expectancy of 60,000 hours.

G. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

H. Sleeve-type bearings shall have a Babbitt or bronze liner.

2.14 SHAFTING

A. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as shown or specified unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A108, Grade 1018.
2. Medium carbon cold-rolled shafting shall conform to ASTM A108, Grade 1045.
3. Corrosion-resistant shafting shall be stainless steel or monel, whichever is most suitable for the intended service.

C. Where differential settlement between the driver and the driven equipment may be expected, a shaft of sufficient length with two sets of universal type couplings shall be provided.

D. All shafting shall be dynamically balanced in accordance with the recommendations of the shafting manufacturer.

E. The Contractor shall furnish and install a heavy-duty shaft guard for all drive shafting which is less than seven feet above floor or platform level I accordance with the provisions of Paragraph 1910.210 of OSHA Rules and regulations. Provision shall be made in the guard as necessary for lubrication and inspection access of the joints and bearings without the necessity of removing the entire guard assembly.

2.15 COUPLINGS

A. Flexible couplings shall be provided between the drivers and driven equipment. Flexible couplings shall accommodate angular misalignment, parallel misalignment, end float. Flexible couplings shall cushion shock loads.

B. Equipment manufacturer shall select or recommend the size and type of coupling required to suit each specific application.

C. Where required for vertical shafts, 3-piece spacer couplings shall be installed.

D. Taperlock bushings may be used to provide for easy installation and removal on shafts of various diameters.

E. Where universal type couplings are shown, they shall be of the needle bearing type construction, equipped with commercial type grease fittings.

2.16 EQUIPMENT FOUNDATIONS

A. Provide equipment foundations in accordance with equipment manufacturers' written instructions.

B. Mount mechanical equipment, tanks, and floor mounted control cabinets on minimum 4" high concrete bases, as shown on standard details, unless otherwise shown or specified.

C. Submit foundation drawings for review.

2.17 SHOP FABRICATION

Perform shop fabrication in accordance with the final reviewed and processed shop drawings.

2.18 NAMEPLATES

A. Equipment nameplates shall be stainless steel. Nameplates shall be engraved or stamped. Fasten nameplates to equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.

B. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.19 WARRANTIES

Furnish warranties as specified in Section 01780 – Warranties and Bonds

2.20 SPARE PARTS

Following approval of the spare parts list by the Engineer and immediately prior to Substantial Completion, furnish spare parts suitably packaged for long-term storage and labeled with the date of supply, the equipment number and part number, equipment description and part description.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for the delivery, storage, and handling of products.

B. Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry.

C. Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.

D. Transport products by methods that prevent product damage. Deliver products dry and in undamaged condition in manufacturer's unopened containers or packaging. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

E. Load and unload equipment and appurtenances by hoists or skidding and in accordance with the manufacturer's recommendations. Do not drop products. Do not skid or roll products on or against other products. Pad slings and hooks in a manner that prevents damage to products.

F. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions. Store products that will be deteriorated by sunlight in a cool location out of direct sunlight. Rubber products shall not come in contact with petroleum products.

G. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering and as recommended by manufacturer; provide ventilation that avoids condensation.

H. Deliver pipe, fittings, valves, and accessories in a clean and undamaged condition. Store pipe, fittings, valves, and accessories off the ground and in accordance with manufacturer’s instructions. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings, valves, valve boxes, or valve stands.

I. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings, valves, and appurtenances free from dirt or foreign matter. Drain and store valves in a manner that will protect valves from damage. Store gaskets, plastic pipe and fittings, and other products that will be deteriorated by sunlight in a cool location out of direct sunlight.

J. Equipment having moving parts such as gears, bearings, and electric motors; instruments; control panels; motor control centers; and switchgear shall be stored in a temperature and humidity controlled area until equipment is installed and permanent HVAC systems are in operation.

K. Stored electric motors and actuators with space heaters shall have the space heaters energized. When electric motors and actuators with space heaters are installed, the space heaters shall be connected and energized. Space heaters shall remain energized until equipment is accepted and placed in service.

L. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

M. Promptly remove damaged products from the job site. Replace damaged products with undamaged products at no expense to Owner.

3.02 MANUFACTURERS' REPRESENTATIVES

A. Provide the services of experienced, competent, and authorized service representative of the manufacturer of the items of equipment when specified in the individual Product Section.

B. Manufacturers' representatives shall visit the site of Work, and shall perform the following tasks:

1. Assist Contractor in installation of equipment.

2. Inspect, check, adjust equipment, and approve equipment installation.

3. Start-up and field-test equipment for proper operation, efficiency, and capacity. Perform necessary field adjustments during the test period until equipment installation and operation are satisfactory to the Engineer.

4. Supervise functional test as specified in Section 01750 – Testing and Start-Up

5. Instruct Owner's personnel in operation and maintenance of equipment as specified in this Section.

C. The times specified in the individual product sections for the Manufacturer's Representative to provide services are exclusive of travel time to and from the facility. The times specified shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

3.03 INSTALLATION - GENERAL

A. Install equipment in accordance with acceptable procedures submitted with the shop drawings and as indicated on the Drawings, unless otherwise accepted by the Engineer.

B. Measure drive shafts just prior to assembly to ensure correct alignment without forcing.

C. Support pipe, fittings, valves, conduit, and other items connected to equipment so that there are no excess stresses and loads on equipment.

D. Equipment shall be secure in position and neat in appearance.

3.04 IINSTALLATION OF EQUIPMENT

A. Equipment and materials shall be installed in accordance with the requirements of the General Conditions, Supplemental Conditions and the respective Specification Sections.

B. Concrete foundations for equipment shall be of approved design and shall be adequate in size, suitable for the equipment erected thereon, properly reinforced, and tied into floor slabs by means of reinforcing bars or dowels. Foundation bolts of ample size and strength shall be provided and properly positioned by means of suitable templates and secured during placement of concrete. Foundations shall be built and bolts installed in accordance with the manufacturer’s certified drawings.

C. Before mounting equipment on a foundation, the Contractor shall clean the top surface; if necessary, rough it with a star chisel and clean again; and clean out all foundation bolt sleeves. The Contractor shall provide a sufficient number of stainless steel plate shims about 2-inches wide and 4-inches long, and of a varying thickness from 1/8 to 1/2 inch. A combination of these shims shall be placed next to each foundation bolt to bring the bottom of the bedplate or frame about 1/8 inch above the final setting. The equipment shall be lowered by changing the combination of shims. Using stainless steel shim stock of various thicknesses, continue to level the equipment a little at a time and in rotation until it is at the correct elevation in both directions. When the equipment is level, tighten

down on the foundation bolts a little at a time in rotation to make certain the equipment remains level and does not shift on the shims. A preliminary alignment check shall be made before grout is placed.

D. Equipment shall be set, aligned and assembled in conformance with manufacturer's drawings or instructions. Run out tolerances by dial indicator method of alignment shall be plus or minus .002 inches, unless otherwise directed by the Engineer.

E. All blocking and wedging required for the proper support and leveling of equipment during installation shall be furnished by the Contractor. All temporary supports shall be removed, except stainless steel wedges and shims, which may be left in place with the approval of the Engineer.

F. Each piece of equipment or supporting base, bearing on concrete foundations, shall be bedded in grout. The Contractor shall provide a minimum of 1-1/2 inch thick grouting under the entire baseplate supporting each pump, motor drive unit and other equipment. Grout shall be non-shrink, epoxy, non-metallic grout. Submit grout data for approval.

G. When motors are shipped separately from driven equipment, the motors shall be received, stored, meggered once a month, and the reports submitted to the Engineer. After driven equipment is set, the motors shall be set, mounted, shimmed, millrighted, coupled and connected complete. Motors shall then be turned once per month and documented by the Contractor to the Owner/Engineer.

3.05 CONNECTIONS TO EQUIPMENT

A. Connections to equipment shall follow manufacturer's recommendations as to size and arrangement of connections and/or as shown in detail on the Drawings or approved Shop Drawings. Piping connections shall be made to permit ready disconnection of equipment with minimum disturbance of adjoining piping and equipment.

3.06 LUBRICANTS

A. Furnish and install lubricants required for initial operation.

B. Maintain lubricants at proper levels until equipment is accepted.

C. Change lubricants in each piece of equipment following equipment initial run-in. The manufacturer shall test removed lubricants for metal particles and lubricant breakdown. Submit lubricant test report to the Engineer. If the equipment manufacturer requires the first lubricant change prior to Final Completion, the Contractor shall remove lubricant and furnish and install the necessary lubricants.

3.07 FIELD TESTS

A. Field test equipment in accordance with Section 01750 - Testing and Start-up.

B. Field test equipment as specified in individual Specification Sections.

3.08 FUNCTIONAL TEST

Prior to placing systems in service, perform functional tests of each system as specified in Section 01750 - Testing and Start-up.

3.09 TRAINING

A. Manufacturer's representative, responsible subcontractor, or both shall instruct Owner's designated operating and maintenance personnel in correct operation and maintenance procedures for equipment and systems when specified in individual product specification sections. Qualified persons who have been made familiar in advance with equipment and systems at Owner's facility shall give on-site instruction.

B. Submit to Engineer not less than 14 days prior to each training session an outline of the training program and the qualifications of the trainer(s).

C. Coordinate training with the Owner. Notify Owner not less than 14 days in advance of each training session.

D. Provide training while equipment is fully operational.

E. Provide training for up to three separate shifts of Owner's personnel between the hours of 6:00 A.M. and 6:00 P.M. as necessary to accommodate Owner's personnel schedule. Duration of each training session shall be not less than two hours or more than six hours.

F. **Operation and Maintenance Data as specified in Section 01830 shall be submitted and accepted prior to commencement of training. Use accepted Operation and Maintenance manuals as the basis of instruction**.

1. Review contents of manual with personnel in full detail.
2. Explain all aspects of operation and maintenance.
3. Demonstrate start-up, operation, control, adjustment, calibration, trouble-shooting, servicing, maintenance, and shutdown of equipment.

END OF SECTION

SECTION 01740

CONSTRUCTION CLEANING

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for cleaning project site and disposal of waste materials, debris, and rubbish during construction.

1.02 SITE AND FACILITIES CLEANING

A. Site Not Occupied by Owner: The Contractor shall be fully responsible for cleaning until site is partially or fully occupied by Owner after attaining Substantial Completion.

B. Facilities Partially Occupied by Owner: Cleaning of partially occupied sites shall be responsibility of the Contractor.

1. Contractor shall clean the following:
   a. Contractors and subcontractors' staging areas and storage areas.
   b. Field offices and sheds.
   c. New facilities under construction.
   d. Existing facilities being renovated.
2. Owner shall be responsible for cleaning the following:
   a. Facilities occupied solely by Owner.
   b. Site areas solely occupied by Owner.

PART 2 - PRODUCTS

2.01 EQUIPMENT

Provide covered containers for deposit of waste materials, debris, and rubbish.

PART 3 - EXECUTION

3.01 CLEANING - GENERAL

A. Maintain areas under Contractor's control free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing the space.

C. Periodically clean interior areas to provide suitable conditions for work.

D. Broom clean interior areas prior to start of surface finishing, and continue cleaning on an as-needed basis.

E. Control cleaning operations so that dust and other particulates will not adhere to wet or newly coated surfaces.

3.02 CLEANING OF NEW WORK

A. The Contractor shall be fully responsible for cleaning related to new Work including, but not necessarily limited to, the following:

1. Cleaning of cured, or partially cured, concrete surfaces prior to placement of additional concrete.

2. Cleaning of joint surfaces prior to making joints.

3. Cleaning of surfaces prior to application of finish.

4. Cleaning of equipment and enclosures prior to Substantial Completion.

5. Cleaning of new buildings and renovated buildings prior to Substantial Completion.

B. Cleaning relative to new Work shall be as specified in individual specifications sections.

3.03 DISPOSAL

A. Remove waste materials, debris, and rubbish from site periodically.

B. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.

3.04 REPAIR AND RESTORATION

A. Clean and repair damage caused by installation or use of temporary facilities.

B. Restore existing facilities used during construction to condition prior to construction.

END OF SECTION

SECTION 01750

TESTING AND START-UP

PART 1 - GENERAL

1.01 SECTION INCLUDES

Procedures for starting of mechanical, electrical, control systems, and monitoring systems.

1.02 GENERAL

A. Do not place new facilities and modified facilities in service until:

1. Equipment and controls have been successfully started up and tested;
2. Draft O&M manuals have been provided;
3. Training of Owner’s personnel has been satisfactorily completed.

1.03 QUALITY CONTROL

A. When specified in individual Product Specification Sections, require manufacturer to provide authorized representative to be present at site at time of startup, testing, and training

B. Manufacturer's representative shall perform services as described in Section 01600 − Material and Equipment.

1.04 SUBMITTALS

A. General: as specified in Section 01330 - Submittals.

B. In addition, submit the following to the Engineer:

1. Preliminary schedule listing times, dates and sequence for start-up of each item of equipment fourteen days prior to proposed dates.

2. Manufacturer's representative reports within ten (10) days after testing.

3. Each manufacturer shall prepare and submit a completed document, which is contained at the end of this Section, certifying the installation is acceptable and meets their standards and the equipment or device is functioning properly. The Contractor shall submit these certifications to the Engineer prior to either Substantial Completion or placing the equipment in service. A sample of the required certification document is appended to this Section 01750.

PART 2 - PRODUCTS (not used)

PART 3 – EXECUTION

3.01 INSPECTION

A. Verify that Project conditions comply with requirements.

B. Verify that status of Work meets requirements for starting of equipment and systems.

3.02 PREPARATION AND CONTRACTOR'S INITIAL START-UP AND INTIAL FUNCTIONAL TEST

A. Coordinate sequence for initial start-up of various items of equipment.

B. Notify Engineer fourteen (14) days prior to initial start-up of each item of equipment.

C. Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during entire start-up process.

D. Provide control diagrams that show actual control components and wiring.

E. Verify that each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, noise, vibration and other conditions that may cause damage.

F. Verify control systems are fully operational in automatic and alternate modes of operation.

G. Verify that tests, meter readings, and specific electrical characteristics agree with those specified by electrical equipment manufacturer.

H. Verify that instruments, meters, and gages have been calibrated. Perform three-point calibration on continuous elements and systems. Provide calibration records.

I. Conduct start-up and initial functional testing.

J. Provide temporary flow meters and other measurement devices as required for testing of equipment and systems.

3.03 START UP AND FUNCTIONAL TEST – DEMONSTRATION FOR OWNER AND ENGINEER

A. Perform satisfactory Contractor's initial start-up and functional test prior to demonstration for Owner and Engineer.

1. Perform pre-startup inspection of installation.

2. Perform startup under no-load conditions, if possible. Observe noise, vibration and operation.

3. If all operating characteristics are normal, proceed with startup.

4. Operate equipment and system under all lead conditions and confirm all operating characteristics are normal. If normal operation is observed, proceed with witnessed functional test and performance test as required.

B. Perform functional and performance tests.

1. Perform functional and performance tests under supervision of responsible manufacturers' representatives, instrumentation and control subcontractor, and Contractor personnel.

2. Representatives of Owner and Engineer shall witness functional test.

3. Perform functional and performance tests on each piece of equipment and operational system as specified in the individual product sections.

4. If system is to be placed in service in phases, perform functional and performance tests on each part of system prior to placing each part of system in service.

C. Demonstrate that equipment operates and complies with specified performance requirements.

D. Demonstrate that control panel functions, including failures and alarms, operate and comply with specified performance requirements.

E. Functional test shall be non-destructive.

F. If approved by the Engineer, simulate failures and alarm conditions by jumping failure input terminals.

G. Provide signal generators that simulate control conditions if it is not feasible to create actual conditions.

H. Use actual as-built control diagrams in demonstration of functions.

I. Use Operation and Maintenance manuals to demonstrate operation of equipment.

J. If functional test or performance test does not meet requirements specified in this Section, Contractor shall compensate Engineer for additional time required to observe functional testing until system successfully completes functional testing.

3.04 TRAINING

A. Training shall not occur until after completion of successful functional testing and performance testing.

B. Comply with Section 01600 – Material and Equipment, Parts 3.02 and 3.09.

C. Comply with Section 01830 – Operation and Maintenance Data.

3.05 PLACING SYSTEMS IN SERVICE

A. Complete functional and performance testing prior to placing system in service.

B. Execute start-up under supervision of responsible manufacturer's representative and Contractor personnel.

C. Place equipment in operation in proper sequence.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF

PROPER INSTALLATION AND OPERATION

SOUTH COUNTY WATER RECLAMATION FACILITY Date_____
REPLACEMENT OF PROCESS AIR BLOWERS

PRODUCT : _____

SERIAL NO.: _____

SPECIFICATION SECTION: _____

As an authorized representative of the manufacturer, the undersigned certifies the product identified above has been inspected and is installed in accordance with the manufacturer's recommended standards, except as noted below.

The undersigned further certifies that the product identified above has been placed into satisfactory operation and that all controls, safety devices and product systems are functional, except as noted below.

Exceptions and comments:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Signature: _____

Printed Name:_____

A copy of this executed Certificate must be included in the Operation and Maintenance Data. A copy must be forwarded to the Engineer upon completion of startup and testing.

SECTION 01770

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for contract closeout.

1.02 CLOSEOUT PROCEDURES

A. Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion.

B. When Contractor considers work has reached final completion, submit written certification that Contract Documents have been reviewed, work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

C. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

D. If appropriate, Engineer will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.03 PROJECT RECORD DOCUMENTS

A. Project Record Documents shall be as specified in Section 01781 – Project Record Documents.

B. Prior to Contract closeout, submit Record Documents to Engineer with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

1.04 WARRANTIES AND BONDS

Contractor shall ensure that all warranties and bonds have been received and submitted to Owner as specified in the Contract Documents.

1.05 SPARE PARTS

A. Contractor shall ensure that all spare parts have been provided as specified in individual Product Sections. Spare parts shall be packaged and labeled as specified in Section 01600 – Material and Equipment.

B. Contractor deliver the spare parts to the Owner at one time. The delivery shall include an itemized list to be signed and dated by the receiving party for the SCWRF.

1.06 OPERATION AND MAINTENANCE MANUALS

Contractor shall ensure that Operation and Maintenance manuals have been provided to the Owner as specified in Section 01830 – Operation and Maintenance Data.

1.07 CERTIFICATES OF PROPER INSTALLATION AND OPERATION

Contractor shall provide complete Certificates of Proper Installation and Operation as specified in the Contract documents.

PART 2 - PRODUCTS (not used)

PART 3 – EXECUTION

3.01 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean or replace all filters of mechanical equipment immediately after issuance of Substantial Completion. Clean roofs, gutters, downspouts, and drainage systems.

C. Clean site, sweep paved areas, and rake clean other surfaces.

D. Remove waste, surplus materials, rubbish and temporary construction facilities from the site.

END OF SECTION

SECTION 01781

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

Requirements for preparation, maintenance and submittal of project record documents. **The Contractor's attention is specifically directed to Part 3.02.B of this Section.**

1.02 SUBMITTALS

A. General: as specified in Section 1330 - Submittals

B. At Contract close out, deliver one copy of record documents to Engineer as specified in Section 01770 − Contract Closeout.

1.03 REQUIREMENTS

Contractor shall maintain at the site for the Owner one record copy of:

A. Drawings
B. Specifications
C. Addenda
D. Change orders and other modifications to the Contract
E. Engineer’s field orders or written instructions
F. Approved shop drawings, working drawings and samples
G. Field test records
H. Construction photographs
I. Detailed Progress Schedule

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION

3.01 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Project record documents shall be stored in Contractor’s field office or other location approved by the OWNER apart from documents used for construction

B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

C. Make documents and samples available at all times for inspection by the Engineer and/or Owner.

3.02 RECORDING

A. General

1. Label each document “PROJECT RECORD” in neat, large printed letters.
2. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
3. Record information in red ink.

B. Record Drawings

1. **Record information on Drawings shall be as specified in Section 01541 – Field Engineering. The Record Drawings require certification of all as-built information, including vertical and horizontal data, for above and below ground improvements by a Florida Registered Land Surveyor.**
2. Drawings shall indicate all deviations from Contract Drawings including:
   a) Field changes of dimension and detail
   b) Changes made by Change Order
   c) Details, utilities, piping or structures not on original Contract Drawings.
   d) Equipment and piping relocations.

C. Specifications and Addenda

Legibly mark each Section to record:

1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
2. Changes made by Field Order or Change Order.

D. Shop Drawings

1. Keep one copy of the final, approved shop drawing with the Record Documents. Do not keep previously rejected submittals unless they are necessary to complete the submittal.
2. Record documents should include all shop drawing information submitted. Additional information submitted during the Engineer’s review process should be filed with the appropriate submittal.

END OF SECTION

SECTION 01830

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for content and submittal of manufacturers' operation and maintenance data and content and submittal of Facility's Operation and Maintenance manual.

1.02 SUBMITTALS: MANUFACTURERS' O&M DATA

A. Submittals shall be as specified in Section 01330 – Submittals.

B. Draft: Submit three draft hard copies of manufacturer's O&M Data along with a CD containing the appropriate digital files not later than shipment of product. Draft O&M Data shall include binding. The Engineer will review and return two copies with comments.

C. Final: Revise the manufacturer's O&M Data based upon the Engineer's comments as well as the completed installation and any deficiencies noted during instruction of Owner's personnel. Submit three hard copies of the complete, final O&M Data along with two DVDs with each containing all of the O&M Data in PDF format. Submit final O&M Data not more than 30 days after final inspection and startup.

1.03 CONTENTS, EACH VOLUME OF MANUFACTURER O&M DATA

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses, facsimile and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

E. Instructions: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

F. Each manual shall comply with Parts 2.01 .D through .G and 2.02 of this Section.

G. Warranties and Bonds: Bind in copy of each.

H. Additional Requirements: As specified in individual Product specification sections.

1.04 DATA FOR MATERIALS AND FINISHES

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. (Provide information for re-ordering custom manufactured Products.)

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

1.05 DATA FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Provide the following:

1. Product description;
2. Operating Procedures;
3. Maintenance Procedures;
4. Parts;
5. Lubricants;
6. Procedures and requirements for short term (<3 months) storage and for long term storage;
7. Other Specified Data.

B. Manufacturer's Printed Operation and Maintenance Instructions: Provide manufacturer's printed operation and maintenance instructions.

C. Control Data: Provide the following:

1. Include sequence of operation by controls manufacturer.
2. Control diagrams by controls manufacturer as installed.

D. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.

E. Drawings, Diagrams, and Charts: Provide the following:

1. Color coded wiring diagrams as installed;
2. Contractor's coordination drawings, with color-coded piping diagrams as installed.

3. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

F. Tests and Reports: Include tests and reports as specified in the following Sections:

1. Section 01430 – Material Testing
2. Section 01450 – Quality Control
3. Section 01750 – Testing and Startup
4. Division 02 through Division 16 − Individual Product specification sections.

1.06 OPERATION AND MAINTENANCE DATA REQUIREMENTS

A. Product Description

1. Identify each system and system component. Use identification numbers presented in the Contract Drawings and Specifications.
2. Describe function, physical characteristics, normal operating characteristics, and alternate operating procedure.
3. Present performance curves, engineering data, and test results.
4. Describe operating limitations, environmental limitations, and any other limitations.

B. Operating Procedures

1. Provide instructions, including required sequences, for the following operations:
   a) Start-up following installation.
   b) Break-in.
   c) Routine
   d) Preventative maintenance.
   e) Calibration.
   f) Emergency shutdown.
   g) Start-up following emergency shutdown.
2. Provide operating procedures for variations in sunlight, temperature, and humidity.
3. Provide operating procedures for variations in demand, flow, and loading.
4. Provide special operating procedures vital to the product.

C. Maintenance Procedures

1. Provide instructions for preventative, routine, and periodic maintenance including the following:

a) Servicing and lubricating schedule and sequences.

b) Wearing parts replacement schedule, including part numbers.

c) Product disassembly and assembly.

d) Alignment, adjustment, and testing.

e) Product re-calibration.

2. Provide a "trouble shooting" guide and repair instructions.

D. Parts

1. Provide complete nomenclature for all product parts including manufacturer's part number for replacement parts.

2. Provide a list of recommended spare parts with instructions for storage of recommended spare parts.

3. Provide a list of local sources of supply for parts.

E. Lubricants

1. Provide a list of lubricants required. Identify the parts to be lubricated with each listed lubricant.

2. Submit separate lubrication schedule for each piece of equipment.

3. Other Data: Provide other Operation and Maintenance Data as specified in the individual Product specification sections.

F. Other Data: Provide other operation and maintenance data as specified in the individual product specification sections.

PART 2 – PRODUCTS

2.01 GENERAL DESCRIPTION: FACILITY OPERATION AND MAINTENANCE MANUAL

A. General: The Contractor shall submit a Facility Operation and Maintenance Manual, which shall be a compilation of all manufacturer's O&M data. This data shall include the data provided by the Contractor for the project known as Compliance Assurance Project Odor Control Containment and IQ Water Upgrades – (Year Completed). The compilation shall be organized in binders by unit process.

B. Binding

1. The Facility Operation and Maintenance (O&M) Manual shall be bound in multiple binders. Binding by suppliers and manufacturers of their O&M data is acceptable if the binding meets the requirements of this Section. Contractor shall provide binding for O&M Manual if the supplier does not provide binding which meets the requirements of this Section.

2. Binding shall be 8-1/2” X 11” size. Binder capacity shall be not less than 2” or

more than 3".

3. Binding shall be three-hole, left margin.
4. Binders shall be telescoping post type.
5. Binder covers shall be polyethylene.
6. Each binder shall be identified on the binder front and spine. Lettering and art work shall be silk screen applied to binders. Multiple volumes with the same identification shall be numbered sequentially using Arabic numerals. Binder data and copy of art work shall be submitted to Engineer for approval.

C. Table of Contents: Provide a detailed Table of Contents in each Binder.

D. Index of Tabs

1. Provide a tabbed index sheet for each equipment item, component, or subject. Index tabs shall provide quick reference points, which assist the Owner's personnel in the use of the manual.
2. Indexes shall be 90-lb. stock, minimum. Tabs and binding strips shall be reinforced.

E. Text

1. Text shall be legible and written in English. Each letter in the text shall be identifiable. Text shall be technically and grammatically correct.
2. Prepare the text so that operation and maintenance personnel can easily read, understand, and properly apply the instructions contained in the text. Arrange the text in a logical format. Use headings to identify each set of procedures.
3. Prepare text specific to this project. Preprinted text and brochures may be used to supplement text specific to this project if the text specific to this project contains reference, or references, to the preprinted material and if the preprinted material has been annotated to clearly show the part, or parts of the preprinted material that are applicable to this project.
4. Text character height shall not be less than 8 points or more than 12 points. Larger size letters may be used for headings. Pitch shall be between 10 characters per inch and 16.66 characters per inch. The pitch may be less than 10 characters per inch in headings. Select character point and pitch to produce text, which is easy to read. Select a font style which is easy to read.

F. Illustrations

1. Provide illustrations as required to clearly present instructions, clarify the text, or both. Place illustrations so that the illustrations are in a logical relationship to the text.
2. Pages of the O&M Data may contain text, illustration, or text and illustrations. Preprinted illustrations and brochures containing illustrations may be used if the preprinted illustrations are applicable to this project or the preprinted illustrations are annotated to clearly show the illustrations or parts of illustrations that are applicable to this project.

G. Drawings

1. Provide drawings for each system in the O&M Data. Drawings shall show the relationship between the various components in each system and the equipment installed in each system. If there is fluid flow within a system, the drawings for the system shall include a flow diagram. If there is electrical power, control wiring, or both in a system, the drawings for the system shall include a wiring diagram, a control diagram, or both as applicable.
2. Identify systems, components, and enclosures on the O&M Data drawings. Present definitions of all abbreviations and symbols used on the O&M Data drawings.
3. Identify wire and terminal numbers on all wiring diagrams.
4. Drawings shall be specific to this project. Standard drawings may be used in the O&M data if the drawings are revised for this project.

H. Quality Assurance

1. Personnel who assemble the O&M Data and the Facility Manual shall be familiar with requirements of this Section.
2. O&M Data shall be written by, edited by, or written and edited by personnel skilled in technical writing to the extent required to communicate essential data.
3. Drawings, diagrams, figures, and illustrations shall be prepared by skilled draftsmen or CADD operators competent to prepare required. Drawings.

2.02 REPRODUCTION

A. Text and drawings, sketches and diagrams used for illustrations shall be on 8-½" x 11" paper, 20-lb. minimum. Do not use sensitized paper.

B. Photo prints shall be securely mounted on 8-½ x 11" backing or shall be mounted in sheet protectors. Photo print backing shall be heavy paper, 90-lb. minimum, card stock, or equal. Sheet protectors shall be non-glare, clear vinyl.

C. Drawings shall be 8-½" x 11", 11" x 17", or larger. Drawings 8-½" x 11" and 11" x 17" shall be bound together with text and shall have reinforced holes. Drawings larger than 11" x 17" shall be folded and placed in pockets which are bound together with text or inside the back cover of the binder.

D. Text and illustrations shall be originals, offset printed, photo prints, or first quality machine copies. Text and illustrations shall be crisp with a uniform background. If originals have characters, lines, or shading which are a color, or colors, other than black or the medium is a color, or colors other than white, provide machine color copies.

E. Drawings shall be offset printed, blue line prints, black line prints, or first generation machine copies. Drawings shall be crisp with a uniform background. If originals have lines, characters, symbols, or shading which are a color, or colors, other than black, provide offset prints of drawings.

PART 3 – EXECUTION

3.01 TRAINING OF OWNER'S PERSONNEL

A. Fully instruct Owner's designated operating and maintenance personnel in the operations, maintenance, adjustment, and calibration of products, equipment, and systems if specified in the applicable Section of the Specifications. The requirements for the training are described in Section 01660 – Material and Equipment.

B. Use the O&M Data as the basis of instruction.

1. Review contents of manual with personnel in full detail.
2. Explain all aspects of operation and maintenance.

END OF SECTION

SECTION 02220

DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of structures, equipment, piping, wiring, and other existing materials, wholly or in part, as required to complete Work as shown on the Drawings and specified in this Section.

B. Removal and salvaging of designated equipment, materials, and piping. Disposal of rubble, debris, equipment, piping, wiring, and other materials removed.

C. Special requirements to locate embedded conduit in concrete structures receiving partial or spot demolitions.

1.02 SUBMITTALS

A. General: as specified in Section 01330 - Submittals

B. Submit the following:

1. Proposed methods for demolition;
2. Equipment proposed to be used to do demolition work;
3. Demolition schedule/sequence.

1.03 PROJECT/SITE CONDITIONS

A. General

1. Execute demolition so that there is no injury to persons or damage to adjacent buildings, structures, equipment, materials, piping, wiring, pavement, fences, guardrails, and other adjacent improvements. Execute demolition so that access to facilities that are in operation is free and safe.

2. Execute demolition so that interference to vehicular traffic and personnel traffic does not exceed scheduled interference. Do not place rubble, debris, equipment, piping, wiring, pavement, fencing, or other materials removed on roadways, drives, or sidewalks that are to remain in service.

B. Dust Control

1. Control dust resulting from demolition with temporary dust-tight enclosures and partition so that dust does not spread to occupied portions of buildings and to facilities in service. See Section 01160 for additional information and requirements.

2. Control dust resulting from demolition so that no nuisance is created in areas surrounding the project site.

PART 2 - PRODUCTS

2.01 TEMPORARY MATERIALS

A. Provide temporary fencing, barricades, barriers, and enclosures to meet the requirements of this Section.

B. Temporary fencing, barricades, barriers, and enclosures shall be suitable to the purpose intended.

2.02 REPAIR AND REPLACEMENT MATERIALS

For repair or replacement of existing work to remain, use materials identical to, or equal to, materials used in existing work when new.

PART 3 - EXECUTION

3.01 GENERAL

A. Conduct demolition as shown and specified in the Contract Documents.

B. Conduct demolition so that existing equipment, piping, wiring, structures, and other improvements to remain are not damaged. Repair or replace equipment, piping, wiring, structures, and other improvements damaged at no additional cost to the Owner.

C. Do not remove equipment, piping, wiring, structures, or other improvements not shown or specified to be removed. If equipment, piping, wiring, structures, or other improvements not shown or specified to be removed is removed, replace equipment, piping, wiring, structures, or other improvements at no additional cost to the Owner.

3.02 PROTECTION OF CONDUIT AND CONDUCTORS

A. It is the Contractor's responsibility in existing structures that receive partial or spot demolition, to protect embedded conduit and conductors. The Contractor shall use non-destructive imaging methods (radar, x-ray, etc.) to locate embedded conduit in concrete prior to demolition, saw cutting and core drilling.

Relocate, repair and reconstruct functional conduits and conductors affected by the demolition.

3.03 DISCONNECTIONS

A. Prior to starting demolition, check underground and exposed existing utilities, piping, and equipment within the limits of demolition. Prior to starting demolition, check underground and exposed existing utilities, piping, wiring, and equipment connected to and associated with buildings, structures, equipment, materials, piping, wiring, pavement, fences, guardrails, and other existing improvements to be removed. Verify the following:

1. Piping is inactive (abandoned);
2. Electrical power to equipment, lighting, controls, and other facilities has been permanently or temporarily disconnected, if required:
3. Utilities have been permanently disconnected or temporarily if required:

B. Do not proceed with salvage or demolition if piping is active, electrical power has not been disconnected, or utilities have not been disconnected.

3.04 EMBEDDED ANCHORS, REBAR AND FASTENERS

A. Remove all anchors, fasteners, reinforcing steel or similar devices embedded in concrete and associated with equipment, piping and materials to be removed or demolished.

B. Chip around each anchor, fasteners, reinforcing steel or similar device to allow removal of the embedded material 0.5 inches from the surface for concrete not in continuous contact with water or earth and 1.0 inches from the surface for submerged or buried concrete surfaces or as directed by the Engineer. Unless noted otherwise, repair concrete with Sikatop 122 plus or approved equal. Provide exposed finish surface to match adjacent surface texture and color.

3.05 SALVAGE OF EQUIPMENT, PIPING, AND MATERIALS

A. Remove items identified on the drawings, or specified, to remain the property of the Owner. Do not damage equipment, piping, and materials to be salvaged.

B. Following removal or equipment, piping, and materials to be salvaged, place equipment, piping, and materials in a location designated by the Owner.

3.06 REPAIRS

Repair structural elements, equipment, piping, conduit, and other improvements to remain that are damaged during demolition. Use workers specifically qualified in trade, or trades, involved to repair damaged work.

3.07 DISPOSAL

A. Remove equipment, piping, and materials not specifically designated to be retained by the Owner from the project site as Contractor's property.

B. Contractor shall not accumulate or store debris from demolition on the project site.

3.08 FILLING

A. Backfill excavations, trenches, craters, holes, and pits resulting from demolition and below ground, abandoned remains of partially demolished structures. Do not use debris in backfill.

3.09 CLEANUP

A. Following demolition, clean-up areas where other work is to be done as specified in this Section, or Sections applicable to work to be done.

B. Following demolition, clean-up areas where no other work is to be done under this Contract. Remove debris and rubbish, temporary facilities, and equipment. Level surface irregularities to eliminate depressions. Leave work in a neat and presentable condition.

END OF SECTION

SECTION 02320
FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flowable fill (excavatable cement stabilized backfill).

1.2 RELATED SECTIONS AND REFERENCES

A. 03300 - Reinforced Concrete

B. American Concrete Institute - ACI 229 R – Controlled Low-Strength Materials

1.3 SUBMITTALS

A. Submit the following in accordance with project submittal procedures.

1. Material certifications. A complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, [silica fume], ground slag, and admixtures; and applicable reference specifications shall be included in the mix design submittal. Provide design mixes and test reports.

2. Batch tickets.

3. Field test reports.

1.4 DESCRIPTION

A. Flowable fill is a self-leveling slurry of cement, fly ash, aggregates, admixtures, and water with low final strength so can be hand dug later.

B. Flowable fill may be used for trenches, pipe structures, fill for abandoned water and sewer lines, voids under new slabs/foundations and other works where cavities exist and firm support is required.

C. The use of flowable fill around or adjacent to utility lines shall be reviewed and approved by the engineer. Flowable fill shall not be around or adjacent to utility lines that have requirements for movement.

1.5 QUALITY ASSURANCE

A. When work or portions of work of this section are completed and require testing, notify the engineer.

B. Ensure all required cast-in-place concrete, embedment items, and utility work has been completed prior to placing flowable fill.

1.6 JOB CONDITIONS

A. Perform concrete washout, trucks and mixers, in a designated and controlled area to prevent the runoff of washout material and the co-mingling of unset concrete with storm water. Properly dispose of all hardened excess concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C 150, Type I or Type II.

B. Fine and Coarse Aggregates: Conform to ASTM C 33. Provide a uniform mixture of fine aggregate or fine and course aggregate, as determined by ASTM D 422.

Aggregate Mixture Gradation Requirements

Sieve Size	Percent Passing
1 inch	100
3/8 inch	95 – 100
No. 4	80 – 100
No. 8	60 – 95
No. 16	45 – 80
No. 30	25 – 60
No.50	5 – 45
No. 100	5 – 35
No. 200	0 - 30

C. Water: Potable water that is clean and not detrimental to concrete.

D. Fly Ash: Conform to ASTM C 618, Class C or Class F.

E. Air Entrainment: Conform to ASTM C260. Air entrainment may be between 6 and 25 percent. Air entraining is not required for below grade installation in areas not subject to freeze/thaw cycles.

2.2 Proportioning and Physical Property Requirements

A. Provide a flowable fill mix design in accordance with the following limits:

1. Cement, maximum 50 lbs/yd3
2. Fly ash, from 150 lbs/yd3 to 300 lbs/yd3
3. Air content, optional
4. Slump, from 6 to 11 inches
5. Water/Cement ratio, proportioned by weight to produce a slump within limits.
6. Consistent aggregate throughout the concrete mixture
7. Compressive strength will not exceed 50 psi at 28 days.

2.3 FLOWABLE FILL

A. Mix and deliver flowable fill in accordance with ASTM C94.

B. Use accelerating admixtures in cold weather only when approved by the engineer. Use of admixtures will not relax cold weather placement requirements.

C. Use set retarding admixtures during hot weather only when approved by the engineer.

D. Do not use calcium chloride as an admixture.

E. Add air-entraining agent if required to produce a flowable mix.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that all items of cast-in-place concrete, grading, trenching, and all utilities and other embedded items are in place prior to placing flowable fill.

B. Utilities that are subject to required movement (e.g., steam and condensate lines), shall not be embedded in flowable fill or otherwise have restricted movement.

C. Flowable fill shall not be used as a substitute for sand bedding or earth backfill for primary utilities unless approved by the Utilities and Infrastructure system engineers.

3.2 PREPARATION

A. Remove all loose material from the uneven tuff and the concrete structures.

B. Set elevation marks or otherwise determine the proper top elevation for the flowable fill.

3.3 PLACEMENT OF FLOWABLE FILL

A. Notify engineer a minimum of 48 hours prior to placement of flowable fill.

B. Flowable fill may be placed by direct discharge from the truck, by pumping, or by other approved methods.

C. The flowable fill shall be placed in a uniform manner that will prevent voids or segregation of the bedding and filling material. If required, the flowable fill shall be consolidated with internal vibrators.

D. Pipes, reinforcement, inserts, or other embedded parts shall be placed, supported, and secured in a manner that shall prevent the flowable fill from displacing, sagging, or from floating embedded items.

E. Flowable fill shall be brought up uniformly to the fill line shown on the plans. Formed walls or other bulkheads shall be constructed to withstand the exerted hydrostatic pressure and confine the material within a dedicated space.

F. Placement of flowable fill shall start only when weather conditions are favorable. The temperature shall be at least 35 degrees F and rising. Flowable fill shall not be placed on frozen ground or when it is raining.

3.4 CURING AND PROTECTION

A. Immediately after placement, protect flowable fill from premature drying, excessively hot or cold temperatures and mechanical injury.

B. The flowable fill shall not be subjected to load and shall remain undisturbed by construction activities for at least 24 hours after placement.

3.5 FIELD QUALITY CONTROL

A. The Subcontractor shall provide a engineer approved, certified, independent testing agency to perform compressive strength test cylinders.

B. For field testing use a standard (15 lb) T-post driver to drive a #6 reinforcing bar with a flat end into the flowable fill material 24 hours after placement. Lift the driver until the bottom of the driver is even with a mark located 6 inches below the top of the rebar and then allow it to fall under its own weight. Remove and replace the flowable fill if fewer than 6 blows or more than 25 blows are required to drive the rebar 12 inches into the fill.

C. Provide unobstructed access to work and cooperate with appointed firm.

3.6 DEFECTIVE FLOWABLE FILL

A. Do not accept or place defective flowable fill that is not in conformance with acceptance criteria. Return the fresh flowable fill to the supplier.

B. Defective flowable fill is material having excessive honeycomb, embedded debris, higher than maximum compressive strength, or not conforming to required lines, details, dimensions, tolerances or specified requirements. Repair or replace defective flowable fill as directed by the engineer.

C. Replace flowable fill not in conformance with details, tolerances, and other construction requirements at Contractor’s expense.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 DESCRIPTION

Supply and install reinforcing steel as shown on the drawings and as specified.

1.2 APPLICABLE CODES, STANDARDS AND SPECIFICATIONS

The installation of concrete reinforcement shall be in accordance with the following codes and standards:

A. Florida Building Code 2006 with 2009 Supplement

B. Concrete Reinforcing Steel Institute (CRSI)

C. American Concrete Institute (ACI).

D. American Society for Testing and Materials (ASTM).

1.3 SHOP DRAWINGS

Provide bar schedules and placing lists or fabrication drawings in accordance with ACE 315 for all steel for Engineer's review prior to fabrication. Clearly indicate construction joints, openings, bar arrangement, bar spacing and splicing. Include sketch of typical mill marks and deformations on reinforcing bars. Furnish copies to the Engineer for approval.

1.4 STORAGE

Reinforcing steel shall be clean, new stock, properly marked and tagged for identification prior to placing. Store reinforcing steel to avoid excessive rusting or coating with grease, oil, dirt or other objectionable materials.

PART 2 MATERIALS

2.1 REINFORCEMENT AND FABRICATION

A. Reinforcing Bars: Shall be deformed conforming to ASTM A615 GR 60.

B. Reinforcement shall be supported by suitably sized dense pre-cast concrete blocks for concrete poured on grade. For concrete members exposed to the elements or a corrosive environment, the reinforcement shall be supported by either plastic coated or stainless steel chairs.

C. Ties: Shall be No. 16 gauge minimum, fully annealed, black steel wire.

D. Hooks and Bends in Reinforcing: Shall conform to ACI 315 unless otherwise shown on the drawings.

PART 3 EXECUTION

3.1 PLACING REINFORCING STEEL

A. Fabrication, detailing and placement of reinforcing steel shall conform to CRSI Manual of Standard Practice, ACI 315 and ACI 318. Reinforcement shall be carefully placed, rigidly supported and well tied with bar supports and spacers.

B. Reinforcement shall be accurately placed and securely tied at intersections with 16 gauge black annealed wire. It shall be maintained in proper position by chairs, bar supports, or other devices approved by the Engineer.

C. All splices shall be as shown on the drawings.

D. Concrete protection shall be as shown on drawings.

E. The clear distance between parallel bars in a layer shall be the nominal diameter of the bar, but not less that one inch. Wherever conduits, piping, inserts or sleeves interfere with the placing of reinforcing steel as shown, the Contractor shall consult with the Engineer before pouring concrete. The bending or field cutting of bars around openings or sleeves will not be permitted.

F. Clean bars of loose scale, heavy deposits or rust and oil, wax or other coatings that may reduce or destroy bonding before placing. Check and clean again if necessary before concrete is poured.

G. Dowel column and wall reinforcing to footing or pile cap with same size and number of dowels as vertical bars above.

H. Dowels shall be hooked “L” at bottom and shall be lapped as indicated in the plans with the column or wall reinforcing above.

I. Concrete columns shall be tied columns unless otherwise indicated.

3.2 COORDINATION

Coordinate work with other trades in order to eliminate interference before concrete is poured. Do not cast concrete until all reinforcing has been inspected and permission to pour is granted by the Engineer.

3.3 CLEAN UP

In accordance with General Conditions.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, concrete mix designs and submittals required by ACI 301.

B. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.

C. Comply with ACI 301, "Specification for Structural Concrete"; ACI 117, "Specifications for Tolerances for Concrete Construction and Materials"; and CRSI's "Manual of Standard Practice."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed.

B. Plain Steel Wire: ASTM A 82, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, as drawn, flat sheet.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

E. Portland Cement: ASTM C 150, Type I or II.

F. Fly Ash: ASTM C 618, Type C or F.

G. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

H. Silica Fume: ASTM C 1240, amorphous silica.

I. Aggregates: ASTM C 33, uniformly graded.

J. Synthetic Fiber: ASTM C 1116/C 1116M, Type III, polypropylene fibers, 1/2 to 1-1/2 inches (13 to 38 mm) long.

K. Air-Entraining Admixture: ASTM C 260.

L. Chemical Admixtures: ASTM C 494, water reducing, high-range water reducing and water reducing and retarding. Do not use calcium chloride or admixtures containing calcium chloride.

M. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures.

N. Vapor Retarder: Reinforced sheet, ASTM E 1745, Class A.

O. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

P. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

Q. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

R. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

S. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.2 MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 5000 psi at 28 days for all other structural components.
2. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete at or below grade.
3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 3 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture 4, plus or minus 1 inch (25 mm).
4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of floor slabs to receive troweled finishes to exceed 3 percent.
5. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 20 percent.
6. For concrete exposed to deicing chemicals, limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; silica fume to 10 percent of portland cement by weight.

C. Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 CONCRETING

A. Construct formwork according to ACI 301 and maintain tolerances and surface irregularities within ACI 347R limits of Class A, 1/8 inch (3.2 mm) for concrete exposed to view and Class C, 1/2 inch (13 mm) for other concrete surfaces.

B. Place vapor retarder on prepared subgrade, with joints lapped 6 inches (150 mm) and sealed.

C. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

D. Install construction, isolation, and contraction joints where indicated. Install full-depth joint-filler strips at isolation joints.

E. Place concrete in a continuous operation and consolidate using mechanical vibrating equipment.

F. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.

G. Formed Surface Finish: Smooth-formed finish for concrete exposed to view, coated, or covered by waterproofing or other direct-applied material; rough-formed finish elsewhere.

H. Slab Finishes: Comply with ACI 302.1R for screening, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces. Provide the following finishes:
   1. Troweled finish for floor surfaces and floors to receive floor coverings, paint, or other thin film-finish coatings.

I. Cure formed surfaces by moist curing for at least seven days.

J. Begin curing concrete slabs after finishing. Keep concrete continuously moist for at least seven days or apply membrane-forming curing compound to concrete. Contractor to verify curing materials and methods acceptable to flooring (high performance coating) manufacturer. Contractor to consult with coating specialist and verify existing slab coating compatible with new coating. Refer to Section 09960 for High Performance Specification and Coatings.

K. Contractor will engage a testing agency to perform field tests and to submit test reports.

L. Protect concrete from damage. Repair surface defects in formed concrete and slabs.

END OF SECTION

SECTION 09850

PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, tools, materials, supervision and equipment necessary to do all the work specified herein and as required for a complete installation.

1.02 GENERAL INFORMATION AND DESCRIPTION

A. The term "paint," as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, cement filler, cement-latex filler and other coatings, whether used as prime, intermediate, or finish coats.

B. All paint for concrete and metal surfaces shall be especially adapted for use around wastewater treatment plants and shall be applied in conformance with the manufacturer's published specifications.

C. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to sewage gases, especially to hydrogen sulfide and to carbon dioxide. Pigments shall be materials which do not tend to darken, discolor, or fade due to the action of sewage gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.

D. Coatings used in conjunction with potable water supply systems shall have U.S. Environmental Protection Agency (EPA) and FDA approval for use with potable water and shall not impart a taste or odor to the water.

E. All building, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less then one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to exterior and interior concrete, structural steel, miscellaneous metals, steel and aluminum doors and frames, concrete block, ductwork, sluice gates, operators, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.

F. Baked-on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, toilet partitions, lockers, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum, stainless steel, fiberglass and bronze work shall not be painted unless color coding and marking is required or otherwise specified. A list of surfaces not to be coated is included in this Section.

G. The Contractor shall obtain all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970".

1.03 MANUFACTURERS

A. All painting materials shall be as manufactured by Tnemec, Carboline, Ameron, or approved equal.

1.04 SUBMITTALS

A. The Contractor shall submit paint manufacturer's data sheets, application instructions, and samples of each finish and color to the Engineer for review, before any work is started in accordance with Section 01330 entitled, "Submittals."

B. Submitted samples of each finish and color shall be prepared so that the area of each sample indicates the appearance of the various coats. For example, where a three-coat system is specified, the sample shall be divided into three areas indicating one coat only, two coats and all three coats. The Engineer will provide written authorization constituting a standard, as to color and finish only, for each coating system.

C. The Contractor shall prepare a complete schedule of surfaces to be coated and shall identify the surface preparation and paint system he proposes to use. The Paint Schedule shall be in conformance with Article 3.03 of this Section and the Contract Drawings. The schedule shall contain the name of the paint manufacturer, and the name, address and telephone number of the manufacturer's representative that will inspect the Work. The schedule shall be submitted to the Engineer for review as soon as possible following the Notice to Proceed so that the schedule may be used to identify colors and to specify shop painting systems on order for fabricated equipment.

1.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of his product both in the shop and field. The Contractor, through the manufacturer's representative, shall submit his report to the Engineer at the completion of his Work identifying the products used and verifying that said products were properly applied and that the paint systems were proper for the exposure and service.

B. Services shall also include, but not be limited to, inspecting prior coatings of paint, determination of best means of surface preparation and inspection of complete work.

1.06 MANUFACTURER'S INSTRUCTIONS

A. The manufacturer's published instructions for use as a guide in specifying and applying the manufacturer's proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before acceptance of the manufacturer's instructions is given by the Engineer.

B. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meets the following requirements:

1. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application

of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.

2. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended; that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following:

   a. Methods of application
   b. Number of coats
   c. Thickness of each coat
   d. Total thickness
   e. Drying time of each coat, including primer
   f. Primer required to be used
   g. Primers not permitted
   h. Use of a primer
   I. Thinner and use of thinner
   j. Temperature and relative humidity limitations during application and after application
   k. Time allowed between coats
   l. Protection from sun
   m. Physical properties of paint including solids content and ingredient analysis
   n. Surface preparation
   o. Touch up requirements and limitations

C. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating.

1.07 QUALITY ASSURANCE

A. The Contractor shall give the Engineer a minimum of three days advance notice of the start of any field surface preparation work of coating application work.

B. All such Work shall be performed only in the presence of the Engineer, unless the Engineer has specifically allowed the performance of such Work in his absence.

C. Review by the Engineer, or the waiver of review of any particular portion of the Work, shall not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.

D. Where special coatings are to be performed by a subcontractor, the Contractor shall provide five references which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems. Include the name, address,

and the telephone number for the Owner of each installation for which the painting subcontractor provided the protective coating.

1.08 SAFETY AND HEALTH REQUIREMENTS

A. In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets, the Contractor shall provide and require use of personnel protective and safety equipment for persons working in or about the project site.

B. All paints must comply with the requirements of the National Ambient Air Quality Standards.

1.09 SURFACES NOT TO BE COATED

A. The following items shall not be coated unless otherwise noted:

1. Stainless steel.
2. Galvanized checkered plate.
3. Aluminum handrails, walkways, windows, louvers, grating and checkered plate.
4. Flexible couplings, lubricated bearing surfaces and insulation.
5. Packing glands and other adjustable parts of mechanical equipment.
6. Finish hardware.
7. Plastic switch plates and receptacle plates.
8. Signs and nameplates.

1.10 ADDITIONAL PAINT

A. At the end of the project, the Contractor shall turn over to the Owner a gallon can of each type and color of paint, primer, thinner or other coating used in the field painting. If the manufacturer packages the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with type labels indicating brand, type, color, etc. The manufacturer's literature described the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.11 SHIPPING, HANDLING AND STORAGE

A. All painting materials shall be brought to the job site in the original sealed labeled containers of the paint manufacturer and shall be subject to review by the Engineer. Where thinning is necessary, only the product of the manufacturer furnishing the paint shall be used. All such thinning shall be done strictly in accordance with the manufacturer's instructions, and with the full knowledge of the Engineer.

B. Materials and their storage shall be in full compliance with the requirements of pertinent codes and fire regulations. Receptacles shall be placed outside buildings for paint gates and containers. Paint waste shall not be disposed of in plumbing fixtures, process drains or other plant systems or process units.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Table 09850-1 depicts the coatings referenced in Article 3.03 of this Section entitled, "Paint Schedule". Table 09850-1 lists Tnemec products as a reference. Equivalent products by the manufacturers listed in Article 1.03 of this Section may be submitted for review.

TABLE 09850-1

PRODUCT LISTING

Ref. No.	Description	MANUFACTURERS REFERENCE Tnemec
103	Epoxy Mastic	135 - Color
104	Polyamidoamine Epoxy Primer	N69 - 1211
105	Polyamidoamine Epoxy	N69 - Color
110	Endura Shield III	73 - Color
111	Modified Waterborne Acrylate	157 - Envirocrete (Sand Texture if required)
114	Waterborne Polyamide Epoxy	151 - Elasto-Grip

PART 3 -- EXECUTION

3.01 SURFACE PREPARATION

A. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale and all foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless acceptable to the Engineer or specified herein.

B. Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the Steel Structures Painting Council (SSPC). Where Steel Structures Painting Specifications are referred to in these Contract Documents, the corresponding Pictorial Surfaces Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in accordance with the appropriate Specification SP-1 through SP-10.

C. Weld flux, weld spatter and excessive rust scale shall be removed by power tool cleaning as per SSPC-SP-3-63.

D. Threaded portions of valve and gate stems, machined surfaces which are limited for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze

trim on slide gates and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated or galvanized items shall not sandblasted unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to the sandblasted shall be sandblasted in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

E. Hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place prior to cleaning and painting, and not intended to be painted, shall be protected or removed during painting operations and repositioned upon completion of painting operations.

F. Any abraded areas of shop or field applied coating shall be touched up with the same type of shop or field applied coating, even to the extent of applying an entire coating, if necessary. Touch-up coating and surface preparations shall be in addition to and not considered as the first field coat.

G. Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the Engineer.

H. Exposed Pipe

1. Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated ferrous pipe which is inadvertently installed in exposed locations shall be sandblasted to SSPC-SP-5 White Metal before priming and painting.

2. After installation and prior to finish painting, all exterior, exposed flanged joints shall have the gap between adjoining flanges and gaps between the pipe wall and threaded-on flanges sealed with a single component Thiokol caulking to prevent rust stains.

I. Ferrous Metal Surfaces

1. All ferrous metal surfaces not required to be galvanized shall be cleaned of all oil grease, dirt, rust and tight and loose mill scale by blasting in accordance with the following: SSPC-SP-5, White Metal Blast Cleaning and comply with the visual standard NACE 1, for submerged metal. SSPC-SP-10 Near White Metal Blast Cleaning, and comply with the visual standard NACE 2 for all other locations. Pickling, complying with SSPC-SP-8, may be substituted for Near White Blast in areas as determined by the Engineer. Priming shall follow sandblasting before any evidence of corrosion occurs, before nightfall and before any moisture is on the surface.

2. Existing painted ferrous metal surfaces shall be cleaned of all oil, grease and dirt by blasting with a minimum 2,500 psi high pressure blast. All rust shall be removed in accordance with SSPC-SP-3 and spot primed with the applicable primer.

J. Field surface preparation of small, isolated areas such as field welds, repair of scratches, abrasions or other marks to the shop prime or finish shall be cleaned by power tools in accordance with SSPC-SP-3, or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2 and spot primed.

K. Primed or Coated Surfaces and Non-Ferrous Surfaces

1. All coated surfaces shall be cleaned prior to application of successive coats. All non-ferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.

L. Shop Finished Surfaces

1. All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be prepared in accordance with SSPC-SP-2, Hand Tool Cleaning and then touched up with the same materials as the shop coat.

2. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up, in the opinion of the Engineer, shall be repainted. Cut edges of galvanized sheets, electrical conduit, and metal pipe sleeves, not to be finish painted, shall be cleaned in accordance with SSPC-SP-1, Solvent Cleaning and primed with zinc dust-zinc oxide metal primer.

M. Galvanized and Copper Alloy Surfaces

1. All copper, or galvanized metal surfaces shall be brush blasted and given one coat of epoxy primer.

N. Concrete and Masonry Surfaces

1. Concrete and masonry surfaces to be painted shall be prepared by removing efflorescence, chalk, dust, dirt, grease, oil, form coating, tar and by roughening to remove glaze. All surfaces shall be repaired prior to commencement of the coating operation.

2. Concrete and masonry surfaces are to be cured for at least 28 days prior to coating them.

O. Existing Painted Concrete and Masonry Surfaces

1. Existing painted concrete and masonry surfaces requiring paint as identified herein shall be prepared by applying high pressure water blast to the existing painted surface to remove all loose paint, chalk, dust, dirt, grease, oil, latents, and other foreign materials. Cracks, chips or voids in the existing concrete shall be repaired in accordance with paint manufacturer recommendations.

Q. PVC Pipe Surfaces

1. All pipe surfaces shall be lightly sanded before painting.

3.02 SHOP PAINTING

A. All fabricated steel work and equipment shall receive at the factory at least one shop coat of prime paint compatible with the paint system required by these Specifications. The Contractor shall coordinate all shop priming to ensure compatibility with paint system specified. Surface preparation prior to shop painting shall be as specified. Finish coats may be applied in the shop as specified or if acceptable to the Engineer. All shop painted items shall be properly packaged and stored until they are incorporated in the Work. Any painted surfaces that are damaged during handling, transporting, storage or installation shall be cleaned, scraped, and patched before field painting begins so that Work shall be equal to the original painting received at the shop. Equipment or steel Work that is to be assembled on the site shall likewise receive a minimum of one shop coat of paint at the factory. Surfaces of exposed members that will be inaccessible after erection shall be prepared and painted before erection.

B. The Contractor shall specify the shop paints to be applied when ordering equipment in order to assure compatibility of shop paints with field paints. The paints and surface preparation used for shop coating shall be identified on shop drawings submitted to the Engineer for review. Shop paint shop drawings will not be reviewed until the final project paint system has been submitted by the Contractor and reviewed by the Engineer.

C. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer if it can be demonstrated to the Engineer that the paint system is equal to and compatible with the paint system specified. However, all pumps, motors and other equipment shall receive at least one field applied finish coat after installation.

3.03 PAINT SCHEDULE

A. The Contractor shall adhere to this paint schedule, providing those paints named or equal. DFT shall mean the minimum dry film thickness per application measured in mils. Products are referenced by numbers listed in Article 2.01 of this Section entitled "Product Listing." The paint schedule identifies the minimum DFT required per coat. If the Contractor does not achieve the specified DFT range in a single coat, he shall provide additional coats as necessary at no additional cost to the Owner.

B. Metal Surfaces, Exterior or Interior Exposure

1. Metal surfaces that do not come into contact with wastewater including the following types of surfaces shall be painted as described below:

    a. New and modified pumps, motors, process equipment, machinery, etc.
    b. Above ground piping, valves and pipe supports.
    c. Structural steel, miscellaneous steel shapes, angles, etc.
    d. Exposed surfaces of conduit, ductwork, etc.

Ferrous Metal

Application	No.	Description	DFT
First -1 coat	104	Epoxoline Primer	3.0 - 5.0
Second - 1 coat	105	Hi-Build Epoxoline	2.0 - 3.0
Finish - 1 coat	110	Endura Shield	2.0 - 3.0
		Min. Total	9.0 Mils

Non-Ferrous Metal

Application	No.	Description	DFT
First - 1 coat	105	Hi-Build Epoxoline	2.0 - 3.0
Second - 1 coat	110	Endura Shield	2.0 - 3.0
		Min. Total	5.0 Mils

Galvanized

Application	No.	Description	DFT
First – 1 coat	115	Aromatic Urethane, Zinc-Rich	2.0 – 3.5
First - 1 coat	105	Hi-Build Epoxoline	2.0 - 3.0
Second - 1 coat	110	Endura Shield	2.0 - 3.0
		Min. Total	7.5 Mils

C. New Concrete Surfaces (Walls and Coating) and Existing Concrete, Stucco and Masonry Surfaces requiring Touch-Up caused by Contractor's Construction Activities:

1. Paint colors and color scheme shall match existing. Contractor shall confirm compatibility of proposed coating with existing coating system.

Application	No.	Description	DFT
First - 1 coat	114	Waterborne Polyamide Epoxy	1.0 - 2.5
Brush - 1 coat*	111	Modified Waterborne Acrylate	4.0 - 6.0
Finish - 1 coat	111	Modified Waterborne Acrylate	6.0 - 9.0
		Min. Total	12.0 Mils

* (Apply a brush coat of TNEMEC Series 157 Enviro-Crete into all exposed cracks prior to application of finish coat.)

D. Existing Painted Exterior and Interior Pumps, Equipment, Piping, Valves, Fittings and Supports Requiring Touch-Up Caused by Contractor's Construction Activities.
Existing modified painted exterior and interior piping, pumps, valves, fittings, supports, shall also be painted as described below:

1. Paint colors and color scheme shall match existing. Contractor shall confirm compatibility of proposed coating with existing coating system.

Application	No.	Description		DFT
First - 1 coat	103	Epoxy Mastic		3.0 - 5.0
Finish - 1 coat	110	Endura Shield		2.0 - 3.0
			Min. Total	8.0 Mils

3.04 PAINTING

A. All paint shall be applied by experienced painters with brushes or other applicators acceptable to the Engineer.

B. Paint shall be applied without runs, sags, thin spots, or unacceptable marks. Paints shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Additional coats of paint shall be applied, if necessary, to obtain thickness specified.

C. Paint shall be applied with spraying equipment only on those surfaces approved by the Engineer. If the material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed-on material. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint shall be used; and all such thinning shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.

D. Surfaces not accessible to brushes or rollers may be painted by spray by dauber or sheepskins and paint mitt. If any of these methods is to be used, it shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.

E. Drying Time

1. A minimum of twenty-four hours drying time shall elapse between application of any two coats of paint on a particular surface unless shorter time periods are a requirement of the manufacturer or specified herein. Longer drying times shall be required for abnormal conditions as defined by the manufacturer.

F. Weather Restrictions

1. No painting whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees Fahrenheit or above throughout the entire drying period. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 50 degrees Fahrenheit within 18 hours after the application of the paint.

2. Dew or moisture condensation should be anticipated; and if such conditions are prevalent, painting shall be delayed until midmorning to be certain the surfaces are dry. The day's painting shall be completed well in advance of the probable time-of-day when condensation will occur.

G. Inspection of Surfaces

1. Each and every field coat of priming and finishing paint shall be inspected by the Engineer or his authorized representative before the succeeding coat is applied. The Contractor shall follow a system of tinting successive paint coats so that no two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall in such cases be tick-marked with white or actually gauged as to thickness when finished.

H. Before application of the prime coat and each succeeding coat, any defects or deficiencies in the prime coat or succeeding coat shall be corrected by the Contractor before application of any subsequent coating.

I. Samples of surface preparation and of painting systems shall be furnished by the Contractor to be used as a standard throughout the job, unless omitted by the Engineer.

J. When any appreciable time has elapsed between coatings, previously coated areas shall be carefully inspected by the Engineer, and where, in his opinion, surfaces are damaged or contaminated, they shall be cleaned and recoated at the Contractor's expense. Recoating times of manufacturer's printed instructions shall be adhered to.

K. Coating thickness shall be determined by the use of a properly calibrated "Nordson-Mikrotest" (or equal) dry mil thickness gauge.

L. The Contractor shall provide free of charge to the Engineer two new "Nordson-Mikrotest" dry film gauges to be used to inspect coating by Engineer and Contractor. One gauge may be used by Contractor and returned each day to the Engineer. Engineer will return gauges to Contractor at completion of job.

M. Special Areas

1. All surfaces which are to be installed against concrete, masonry etc., and will not be accessible for field priming and/or painting shall be back primed and painted as specified herein, before erection.

N. Special attention shall be given to insure that edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of the adjacent painted surfaces.

O. Safety

1. Respirators shall be worn by persons engaged or assisting in spray painting. The Contractor shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the Work.

P. Quality Workmanship

1. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect the Work whenever such covering is necessary, or if so requested by the Owner. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the

entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the Owner.

Q. Painting found defective shall be scraped or sandblasted off and repainted as the Engineer may direct. Before final acceptance of the Work, damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

3.05 SCHEDULE OF COLORS

A. All colors shall be as designated by the Engineer at the shop drawing review. The Contractor shall submit color samples including custom color choices as required to the Engineer as specified in Article 1.04 of this Section. The Contractor shall submit suitable samples of all colors and finishes for the surfaces to be painted, or on portable surfaces when required by the Engineer. The Engineer shall decide upon the choice of colors and other finishes when alternates exist. No variation shall be made in colors without the acceptance from the Owner. Color names and/or numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.06 COLOR CODING AND LETTERING OF PIPING

A. The Contractor shall paint all piping, valves, equipment, exposed conduits and all appurtenances which are integral to a complete functional mechanical pipe and electrical conduit system. Where colors are not designated for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.

B. In general, the pumps and equipment shall be painted the same color as the piping system to which it is connected unless otherwise directed by the Engineer. Where colors are not designated for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.

C. Lettering of Piping

1. The Contractor shall apply identification titles and arrows indicating the direction of flow of liquids to all types and sections of all new and existing connected or adjacent plant piping. Titles shall be as directed by the Engineer. Identification titles 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 feet in pipe length and shall be properly inclined to the pipe axis to facilitate easy reading. Titles shall also appear directly adjacent to each side of any wall or slab the pipeline passes through.

D. The titles shall be painted by use of stencils and shall identify the contents by complete names at least once in each area through which it passes and thereafter be abbreviated.

E. Title color shall be black or white as directed and shall have an overall height in inches in accordance with Table 09850-1. Letter type shall be Helvetica Medium upper case. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application. For piping less than 3/4-inch diameter (as identified in Table 09850-1), the Contractor shall furnish and attach corrosion resistant color tags with the required lettering.

3.07 FLOW ARROWS

The Contractor shall install self-sticking directional flow arrows on all exposed piping. The arrows shall be designed for exterior use in direct sunlight and shall be sized for the pipe. The arrows shall be installed on maximum of 5 foot intervals and at changes in direction. The Contractor shall submit manufacturer's information and schedule for flow arrows to Engineer for approval.

3.08 OSHA SAFETY COLORS

A. Items listed in ANSI Z53.1-1971, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; wall mounted breathing apparatus, danger signs and locations; and stop bars, buttons or switches. In addition all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.

B. Items listed in ANSI Z53.1-1971, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.

3.09 WORK IN CONFINED SPACES

A. The Contractor shall provide and maintain safe working conditions for all employees. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans, or by direct air supply to individual workers. Paint fumes shall be exhausted to the outside from the lowest level in the contained space.

B. Electrical fan motors shall be explosion proof if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done.

3.10 CLEANING

A. The buildings and all other Work area shall be at all times kept free from accumulation of waste material and rubbish caused by the Work. At the completion of the painting, all tools, equipment, scaffolding, surplus materials, and all rubbish around the inside the buildings shall be removed and the Work left broom clean unless otherwise specified.

TABLE 09850-1

HEIGHT OF PIPING LETTERING

Diameter of Pipe or Pipe Covering	Height of Lettering
3/4 to 1-1/4 inches	1/2 inch
1-1/2 to 2 inches	3/4 inch
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

Notes:

1. *Letter type shall be Helvetica Medium upper case. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application.*

2. *For piping less than 3/4-inch diameter (as identified in Table 09850-2), the Contractor shall furnish and attach corrosion resistant color tags with the required lettering.*

END OF SECTION

SECTION 09960

HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Interior Substrates:

a. Concrete horizontal surfaces. Products used for horizontal surfaces are to be designed for forklift traffic.

B. Related Sections include the following:
1. Division 09 painting Sections for special-use coatings and general field painting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of finish-coat product indicated.

C. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

A. Master Painters Institute (MPI) Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

B. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each type of coating and substrate.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Engineer at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings in rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Floor Coatings: VOC not more than 100 g/L.

C. Colors: As selected by Engineer from manufacturer's full range.

2.2 Epoxy Coating

A. Epoxy, Cold-Cured, Gloss: Master Painters Institute #77.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following or approved equal:
   a. Benjamin Moore & Co.; Polyamide Epoxy Coating, M36/M37.
   b. California Paints; H. P. Industrial, Tile-Cote Polyamide-Epoxy Coating, 12XX/1200.
   c. Cloverdale Paint; ClovaCoat 300, 833.
   d. Columbia Paint & Coatings; Insl-x, Insl-Tile II, EP-5300.
   e. Coronado Paint; Polyamide Epoxy Coating, 101 Line.
   f. Frazee Paint; Ameron, 72HS.
   g. Miller Paint; PPG Aquapon, Epoxy Cold Cured - Gloss, 95-1.
   h. Porter Paints; Porterglaze 4000, Gloss Epoxy, 4000.
   i. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Cold Cured Gloss, 95-1.
3. VOC Content: Minimum E Range of E1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   a. Concrete: 12 percent.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi (10 350 to 27 580 kPa) at 6 to 12 inches (150 to 300 mm).

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:

1. Contractor will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with specified requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces.

1. Epoxy Coating System:

a. Prime Coat: Epoxy, cold-cured, gloss, MPI #77.
b. Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
c. Topcoat: Epoxy, cold-cured, gloss, MPI #77.

END OF SECTION

SECTION 11380

TURBO BLOWERS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes furnishing; installing and placing into successful operation six turbo blower systems complete with accessories and appurtenances. It is anticipated the six blower systems will be installed in three sequential phases. Each phase will be provided under a separate County construction contract. Refer to the Bid Schedule and Section 01120 for additional information. Each blower shall be provided with an inlet filter, inlet silencer, outlet flexible joint, outlet silencers, back flow barrier, manual isolation valve, blow-off valve and silencers, motor cooling air outlet silencer, acoustic sound enclosure, VFD, local panel, magnetic bearings and other appurtenances as described in this Specification Section needed for a complete system. The same supplier shall furnish the turbo blowers, accessories and appurtenances.

1. Each single-stage radial centrifugal turbo blower is to be designed to provide absolutely oil-free air to the aeration system.

2. The turbo blower and local control cabinet shall be shall be mounted on a common base plate.

3. A UL listed VFD shall vary the turbo blower speed to provide continuous flow control and power optimization according to the changes in the process (air flow and differential pressure) and ambient conditions (ambient temperature and relative humidity) automatically without operator interface when the controls are in the remote mode.

4. The speed of the blowers shall be varied using either the local Touchpad or the Master Control Unit to assure the turbo blower(s) are operating at maximum efficiency.

5. Accessories and appurtenances shall be as shown on the Contract Drawings and described in the Contract Specifications.

B. Refer to Sections 01110, 01120 and 16850 for information and requirements regarding sequence of work and different work phases and stages. The turbo blowers' local SCADA control shall also be completed in phases and stages.

1.02 REFERENCES

A. The turbo blower, accessories and appurtenances shall be in accordance with the referenced standards listed below.

1. American Iron and Steel Institute (AISI).

2. American National Standards Institute (ANSI).
3. International Standards Organization (ISO) 5389: 1992 – Turbo blowers.
4. VDI 2045: 1993 – Acceptance and Performance Tests on Turbo Compressors and Displacement Compressors.
5. ASME PTC 10 – 1974, reaffirmed 1986 Compressors & Exhausters.

1.03 SYSTEM DESCRIPTION

A. Design Requirements

1. Site conditions
   a. Elevation: 10 feet (above sea level)
   b. Inlet air temperature range: 30 ^{o}F to 105 ^{o}F
   c. Relative humidity range: 40 % to 95 %
2. Quantity: Contract Phase 1 — 2 blowers (See Section 01120)
3. Quantity: Contract Phase 2 — 2 blowers (See Section 01120)
4. Quantity: Contract Phase 3 — 2 blowers (See Section 01120)
5. Range of Air flow rate per blower: 2,000 to 4,000 scfm
6. Total design air flow rate Phase 1 — 16,000 scfm
7. Total design air flow rate Phases 1 & 2 — 24,000 scfm
8. Differential pressure: 9.7 psi
9. Motor horsepower per blower: 250 hp
10. Maximum design speed: 26,100 rpm maximum

B. Motor Design Requirements

1. The high-speed permanent magnet type motor shall be as follows:

   a. Motor horsepower per blower: 250 hp maximum
   b. Volts/Phase/Hertz: 480 volts/3 phase/60 hertz
   c. Motor speed: 26,100 rpm maximum
   d. Enclosure: IP33D

1.04 DEFINITIONS

A. Continuous operation shall be defined as 24 hour per day 7 days per week operation

B. Intermittent operation shall be defined as periodic operation, including unlimited starts and stops or be out of operation for extended periods of time. Stops are defined as 0 RPM of rotor and shaft.

C. Each turbo blower system shall be defined as a single-stage high-speed centrifugal turbo blower with an integral high speed unit, internal inlet silencer, internal outlet silencer variable frequency controller, blow off valve and internal silencer, local control cabinet, internal controller, magnetic bearing controller and non-contacting magnetic bearing system, all mounted in a single cabinet enclosure on a common skid. Each turbo blower system shall also include a remotely mounted Master Control Unit and a separate harmonic filter as described in this Section.

1.05 SUBMITTALS

A. Product Data: Submit data completely describing the turbo blower system products and listings of all components and accessories with materials of construction including but not limited to the following:

1. Manufacturer's experience including full compliance with Article 2.01 of this Section.

2. Turbo blower operating characteristics over the entire speed range and complete specifications.

3. Motor characteristics and specifications.

4. All other information required or specified elsewhere in this Specification Section and in Sections 01330, 01600 and 09850.

5. Materials of construction for all major turbo blower components and accessories.

6. Weight of turbo blower assembly including turbo blower, motor and control cabinet as well as the individual weights of all accessories.

7. Installation instructions including leveling, alignment, pre-start up checklist and initial startup procedures.

8. Proposed surface preparation and factory coatings for all painted surfaces.

9. Proposed manufacturer's factory test procedure.

B. Shop Drawings

1. Certified dimensional drawings of the turbo blower unit assembly including accessories and appurtenances shall be provided.

2. Certified anchor bolt layout drawings.

3. Instrumentation, control system schematic, all electrical and control components wiring diagrams including the Master Control Unit.

4. All dimensional drawings necessary to coordinate piping layout with structural, architectural, and/or other mechanical work.

5. Certified turbo blower wiring diagrams including the local control panel located in the turbo blower door and the VFD.

6. Manufacturer's Affidavit of Compliance. Refer to Sections 01330 and 01600 for additional information and requirements.

7. Draft Installation, Operation and Maintenance Manual as described in Section 01830. Manual shall be prepared specifically for the proposed model, accessories and appurtenances.

C. Quality Assurance Submittals

1. Performance Test Reports signed by the manufacturer's test engineer shall be submitted after fabrication of complete package unit, but prior to shipment of the turbo blowers. Tests shall be performed on each complete package only, as testing of core units only will not be acceptable. Tests shall be conducted on each turbo blower package. Refer to Article 2.07 in this Section.

    a. Results of each test shall be summarized in a separate, certified, standard factory written test report.

    b. Reports shall be organized and clearly present testing methods and procedures, testing equipment used as well as the test data. A copy of the report shall be placed in a metal holder that is part of the electrical cabinet door for reference.

    c. One copy of each certified written test report shall be submitted to the Engineer for review and acceptance. Test reports shall be reviewed and accepted by the Engineer prior to shipment unless the Engineer or Owner waive this requirement.

    d. Certified test report(s) should include the following:

        1. Performance curves that includes air flow rate in scfm versus kw input/ horsepower and air flow rate in scfm versus rpm curves for each turbo blower
        2. Hydrostatic test results.
        3. Dynamic balancing test results for each turbo blower.

D. Additional Submittal Data Required Prior to Start-Up

1. Operation and Maintenance Manuals

    a. Prepare final operation and maintenance manuals for the entire turbo blower system, including accessories and appurtenances called out in this Specification Section and Section 01830.

    b. Provide Project Record Documents showing as-built dimensions, as-built wiring and control diagrams, as-built logic diagrams and design information for the turbo blower(s) and accessories supplied being supplied.

    c. Provide a description of the internal turbo blower control system.

    d. Provide panel drawings, wiring diagrams, specifications, and a detailed description of the internal turbo blower control panels.

1.06 QUALITY ASSURANCE

1. Conduct certified performance testing on each turbo blower as outlined in this specification.

2. Tests shall be conducted using the actual turbo blowers being supplied. Test results from previous models or similar sized turbo blower shall are not acceptable.

3. All tests shall be conducted at the manufacturer's factory on each complete turbo blower package. Testing of cores separately from the package shall not be acceptable.

4. If the certified factory tests indicate noncompliance with the requirements of the Contract Documents, the turbo blowers shall be reworked and retested at the manufacturer's expense until compliance with the Specifications is attained.

1.07 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

1. Protect equipment during shipment in accordance with manufacturer's recommendations and the Contract Documents.

B. Storage and Protection

1. Protect each turbo blower system components and accessories at the project site during on-site storage and during installation as noted below and as per manufacturer's instructions.

2. If any turbo blower or its appurtenances is to be stored on-site prior to installation, the following conditions for that equipment must be maintained at all times:

a. Each turbo blower skid and its appurtenances must be continuously stored either in a Contractor provided weather-tight enclosure with humidity control or, if authorized, an existing SCWRF building (except for the North and South blower rooms). Storage in an existing SCWRF building will require prior approval by the SCWRF plant manager.
b. Ambient temperature: +30 F to +110 F
c. Maximum relative humidity <95%.
d. Store the battery pack of the magnetic bearing controller separately and in a fully charged condition, in a cool room with temperature below 75° F and humidity below 70%.

3. Maximum storage time is 6 months.

1.08 EXTENDED WARRANTY

A. Provide manufacturers' extended warranty on each unit for a period of five years after completion of successful functional and performance testing on each unit. Warranty shall include on-site repair and replacement as required as well as all labor, freight, loading and unloading charges.

1.09 SPARE PARTS AND TOOLS

A. Special Tools

1. If needed, provide 1 set of special tools required for complete assembly or disassembly of the turbo blower system and accessories.

2. Special tools shall be defined as any tool not typically necessary for general plant maintenance.

B. Spare Parts

1. For each Project Phase as described in Article 1.01.A of this section, the turbo blower system manufacturer shall furnish the following spare parts labeled and packed for long term storage as specified in Section 01600. Spare parts shall be as follows:

a. One complete sets of main process air filters.
b. One complete sets of cooling air filters.
c. One UPS for Master Control Unit.
d. One spare VFD unit complete.
e. One turbo blower controller.
f. One turbo blower HMI.
g. One Profibus communication card for Master Control Unit.
h. One over-voltage protector unit.
i. One magnetic bearing controller.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Each turbo blower system shall be the ABS Turbocompressor Model HST 20 as manufactured by Sulzer Pump Solutions US, Inc., Meriden, CT and as specifically described in this Specification Section or an equal product meeting all requirements of the Contract Documents.

B. Turbo blower system manufacturer shall have a minimum of 15 years experience in the design and manufacture of turbo blowers using magnetic bearing technology.

C. Turbo blower system manufacturer shall have a minimum of 9 years of installed product experience in the United States with turbo blowers using magnetic bearing technology.

D. Turbo blower system manufacturer shall provide a list of references (name, location and current owner contact information) of at least ten operating installations at five different facilities currently using the same or similar model and drive configuration as is being proposed.

E. Turbo blower system manufacturer shall have a minimum of 50 installed and operating units in the United States.

F. The manufacturer of the turbo blower system shall have at least 10 years of installed product experience using the same high-speed motor manufacturer.

2.02 GENERAL

A. Turbo blowers shall be of single-stage centrifugal design utilizing oil free non-contacting magnetic bearing technology with the following design characteristics.

1. Turbo blowers shall be designed for heavy, continuous, industrial service, be capable of providing a minimum of 60 starts per hour and have a minimum design life of 20 years before any major rebuild will be needed.

2. Operate within specified vibration levels without overloading the drive motor.

3. The rotor shall remain levitated at all times while power is being supplied to the turbo blower. Turbo blowers with rotors that rest on bearings while in the stand-by mode with power supplied to the turbo blower shall not be considered as an equal.

4. Operate without sign of distress when operating at specified operating point and at off design conditions.

5. Have a pressure-volume curve, which extends from the design system pressure to the upper system surge pressure with a continuously rising pressure characteristic.

6. Will not surge at or above specified flow rates corresponding to specified differential pressure.

7. The maximum input motor horsepower should not exceed specified nameplate horsepower when operating at design flows at 40 degrees C.

8. The turbo blower must deliver oil-free and non-pulsation air at all times to the aeration process.

9. The motor and control cabinet components are to be air cooled using ambient air only. Systems that use water cooling are not acceptable or equal.

10. Wire to water power must include all motor, thermal, mechanical and electrical losses of the turbo blower as well as losses of all auxiliary equipment such as all lubrication systems, cooling systems etc.

B. Minimum flow of each turbo blower must be no greater than 45% of the maximum flow rate over the entire temperature range.

C. Rotor critical speed must be a minimum of 20% above the operating design speed.

D. Maximum unfiltered peak-to-peak radial or axial displacement of the rotor shaft shall not exceed 1.25 mils at all operating speeds when measured on the motor or the turbo blower base.

E. Free field (R=infinity) sound pressure level without accessories shall not exceed 70 dBA at any point 3 feet from the turbo blower assembly when operating at specified air flow rates and differential pressure.

F. Local Control Panel (LCP)

1. The local control panel (touchpad and display) shall be located on the turbo blower control cabinet door. This LCP is connected to the internal high speed controller and functions only as an interface using a touchpad and display unit that allows the turbo blower to be operated manually and displays all information needed to operate the turbo blower. In addition the LCP will be intuitive, user friendly, allowing customization of monitoring as process control.

2. A touchpad based mode control shall be provided to select the turbo blower operating mode (Master Control Unit, local touchpad, start and stop) as part of the LCP.

G. Variable Frequency Drive (VFD)

1. A UL approved VFD shall be used to control the speed of the turbo blower. It will communicate with the internal controller that has surveillance and control software that controls the turbo blower(s) operation in accordance with signals received from the Master Control Unit and the Local Control Panel.

H. Heaters

1. The cabinet enclosure and the motor for each turbo blower shall each be equipped with low voltage space heaters to reduce the potential for interior condensation.

2.03 MATERIALS

A. Major turbo blower components shall be manufactured from the following materials.

1. Casings and Inlet Inducer: High-strength aluminum alloy, A1Si7Mg-T6.
2. Impellers: High-strength forged aluminum alloy.
3. Rotor Shafts: Alloy steel with permanent magnetic motor.
4. Turbo blower and Motor Frame: Welded steel.
5. Inlet and outlet accessories: Hot dipped galvanized steel flanges.
6. Expansion Joints: AISI 316SS.
7. Check Valve : AISI 316SS/EPDM.

2.04 TURBO BLOWER

A. High-Speed Unit

High-speed unit shall consist of an integrated turbo blower – permanent magnet electric motor assembly, with the following components:

1. Impeller and Spiral Volute Casing

a. The impeller shall be shaped from a solid forging on a numerical machining center using CAM technology to ensure consistent efficiency. Semi-open impeller design with 3 dimensional shaped blades optimized for the design range of each turbo blower. The impeller shall be attached directly to the motor shaft using an aircraft technology fastener system without a coupling or keyway. A labyrinth and O-ring seal arrangement on the bottom of the impeller shall provide a non-contact seal between the volute and motor. The impeller shall be a standard design configuration. Special impellers designed for a specific duty point shall not be considered acceptable or equal.

b. The spiral valute casing with horizontal intake and vertical discharge connection shall be provided with intake and discharge flanges in accordance with and manufactured to DIN 2576, PN 10 standards.

c. The turbo blower inlet inducer shall be integral to the volute.

2. High-Speed Electric Motor

a. An air-cooled, VFD compatible, high speed, special duty electric permanent magnet motor specifically designed for high-speed service shall be provided.

b. The motor shall have Class F winding insulation (with Class H on critical components) with thermal sensors that are tied into the thermal protection surveillance software built into the blower control system.

c. The motor rotor shaft shall be supported by magnetic bearings at all times while power is supplied to the turbo blower providing a smooth vibration free rotation over the entire speed range. Blowers that use bearing systems that contact stationary parts either during start up or if electrical power is lost are not acceptable.

d. The motor shall be air cooled by a cooling fan that is mounted directly to the end of the motor rotor shaft. Units that are cooled by anything other than ambient air shall not be considered as an equal.

e. The motor and high speed unit shall be mounted to a welded steel base/frame separated by rubber mounts.

3. Magnetic Bearing System

a. The magnetic bearing controller shall be manufactured by the manufacturer of the turbo blower system.

b. The motor rotor shaft shall be continuously levitated in a magnetic field by the digitally controlled magnetic bearing system when power is on. This system shall consist of two radial and two axial active magnetic bearings, two rotor position sensors and a magnetic bearing controller (MBC). The position sensors shall continuously measure the shaft position and send a signal to the MBC controlling the energy in the active magnetic bearings keeping the motor rotor shaft levitated and centered. There shall be no mechanical contact at any time between any moving and stationary surfaces during the turbo blower

operation eliminating friction and wearing of all moving parts. The magnetic bearing system shall not require any oil lubrication.

c. Blowers that use bearing systems that contact stationary parts either during start up or if electrical power is lost are not acceptable.

d. The magnetic bearing controller shall have a maximum input power of 1.3 hp (1 kW).

4. Noise Enclosure

a. The high speed unit shall be enclosed in a noise reduction system that reduces the noise levels to less than 70 dBA. This enclosure shall be easily removable for inspection of the high speed unit using socket head screws.

B. Blower Enclosure

1. Access to the VFD and MBC and control components shall be through panels on the side of the turbo blower. The enclosure shall be a minimum 12 gauge steel with locking bolts but still allowing quick access. The enclosure shall have at a minimum IP33D rating.

2. The cabinet shall be painted using a phosphate treatment system with a zinc chromate iron oxide primer with a baked rust-inhibiting enamel topcoat.

3. Louvers on the enclosure shall be used to provide cooling air to the control cabinet and high speed unit.

4. The equipment mounted within the control side of the enclosure shall be mounted on the enclosure back panel and neatly organized.

C. Variable Frequency Drive

1. A UL rated variable frequency drive shall be installed in the control cabinet to vary the speed of the turbo blower providing optimal turbo blower efficiency at all plant operational demands. The VFD along with the internal controller's software shall automatically control the turbo blower performance based a signal from either an air flow meter(s) or, if in local mode, directly from the local control panel (keypad on the turbo blower door).

2. The VFD shall be a VACON NXP High Performance model; 6 pulse variable speed drive adequately sized for the turbo blower motor and mounted inside the integral control cabinet.

D. Local Control Panel (LCP)

A. Local Control Panel is mounted on the turbo blower front panel and consists of a touchpad with display that shall perform the following functions:

1. Display the turbo blower operating parameters.

The turbo blower functions shall be monitored continuously during operation and communicated to the LCP where the following values are displayed.

Code	To Be Checked	Unit
n1	Actual Flow Volume	%
n2	Output pressure	psi
n3	Inlet pressure	psi
n4	Operating time in hours	HH,hh
n5	Operating time in days	PP,pp
n6	MWh counter	MWh
n7	Differential pressure at motor cooling air filter	psi
n8	Reference flow volume	%
n9	Turbo blower model	xxxxx
n10	Program version	xx
n11	Motor supply frequency	Hz
n12	Current	A
n13	Inverter temperature	ºF
n14	Motor temperature	ºF
n15	Inlet temperature	ºF

2. Fault and Alarm

The turbo blower system is continuously monitored to assure the turbo blower and its control systems are functioning correctly. If the monitoring system detects something that is not functioning properly either an alarm or a fault message appears in the control panel display. If the fault is not critical to the safe operation of the turbo blower an alarm message will be displayed and the turbo blower will continue to operate. If the fault is critical to the safe operation of the turbo blower a fault message will be displayed and the turbo blower will be automatically taken out of service until the reason for the fault is acknowledged and/or corrected.

The detection system shall automatically monitor the following conditions:

a. Power Supply Status:
   1) Over voltage in main power supply
   2) Under voltage in main power supply
   3) One phase missing
   4) Over/under voltage in auxiliary power supply
b. Process Air Inlet and Outlet:
   1) Blockage in the inlet or outlet air piping
   2) Overpressure
   3) Inlet air temperature too high (surge)
c. Cooling Air Inlet and Outlet:
   1) Blockage in the inlet or outlet air piping
   2) Cooling air over temperature via motor/VFD over temperature monitoring.
   3) Motor temperature

4) VFD temperature
5) Magnetic bearing controller temperature

3. Flow Control

The local control system shall allow adjustments of the turbo blower flow while either operating or stopped when in local mode and the “flow set” light is illuminated. If the turbo blower is in operation, adjustments can be made at any time. Any resulting change in the reference flow volume setting shall take effect immediately. If the turbo blower is stopped, adjustments can be made at any time. Changes in the reference flow volume setting shall take effect the next time the turbo blower is put into service.

The turbo blower’s volume flow control shall be based on an indirect flow volume measurement via an internal load-proportional signal in the control card located in the VFD. The limits (surge limit, max pressure ratio limit, power limit and speed limit) for these signals shall be programmed into the application software. The inlet air temperature effects shall be considered when determining these limits.

The 100% reference flow shown on the keypad corresponds to the turbo blower’s maximum specified volume flow at existing plant ambient conditions.

Speed and power limits shall be established and controlled by the VFD programming and parameter settings.

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E. Blow Off Valve

1. A blow off valve shall be an integral part of the turbo blower system protecting it during start up and shut down conditions. It shall be a pneumatically controlled, plug type valve that is controlled by each turbo blower’s internal control system.

   a. The blow off valve and silencer shall be an integral part of the turbo blower, be mounted on the inside of the enclosure and adequately sized to handle the flow and pressures seen during start up and shut down.

F. Uninterruptible Power Supply (UPS) for MBC

1. Each turbo blower is supplied with an uninterruptible power supply (UPS) system that provides a secondary source of power for the magnetic bearings and MBC. This system is a back up to the power generation mode feature that is the first line of safety if a power outage occurs assuring that the turbo blower will spin down without damaging the high speed unit.

2. Power Generation Mode: In case of electric black out, the motor begins to operate as a generator. The rotating energy of the rotor is turned to DC-voltage. The MBC will receive a power supply from the VFD intermediate circuit. This will keep the MBC powered until the unit is brought to a stop.

3. The UPS shall have batteries sufficiently sized and compatible with the MBC to provide a safe spin down until the unit is fully stopped and have a monitoring panel that will indicate the condition of the batteries. When batteries' status is below limits, the MBC will provide a local and SCADA alarm. Under battery alarm conditions, the turbo blower cannot be started.

2.05 ACCESSORIES AND APPURTENANCES

A. General

1. All accessories and appurtenances listed in this Specification Section are to be supplied by the turbo blower manufacturer as part of the turbo blower system to ensure system compatibility. Each specified accessory should be furnished as completely assembled as possible and installed as indicated on the submittal and shop drawings for each turbo blower.

B. Master Control Unit

1. A Master Control Unit (MCU) shall control multiple turbo blowers using a stand-alone Compact Logix PLC by Allen Bradley providing process air into two headers having the same system pressure requirements. The MCU will control the group of turbo blowers to maintain operation at their optimal efficiency as the process demands fluctuate. The MCU must be compatible with the site SCADA/PLC network, have a 4 point analog input card that monitors the delivery pressure and mass air flow from two air flow transmitters. An Allen Bradley Panelview color touch screen shall be provided with the MCU connected through an onboard Allen Bradley Ethernet switch. The MCU will provide a surge suppressed 24VDC power source for the loop powered header pressure transmitter 4-20 ma input. The MCU will be supplied with an Allen Bradley Ethernet E-Tap switch for conversion from the RJ45 copper connection on the PLC to the field fiber optic cable.

   The MCU shall receive a 4-20 mA analog signal from a pressure sensor in the main air header and from two air flow meters; Mass Air Flow North and Mass Air Flow South The Mass Air Flow monitoring will include HART protocol diagnostic information. The MCU shall totalize the air flow signals and communicate control data to each turbo blower using a closed loop daisy chain Profibus protocol. In addition the MCU shall communicate data to an existing communication system using Ethernet I/P protocol to monitor each turbo blower status, reset alarms, etc.

   The Master Control Unit, HMI, and marshalling for the I/O and communications will be assembled into a single NEMA12 wall mounted enclosure approximately 3 feet square by 1 foot deep. The MCU shall include a UPS battery backup, UPS bypass switch and surge suppression.

   The Allen Bradley Logix software PLC control program shall be adequately documented and annotated and shall be provided to the Owner for future modifications.

2. The turbo blower system Master Control Unit (MCU) will provide for remote operator manual control or automatic air flow control for the turbo blowers. The plant's Control Room Operator, through the plant SCADA system, will be capable of placing the turbo blowers into a remote (computer manual) mode such that each blower can be manually started, stopped, and speed set to a fixed value from the plant SCADA screen.

   The MCU will automatically regulate the amount of airflow to the aeration basins by adjusting the number of turbo blowers in operation and by modulating the blower speeds. The airflow PID control residing in the plant SCADA computer will send the airflow demand output signal to the MCU to increase or decrease the delivered flow rate.

   The MCU will total the airflow rates from each operating turbo blower and automatically match the airflow demand signal originating in the plant SCADA system. The MCU will add and subtract turbo blower units and raise and lower VFD unit speeds to match the airflow demand on the most economic basis.

   The MCU will provide an automatic lead/lag turbo blower scheduler based on unit run time. Automatic start of a turbo blower will be based on the lowest total unit run time. Shutdown of a turbo blower will be based on highest unit run time.

3. Refer to Section 16850 for information and requirements relating to turbo blower operation and controls simultaneously with operation of existing blowers. Also refer to Section 01120 for additional information and requirements.

C. Expansion Joints

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1. An outlet expansion joint shall be installed as close as possible to the turbo blower outlet flange as shown on the plan drawings. It shall have Type 304 stainless steel flanges and bellows. It shall have a minimum axial movement of ±0.79 in (±20mm) and lateral movement of ±0.16 in (±4mm) and a maximum axial force of 225 lbf (1000N).

D. Main Air Inlet Filter

1. An internal or external filtration system shall be provided for each turbo blower as indicated on the Contract Drawings and as specified below if room air is used. Each filter system shall be adequately sized for the airflow rate of each turbo blower. The filter system shall either be internal to the blower enclosure or a separate filter housing containing all filter elements with door for easy access. The access door shall be sealed to prevent air infiltration and sufficiently sized to allow easy access to the filters.

2. The filters for external air inlet filter shall be pocket Camfil Hi-Cap having a high density microfine glass fiber filter medium suitable for high efficiency filtration that has a EN779:2002:G4 standards filter class that is mounted on a

galvanized steel frame with a hook and lever arrangement for easy replacement.

E. Inlet Silencer

1. An inlet silencer shall be provided for each turbo blower and be internal to the blower enclosure. Each inlet silencer shall be adequately sized for each turbo blower.

F. Outlet Silencer

1. A flanged outlet silencer shall be provided for each turbo blower inside the blower enclosure. Each outlet silencer shall be adequately sized for each turbo blower.

G. Check Valves

1. A check valve shall be provided with each turbo blower as indicated on the Contract Drawings. It shall prevent back flow into the turbo blower and be installed directly after the expansion joint as indicated on the Contract Drawings.

2. The check valve shall be a high performance wafer type non-slam single flapper check valve with a cast CF8M body, a cast CF8M clam type plate, a CF8M hinge pin, a metal to metal sealing surface, a minimum temperature rating of 302 ^{o}F (150^{o}C) and have a maximum pressure loss of 0.077 psi (534 Pa). Dual flap check valves shall not be considered equal.

H. Shut Off Valve

1. A flanged manual short body lug type butterfly shut off valve shall be provided for each turbo blower as indicated on the plan drawings. The shutoff valve shall be equipped with a handwheel and geared for ease of operation. It shall be installed in the discharge pipe to isolate the turbo blower from the process.

2. The manual butterfly shut off valves shall have a cast iron body, a 316 SS disc, 420SS pivot shaft and an EPDM seal, a minimum 248 ^{o}F (120 ^{o}C) temperature rating and a maximum 0.006 psi (41 Pa) pressure loss.

I. Air Pressure, Temperature and Flow Measurement

1. Provide pressure sensors on the inlet and outlet piping of each turbo blower internal to the blower enclosure.

2. Provide temperature sensors in the inlet and outlet piping and a temperature sensor on the motor for each turbo blower, internal to the blower enclosure.

3. Provide a mass flow meter measurement to each blower.

J. Harmonic Filter – Provided by Owner/Installed by Contractor

1. The harmonic filter shall be a passive series connected low pass filter consisting of an inductor capacitor network. Active electronic components shall not be used. The harmonic filter shall be manufactured by MTE Corporation, Menomonee Falls, WI, or approved equal. The harmonic filter shall treat all characteristic low frequency harmonics generated by a three phase full wave converter load (5^{th}, 7^{th}, 11^{th}, 13^{th}, etc.) The characteristic harmonics shall be suppressed without need for individual tuning or the requirement to phase shift against other harmonic sources.

2. The harmonic filter model supplied shall be capable of feeding a three phase input rectifier with or without line reactors, with or without a DC link choke, with or without a combination line reactor and DC link choke. The harmonic filter model supplied shall be capable of feeding a rectifier composed of diodes, thyristors or any combination thereof.

3. The harmonic filter shall meet the harmonic performance specification with a three percent phase voltage unbalance as defined in ANSI C-84.1-1995. The harmonic filter shall not resonate with the power distribution system nor attract harmonics from other sources. The filter shall be listed per UL-508.

4. In the operating range from full load to half load the power factor shall be 0.98 lagging to 0.95 leading. The harmonic filter in combination with the adjustable frequency drive shall meet all requirements specified in the 1992 edition of IEEE standard 519 for individual and total harmonic voltage and current distortion. The Point of Common Coupling (PCC) for all voltage and current harmonic calculations and measurements shall be the input terminals of the harmonic filter.

5. Total Demand Distortion (TDD) of the current at the input terminals of the harmonic filter shall not exceed the limits defined in Table 10-3 of IEEE-519.

6. Total Harmonic Voltage Distortion (THVD) shall meet the requirements of Table 10-2 of IEE-519. The harmonic filter supplier shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.

7. The full load efficiency of the harmonic filter shall be greater than 98 percent. When fed from a power distribution system operating at the nominal distribution voltage, the harmonic filter output voltage at no load shall not be more than 4.6 percent higher than the nominal RMS and peak distribution voltage. When fed from a power distribution system operating at the nominal distribution voltage, the harmonic filter output voltage at full load shall not be less than the nominal RMS utilization voltage. At no load the harmonic filter shall not cause the voltage at the Point of Common Coupling (PCC) to rise by more than two percent. To assure that voltage source PWM inverters do no experience over voltage trips, the harmonic filter shall not cause the inverter bus voltage to increase by more than 5% when the filter is operating from the nominal distribution voltage. To assure that the filter will not reduce the life of a voltage source inverter's bus capacitor, the output current waveform of the harmonic filter and the input current waveform of the inverter shall be consistent with the

input waveform of an inverter fed from a drive equipped with a 3% minimum impedance line reactor.

8. Provide harmonic filter with optional capacitor disconnect. Provide a contactor to disconnect the filter capacitor bank based on the motor load current. Provide two current operated switches with independent adjustment of the pick-up and drop current levels. The switches are preset at the factory for pick up at 35% and drop out at 20% of the filter output current rating. Provide current switches field adjustable over a 0 – 100% current range. Provide 480Vac to 120Vac control transformer with fusing for control of the contactor. All wiring shall be copper. The harmonic filter shall be installed in an enclosure with a NEMA 3R rating.

9. The Contractor shall unload, store and install the Owner supplied harmonic filter in accordance with the manufacturer's recommended installation practices as found in the manufacturer's User Manual. Installation shall comply with all applicable local codes. Filters shall be fully tested prior to shipment.

2.06 NAMEPLATE DATA

A. A stainless steel, engraved nameplate shall be provided on each turbo blower. The nameplate shall be mounted easily visible and contain the following information.

1. Vendor's Name
2. Model Type and Serial Number
3. Year Manufactured
4. Weight
5. Main Power Supply
6. Auxiliary Power Supply
7. Enclosure

2.07 MANUFACTURER'S FACTORY TESTING

A. Certified Factory Tests

1. General

a. Conduct performance testing on each turbo blower as outlined below. Testing must be done on the complete turbo blower package. No testing of cores outside the complete turbo blower package will be acceptable.

b. All tests shall be conducted at the turbo blower manufacturer's factory.

c. If the certified factory tests indicate noncompliance with the requirements of this Contract Documents, the turbo blowers shall be reworked and retested at the manufacturer's full expense until compliance with the Contract is attained.

2. Impeller Balancing/Vibration Test

   a. Conduct static balancing of impeller units prior to turbo blower shaft assembly.
   b. Conduct dynamic balancing of complete turbo blower rotary assembly.

   c. Impeller and rotor shall be balanced to provide a maximum rotor shaft deflection of less than 20 µm. Provide certified test report for each unit.

   d. Maximum vibration amplitude when operating at maximum design speed.

   e. Submit certified static and dynamic balancing test results for each turbo blower.

3. Performance Tests

   a. Performance tests will be conducted in accordance with ISO 5389 ("Turbo blower's performance test code") and VDI 2045 ("Acceptance and Performance Tests on Turbo Compressors and Displacement Compressors"), Part 1 and Part 2. Measuring of mass flow is made according to VDI 2041 ("Orifice Plates and Nozzles for Special Applications"), chapter 5.2 with a ISA 1932 nozzle, made according to DIN 1952 and ISO 5167 standard ("Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full").

   b. A written statement that the turbo blower meets the specified performance requirements shall be included as a part of the submitted certified test report.

   c. Conduct performance testing in conformance with the above standards and as supplemented by the requirements specified herein:

      1. Conduct performance tests at 9 test points on each turbo blower. Two of these points shall bracket the rated point.
      2. Conduct performance tests at additional points at test conditions equivalent to the full range between specified turbo blower operating limits.

   d. In addition to the data specified above, each test report shall contain the following:

      1. A copy of certified input power data from 50% to 100% full load.

      2. Data showing performance at rated speed vs. discharge pressure from lowest system pressure to maximum pressure. The performance shall be shown in terms of standard cubic feet per minute and brake horsepower required at the input shaft of the turbo blower. The data shall be for the inlet conditions specified in the Performance Requirements section of this Specification and corresponding to operation at rated inlet conditions. Surge points shall be indicated.

e. Prior to conducting the tests, submit the proposed test procedure for review.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the turbo blower system in accordance with manufacturer's recommendations found in the Installation Manual and any addendums including alignment of components, mounting level and connections.

3.02 INSPECTION

A. Visually inspect each turbo blower system for shipping damage and to ensure that all materials and equipment arrived undamaged and are in general conformance with the Contract Documents.

B. The following detailed inspection of each turbo blower installation shall be completed before that turbo blower is started.

1. Piping and accessories are properly aligned.
2. All accessories are adequately supported per the specification and drawings.
3. The turbo blower is adequately grounded per the manufacturer's installation instructions.
4. The turbo blower anchor bolt and all accessory fasteners are properly torqued.
5. Assure that all electrical systems are proper connected and terminals are tight.

3.03 FIELD QUALITY CONTROL

A. <u>Inspection and Check-out – Contractor's Functional Test: Required for Each Turbo Blower System</u>

1. Refer to Section 01750 for additional information and requirements.

2. Prior to operating the turbo blower, complete the inspection as outlined in Paragraphs 3.01 and 3.02, test all support systems, including but not limited to power systems, control systems, piping systems, safety systems, Owner supplied electric harmonic filter (and both flow meters for the Phase 1 Contract), etc.

3. Complete electrical system shall be tested to ensure proper function.

4. Instrumentation and Controls

a. A complete functional test of the internal instrumentation and control systems.
b. A complete functional test of the MCU and communications between each blower system and the MCU.
c. Set operational limits (start/stop, etc.) and alarm and shutdown limits as needed.

5. Inspect piping to assure it is clean and free of any contaminants that may harm the turbo blower.

6. Vibration Test: The turbo blower shall be operated from minimum to maximum speed and the rotor shaft shall demonstrate that the deflection shall not exceed 20 µm throughout this operating speed range and shown graphically on computer printout.

7. Complete all functional start-up and test activities including verification of all alarms, set-points, shut-down and start-up procedures and SCADA system control. The functional test shall include loss and re-establishment of power from the local electrical utility company as well as operation using the SCWRF stand-by electric generators.

8. The turbo blower tests shall be deemed failed if an unintended shutdown occurs or the control system does not respond as it should or vibration is in excess of the specified value. Minor on-line adjustments and tuning of instrumentation, where approved by the Engineer, are not considered a failure.

9. If during the testing the turbo blower fails any of the tests, the cause of the failure will be corrected and the testing repeated until no failures occur.

B. Owner Demonstration – Functional Start-Up and Testing

1. Repeat all aspects of Contractor's Functional Start-up and Testing of each blower system.

2. Refer to Section 01750 for additional details, information and requirements.

C. Performance Test – 14 Continuous Days

1. Run each turbo blower system continuously for 14 continuous days to demonstrate satisfactory performance, local and SCADA control, and reliability. During at least 50 percent of the 14 day period, the blower(s) must be operated trouble-free using only SCADA control from the SCWRF control room.

2. Run each turbo blower from minimum to maximum specified flows using local control and the SCADA system.

3. Record temperatures, pressures, and flows.

4. During the 14 day Performance Test, demonstrate again that all safety features including all available SCADA system functionality as well as loss and re-establishment of power from the local electrical utility company including operation using the SCWRF stand-by electric generators.

D. Manufacturer's Field Service

1. Each manufacturer's field representative or technician will be required to obtain a Collier County security badge, which usually takes one to two days. Refer to Section 01540 for additional information and requirements.

2. A factory trained and authorized field representative shall check out and inspect each turbo blower system before the Contractor's Functional Start-up and Testing and certify that the system has been correctly installed and prepared for start-up. The anticipated time for this work shall be one full day per turbo blower system. Refer to the Bid Schedule for pricing and quantity information.

3. A factory trained and authorized field representative shall be present for the Contractor's Functional Start-up and Testing. Factory representative shall insure proper operation of system protection devices including vibration, temperature, and current alarms as well as interlocks with pre-surge. The anticipated time for this work shall be one full day per turbo blower system. Refer to the Bid Schedule for pricing and quantity information.

4. A factory trained and authorized field representative shall be present for the Owner Demonstration Functional Test of each blower system. The anticipated time for this work shall be two full days for the Contract Phase 1 and one full day for Contract Phases 2 and 3 as described in Section 01120. Refer to the Bid Schedule for pricing and quantity information.

5. The representative shall also be present for at least part of the 14 day Performance Test of each turbo blower system. The anticipated time for this work is one full day for each Project Phase as described in Section 01120. Refer to the Bid Schedule for pricing and quantity information.

6. For the Contract Phase 1 as described in Section 01120, the factory trained and authorized field representative shall also provide training for Owner's personnel in the operation and maintenance of the blower systems. The anticipated time for the training shall be two full days. The first day of training shall occur after the first turbo blower system has completed the Owner Demonstration Functional Test. Refer to the Bid Schedule for pricing and quantity information.

7. Refer to Sections 01600 and 01750 for additional information and requirements.

END OF SECTION

SECTION 15020

PIPE SUPPORTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, and installation of all pipe supports, hangers, guides, and anchors shown, specified, or required for a complete and operable piping system, in accordance with the requirements of the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI / ASME B31.1 Power Piping.

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings: The Contractor shall furnish complete shop drawings of all pipe supports, hangers, anchors, and guides, as well as calculations for special supports and anchors, in accordance with Section 01330 Submittals. Calculations shall be signed and sealed by a registered Florida Professional Engineer.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Code Compliance: All piping systems and pipe connections to equipment shall be properly supported, to prevent undue deflection, vibration, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1, except as supplemented or modified by these Specifications. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code, or local administration requirements.

B. Structural Members: Wherever possible, pipes shall be attached to structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor at no additional cost to the Owner. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction.

C. Support Spacing: Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending and shear stresses in the piping, with special consideration given where components, such as flanges and valves, impose concentrated loads. Spacing of supports shall be as specified herein and/or indicated on the Drawings.

D. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow for free expansion and contraction of the piping, and shall prevent excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the supported pipe. Hangers subject to shock, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading, only.

E. Hangers Subject to Horizontal Movements: At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

F. Spring-Type Hangers: Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. The support shall be designed for a maximum variation in supporting effort of 25 percent for the total travel resulting from thermal movement.

G. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints. They shall permit the piping to expand and contract freely in directions away from the anchored points and shall be structurally suitable to withstand all loads imposed.

H. Heat Transmission: Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment

I. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

J. Freestanding Piping: Freestanding pipe connections to equipment, like chemical feeders, pumps, etc., shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams anchored to the structure. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps, securing the pipes.

K. Pipe Supports: All piping shall be supported with hangers, brackets, clips, or fabricated supports and anchors manufactured of Type 316 stainless steel, unless otherwise shown.

L. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, fiber glass, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on plastic and fiber glass piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

M. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material, at each pipe support, bracket, clip, or hanger.

2.02 MANUFACTURED SUPPORTS

A. Stock Parts: Where not specifically shown or detailed, designs, generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Such parts shall new, of best commercial quality, designed and rated for the intended purpose. See Article 2.03 of this Section for pipe support materials in chemical containment areas.

B. Suppliers, or equal:

1. Basic Engineers, Pittsburgh, PA;

2. Bergen-Paterson Corp., Boston, MA;

3. Elcen Metal Products Company, Franklin Park, IL;

4. ITT-Grinnell Corp., Warren, OH;

5. NPS Industries, Inc., Secaucus, NJ.

2.03 NON – METALLIC SUPPORT SYSTEM

A. Non-metallic supports in locations and as specifically required shall be a heavy duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins.

B. All fiberglass construction shall include suitable ultraviolet inhibitors for exterior UV exposure and shall have a flame spread rating of 25 or less per ASTM E84.

C. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin.

D. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal.

E. Unless otherwise shown or specified the Contractor shall provide support spacings in the conformance with the pipe and support system manufacturer’s requirements.

F. The Contractor shall submit data on the support types and sizes for approval.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and

ANSI/ASME B31.1. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance: Pipe supports and hangers shall be positioned in such a way as to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other Work.

C. Pipe Support Spacing: The distance between supports for each size of pipe shall not exceed those listed in the attached schedule. However, if the pipe size to be supported is not listed in the schedule, the next smaller nominal pipe size spacing shall be used. In all cases, there shall be a minimum of one support per laying length of pipe on uninterrupted horizontal runs. This support shall be placed within one foot of the joint. If the pipe manufacturer recommends a smaller spacing interval than specified herein, then the manufacturer's spacing shall be used.

D. The distance between supports shall not exceed that listed in the following schedule unless otherwise noted:

Table 15020-1
Pipe Support Spacing Requirements

Nominal Pipe Size (inch)	**Metallic Piping** (feet)	**Plastic, Fiberglass and Copper Piping** (feet)
½	5	3
3/4 to 1-1/2	6	3
2 to 3	6	4
4	10	5
6 and larger	10	5

3.02 FABRICATION

A. Quality Control: Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

END OF SECTION

SECTION 15110

VALVES AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

Requirements for furnishing and installing valves, valve operators and accessories as specified in this Section and shown on the Contract Drawings.

1.02 REFERENCES

A. ANSI Standards

1. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 125
2. ANSI B16.3 Malleable Iron Threaded Fitting, Class 125 and 300
3. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

B. ANSI/AWWA Standards

1. ANSI/AWWA C111/A21.1 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
2. ANSI/AWWA C500 Gate Valves
3. ANSI/AWWA C504 Rubber Seated Butterfly Valves
4. ANSI/AWWA C508 Swing Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS.
5. ANSI/AWWA C509 Resilient-Seated Gate Valves 3 through 12 Inch NPS, for Water and Sewage Systems

C. ASTM Standards

1. ASTM A126 Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
2. ASTM A276 Specification for Stainless Steel and Heat-Resisting Steel Bars and Shapes
3. ASTM A351 Specification for Steel Castings, Austenitic, for High-Temperature Services
4. ASTM A743 Specifications for Castings, Iron-Chromium, Iron-Chromium-Nickel and Nickel-Base Corrosion Resistant for General Applications

D. MSS Standards

E. ANSI/NSF Standards

ANSI/NSF 61 Drinking Water System Components-Health Effects

F. Collier County Utilities Standards Manual, latest edition with revisions.

1.03 DEFINITIONS

A. Exposed Valves: Valves that are not buried. Exposed valves include valves outdoors aboveground, valves in buildings, valves on the interior of tanks, valves in the interior of vaults and valves in the interior of pits.

B. Size: References to valve sizes on the Contract Drawings and in the Specifications are intended to be nominal size, and shall be interpreted as nominal size.

1.04 SUBMITTALS

A. General: As specified in Section 01600 - Material and Equipment and Section 01330 – Submittals

B. Manuals as specified in Section 01830 – Operation and Maintenance Data

1.05 WARRANTIES

A. General: As specified in Section 01600 - Material and Equipment and Section 01780 – Warranties and Bonds

B. The Contractor shall warranty all valves, valve operators and appurtenances to be free from defects in material and workmanship for a minimum period of one year as noted in the Contract requirements, and furnish and install any such items found to be defective within the warranty period.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide valves suitable to the intended service as defined in Division 15 - Mechanical and to meet the standards of the Owner.

B. Provide valves with joints suitable to connect to adjoining piping.

C. Exposed Valves

1. Exposed valves shall be provided with valve operators, levers, handwheels, chainwheels and chains, extension stems, bonnet extensions, floor stands, and other accessories as shown or specified.

2. If distance from operating floor or platform to valve operating wheel is less than six feet, valve or valve operator shall be furnished with a handwheel. If the distance from the operating floor or platform to valve operating wheel is 60 inches or more, the valve or valve operator shall be furnished with a chainwheel and chain. Chains shall terminate four feet above operating floor or platform.

3. Effort required to operate valve lever shall not exceed 40 pounds applied at the extreme grip position of the lever. Effort required to operate valve handwheel shall not exceed 40 pounds applied at the extremity of the

handwheel. Effort required to operate valve chainwheel shall not exceed 40 pounds applied to the chain.

4. Handwheels on valves 14” and smaller shall not be less than 8” in diameter. Handwheels on valves larger than 14” shall not be less than 12” in diameter. Handwheels shall be ductile iron. Aluminum handwheels are not acceptable.

5. Operators shall have open direction clearly and permanently marked. Operators for shut-off valves shall have position indicators.

6. Exposed valves shall have integrally cast flanged joints that meet the dimension requirements of ANSI B16.1.

D. Buried Valves

1. Buried valves shall be provided with operators, valve boxes, bonnet extensions, floor stands, and other accessories as shown or specified.

2. Buried valves with valve boxes shall be provide with extension stems.

3. Buried shut-off valves shall have position indicators. Buried valves with exposed operators shall have position indicator on valve operators. Buried valves with valve boxes shall have position indicator on extension stem beneath valve box lid.

4. Buried valves with motor actuators shall have an extended bonnet to locate the actuator above ground and a First-Fail shear pin located above ground in an easily accessible location. Refer to details on the Contract Drawings.

5. Buried valves shall have mechanical joints that meet the requirements of ANSI/AWWA C111/A21.1 and these specfications.

E. Operators, General

1. Unless otherwise shown or specified, valves 6” and smaller shall have lever operators. Valves 8” and larger shall have gear-assisted operators.

2. The valve manufacturer shall also provide valve operators. Valve operators shall be installed, adjusted, and tested by the valve manufacturer at the valve manufacturer's plant.

3. Operators, unless otherwise specified, shall turn counter-clockwise to open.

2.02 CHAINWHEEL OPERATORS

A. Chainwheel operator shall be fabricated of cast iron with epoxy coated pocketed type chainwheels with chain guards and guides.

B. Operators shall have Type 316 stainless steel smooth welded link type chain. Chain that is crimped or has links with exposed ends shall not be acceptable.

C. Chainwheel operators shall be marked with an arrow and the word OPEN indicating direction to open.

2.03 VALVE BOXES

A. Valve boxes shall be adjustable telescope type, adjustable to grade. Valve boxes shall be asphalt varnished cast iron, or enameled cast iron, suitable to withstand heavy traffic. Bases shall be the round type.

B. Valve box covers shall be marked either "WATER", "REUSE" or "SEWER", depending on service.

C. Valve boxes shall be Model No. F-2452, as manufactured by James B. Clow & Sons, Mueller or equal.

2.04 VALVE LABELING

A. Label all exposed valves exclusive of hose bibs and chlorine cylinder valves.

B. Labels shall be square or rectangular, 2” across the flats, minimum and shall be permanently attached to the valve or on a wall adjacent to the valve.

C. Labels for exterior valves shall be 1/16” stainless steel. Labels for interior valves shall be 1/16” stainless steel or plastic. Text as provided by the Engineer shall be permanently engraved on the label.

D. Label all underground valves as shown in the Contract Drawings.

2.05 LIMIT SWITCHES

Provide limit switches on valves where limit switches are indicated on the Instrumentation Drawings.

2.06 BALL VALVES

A. Manufacturers

1. Polyvinyl Chloride (PVC and CPVC) true union ball valves shall be manufactured by Asahi/America, Spears or Heyward.
2. Stainless steel ball valves shall be manufactured by Contromatics, Jamesbury Corporation, Jenkins Bros., Lunkenheimer Flow Control, WM Powel Company or Worchester Controls.

B. PVC or CPVC Ball Valves

1. PVC and CPVC ball valves shall be double union type or flanged with a working pressure of 150 psi, with lever operators.
2. The valve bodies, end pieces, balls and stems shall be constructed of Type 1, Grade 1, PVC or CPVC. The seats shall be constructed of teflon and the seals constructed of Viton. The seals for CPVC ball valves in sodium hydroxide application shall be EPDM. The handles shall be PVC.
3. The ends shall be NPT for sizes up to 2-inch and flanged for sizes over 2-inch.

4. Ball valves for sodium hypochlorite service shall be vented type suitable for the service.

C. Stainless Steel Ball Valves

1. Stainless steel ball valves shall be Class 600, three-piece type, with lever operators unless noted otherwise.
2. The valve bodies, end pieces, balls and stems shall be constructed of AISI 316 stainless steel. The seats shall be constructed of teflon and the seals constructed of reinforced teflon.
3. The valves shall have flanged ends, rated 150 psi, for sizes 2 inch and larger and NPT ends for sizes smaller than 2 inches.

2.07 BUTTERFLY VALVES FOR AIR SERVICE

A. Manufacturers

Manufacturers shall be DeZurick, Mueller or Pratt.

B. Valve Description

1. Valves shall be DeZurik, model BGS with lug ends for ANSI Class 125/150 flange connections unless noted otherwise to have flanged connections.
2. Valves shall have ductile iron body with stainless steel shaft and disc with EPDM seat.
3. Valves without a handwheel shall have either 10-position lever or infinite position lever as required by the Engineer. Memory stops shall be included with either lever.

2.08 GATE VALVES

D. Manufacturers

1. Manufacturers of iron, gate valves shall be Kennedy, Mueller, US Pipe or equal US manufacturer.

E. Valve Standards

1. Exposed iron, gate valves 3” through 48” and buried iron gate valves 18” through 48” shall meet the requirements of ANSI/AWWA C500.
2. Buried iron gate valves 4” through 16” shall meet the requirements of ANSI/AWWA C509

F. Description

1. All valves 16” and larger in size shall have bevel gear operator.

2. Buried iron, gate valves 18” through 48” shall have non-rising stems and bypass valves. Horizontally mounted valves shall be provided with rollers and tracks.

3. Buried iron gate valves 4” through 16” shall have resilient seats and non-rising stems.

4. Exposed iron gate valves 18” through 48” shall have outside screws and yokes and bypass valves. Horizontally mounted valves shall be provided with rollers and tracks.

5. Exposed iron gate valves 3”through 16” shall have outside screws and yokes.

G. Materials

1. Buried and exposed iron gate valves shall have cast iron valve bodies and gates.

2. Buried and exposed iron gate valves shall have 316 stainless steel bolts and nuts.

3. Exposed iron gate valves shall have malleable iron hand wheels.

2.09 CHECK VALVES FOR AIR SERVICE, SWING, DUAL DOORS (UNLESS NOTED OTHERWISE)

A. Manufacturers

1. Manufacturers for swing, dual door, check valves shall be APCO or Techno Corporation.

B. Description

1. Valves shall be wafer or lug style, suitable for use in a horizontal or vertical position.

2. Each valve shall have two spring-loaded, resilient seated doors hinged on a shaft through the center of the valve. The doors shall be opened by the velocity flow and closed by one or more torsion springs the shut the doors before flow reversal occurs.

3. Valves shall have a minimum pressure rating of 150 psi and minimum temperature rating of 250ºF.

C. Joints

1. Valves shall fit between two 125 pound or 150 pound ANSI flanges.

D. Materials

1. The valve body, dual doors, hinge pin, stop pin, and torsion springs material shall be AISI 316 stainless steel.

2. Valve seat material shall be EPDM.

2.10 SERVICE SADDLES

Service or tapped saddles shall be Smith-Blair Style 313, double bale with stainless steel bales and fasteners, or approved equal.

2.11 PRESSURE GAUGES

A. Gauges shall be 4" face diameter (unless otherwise specified) with stainless steel case, glycerin filled. Gauges shall be McDaniel all stainless Model E with quick disconnect or approved equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Verify operator orientation with Engineer prior to valve installation.

B. Install valves, operators, extension stems, valve boxes, and other accessories in accordance with the manufacturer's written instructions and as shown and specified. Support valves so that there are no undue stresses on pipe.

C. Install valves with easy access for operation, removal, and maintenance. Install valves so that there are no conflicts between valve operators and structural members or handrails.

D. Install valves, sensors, switches, and controls so that all systems are compatible and operate properly.

E. Install valve boxes perpendicular, centered around and covering the upper portions of the valve or valve operator, or the pipe. The top of each valve box shall be flush with finish grade unless otherwise indicated on the Contract Drawings.

3.02 TESTING

A. While testing the appurtenant pipeline and system of which the valve is a part, operate the valve or test the valve function to ensure proper operation.

B. Operate each valve through the range of operation without fluid flow.

3.03 MANUFACTURERS' REPRESENTATIVE

A. General: As specified in Section 01600 – Materials and Equipment

B. Provide services of valve manufacturer's representative as required to obtain correct installation of valves and accessories.

END OF SECTION

SECTION 15142

STAINLESS STEEL PIPE

PART 1 - GENERAL

1.01 SECTION INCLUDES

Stainless steel piping system products specified in this Section and shown on the Drawings.

1.02 REFERENCES

A. General: As specified in Section 01420 - Reference Standards.

B. ANSI Standards

1. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 125
2. ANSI B16.3 Malleable Iron Threaded Fittings, Class 150 and 300
3. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

C. ANSI/ASME

ANSI/ASME Stainless Steel Pipe B36.19M

D. ANSI/NSF

ANSI/NSF 61 Drinking Water System Components-Health Effects

E. ASTM Standards

1. ASTM A182 Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service
2. ASTM A193 Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
3. ASTM A194 Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
4. ASTM A312 Specification for Seamless and Welded Austenitic Stainless Steel Pipe
5. ASTM A351 Specification for Steel Castings, Austenitic, for High Temperature Service
6. ASTM A403 Specification for Wrought Austenitic Stainless Steel Pipe Fittings
7. ASTM A774 Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Service at Low and Moderate Temperatures
8. ASTM A778 Specifications for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

1.03 SUBMITTALS

A. General For All Pipe Over 3-Inch: As specified in Section 01330 – Submittals and Section 01600 – Materials and Equipment.

B. Shop Drawings: Include the following in each submittal:

1. Specification Section number;

2. Catalog data including the following:

   a. Specifications;
   b. Intended Service;
   c. Maximum working pressure;
   d. Illustrations in sufficient detail to serve as a guide for assembly and disassembly;
   e. Materials of construction;
   f. Dimensions;

3. Additional information required to evaluate the proposed piping appurtenance product's compliance with the Contract Documents.

4. Layout and Installation: Include the following:

   a. Dimensions and elevations;
   b. Piece numbers coordinated with the tabulated pipe layout schedule;
   c. Weight of all component parts;
   d. Design calculations;
   e. Tabulated piping layout schedule including the following:

      (1) Piece number;
      (2) Service;
      (3) Pipe, fitting and accessory sizes;
      (4) Accessory descriptions.

5. Pipe supports and anchors including the following:

   a. Location;
   b. Support type;
   c. Anchor type;
   d. Support an anchor dimensions;
   e. Hanger rod size;
   f. Loads on supports and anchors

1.04 QUALITY ASSURANCE

A. Certifications

1. Prior to delivery at project site, furnish an Affidavit of Compliance certified by the piping product manufacturer that the pipe, fittings, valves, joint accessories, and other piping appurtenances furnished under this Contract comply with all applicable provisions of applicable referenced standards and these Specifications.

2. Do not deliver pipe product to job site until Affidavit of Compliance has been submitted and accepted by the Engineer.

PART 2 – PRODUCTS

2.01 GENERAL

A. Piping, fittings and accessories furnished under this section shall be in accordance with the requirements of Section 01600 – Material and Equipment.

2.02 MANUFACTURERS OF STAINLESS STEEL PIPE AND FITTINGS

A. Stainless steel pipe shall be manufactured by:

1. Armco Stainless Steel Division
2. Carpenter Technology
3. Douglas Brothers
4. Felker Brothers Corporation

B. Stainless Steel fittings shall be manufactured by:

1. Camco Fitting Company
2. Douglas Brothers
3. Felker Brothers Corporation
4. Flowline

2.03 STAINLESS STEEL PIPE, FITTINGS, AND APPURTENANCES, 4" THROUGH 36"

A. Pipe 4" through 36" shall be AISI 304L, stainless steel that conforms to ASTM A312 or A778, Grade. Pipe dimensions and wall thickness shall conform to ANSI/ASME B36.19M, Schedules 10S unless noted otherwise.

B. Fittings for 4" through 36" pipe shall be AISI 304L, stainless steel that conforms to ASTM A312 or ASTM A774. Fitting dimensions and wall thickness shall conform to ANSI/ASME B 316.9M, Schedule 10S.

C. Joints for Buried piping

1. Buried pipe and fittings shall have welded joints.

D. Joints for exposed piping

1. Joints for exposed piping shall be flanged or welded.
2. Flanges shall be AISI 304L stainless steel, UNS S31603 that conforms to ASTM A182. Flange dimensions shall conform to ANSI B16.5, Class 150.
3. Flange shall be welded neck, or slip-on type with 1/16" raised face.

2.04 STAINLESS STEEL PIPE, FITTINGS, AND APPURTENANCES, 3" AND SMALLER

A. Pipe

1. Pipe shall be AISI 316L, stainless steel that conforms to ASTM A312.

2. Pipe dimensions and wall thickness shall conform to ANSI/ASME B36.19M, Schedule 40S.

B. Fittings

1. Fittings shall conform shall be AISI 316L stainless steel.

2. Fittings shall conform to the following for forged/wrought and cast fittings:

a. Forged/Wrought Stainless Steel Fittings: ASTM A182, Grade 316L.

b. Cast Stainless Steel Fittings: ASTM A351, Grade CF8M.

c. Fitting dimensions shall conform to ANSI B16.3, Class 150.

C. Joints for Exposed Stainless Steel Pipe

1. Joints for exposed stainless steel pipe shall be threaded or flange.

2. Flanges shall be made of AISI 316L, stainless steel.

3. Flange Standard for Stainless Steel Flanges, 3” and Smaller: ASTM A182.

4. Dimension Standard for Stainless Steel Flanges, 3” and Smaller: ANSI B16.5, Class 150.

5. Flange Type for Stainless Steel Flanges, 3” and Smaller: Threaded or welding neck.

6. Face Type for Stainless Steel Flanges, 3” and Smaller: 1/16" raised face.

2.05 JOINT AND COUPLING ACCESSORIES

A. Gaskets

1. Flange Joint Gaskets shall be ring type, 1/8-inch EPDM.

B. Bolts, Studs, and Nuts

1. Bolts, Studs, and Nuts for Flange Joints

a. Bolts for flange joints shall be semi-finished, regular hexagon head cap screws with UNC threads. The bolts shall be AISI 316 stainless steel that meets the requirements of ASTM A193, Grade B8M.

b. Studs for flange joints shall have UNC threads and extend through the nuts a minimum of ¼”. The studs shall be AISI 316 stainless steel that meets the requirements of ASTM A193, Grade B8M.

c. Nuts for flange joints shall be semi-finished regular hexagon nuts with UNC threads. The nuts shall be AISI 316 stainless steel that meets the requirements of ASTM A194, Grade 8M.

PART 3 - EXECUTION

3.01 INSPECTION

A. Quality of materials, process of manufacture, and finished products shall be subject to inspection and approval by Engineer. Such inspection may be made at place of manufacture or at project site after delivery, or at both places. Products shall be subject to rejection at any time on account of failure to meet any of the specified requirements even though sample products have been accepted as satisfactory at place of manufacture.

B. Inspect pipe, fittings and piping appurtenances prior to installation. Reject and promptly remove pipe, fittings, valves, and piping appurtenances that do not meet the Specifications. Remove rejected products from the job site.

3.02 GENERAL INSTALLATION

A. Install pipe, fittings and piping appurtenances in accordance with the requirements of the Contact Documents.

B. Install piping to lines, grades, elevations, or lines, grades and elevations shown on Drawings. Install piping with continuous grade between elevations shown on Drawings. Provide additional grade changes as required to avoid interferences and as required to provide separation distances specified in this Section. Make changes in directions or elevations with fittings, by deflecting pipe joints, or with fittings and deflecting pipe joints.

C. Clean pipe, fittings and piping appurtenances before and during installation.

D. Before setting wall sleeves, pipes, castings and pipes to be cast in place, check the Drawings and equipment manufacturer's drawings that may have a direct bearing on pipe locations. Properly locate pipe, fittings, valves, and appurtenances during construction of and renovation of tanks and structures.

E. Attach piping to pumps and other equipment in accordance with respective manufacturers' recommendations. Use flexible connectors where required to prevent excess load, vibration, or load and vibration on pumps and other equipment.

F. Support pipe, fittings, valves, and piping appurtenances in accordance with requirements as shown.

G. Do not damage pipe, fittings and piping appurtenances during installation. Remove and replace damaged pipe, fitting, valves, or piping appurtenances. Remove damaged products from job site. Remove and replace damaged products at no additional cost to Owner.

H. Do not cut pipe by burning. Cut pipe with a saw, cutter, or abrasion. Use the proper tool, machine, or tool and machine for each pipe material. Examine cut ends for damage caused by cutting. Bevel cut ends of pipe.

3.03 INSTALLATION OF EXPOSED PIPING

A. Alignment

1. Install pipe to accurate lines and grades with fittings, valves and appurtenances at locations shown on Drawings and specified.
2. Wherever possible, install piping parallel to walls and floors.

B. Installation

1. Clean debris, dirt, and other deleterious substances out of piping before installing piping. Keep piping clean until accepted at completion of work. Do not place debris, tools, clothing, lumber, or other materials in pipe during installation.
2. Inspect pipe, fittings, valves, and appurtenances for defects prior to installation.
3. Use proper implements, tools, and facilities. Do not damage piping. Do not damage linings and coating.
4. Install piping so no undue strain is placed upon piping, equipment, or structures.

C. Supports

1. Provide supports necessary to hold pipe and appurtenances at lines and grades shown on the Contract Drawings.
2. Support piping so that there is no undue strain on piping, equipment, or structures.
3. Provide hangers and supports as shown.

D. Wall Pipe and Sleeves

1. Set each wall pipe and each sleeve cast in concrete to line and elevation shown on the Contract Drawings, ±0.01 foot.
2. Align sleeves so that piping passes through sleeves without contacting sleeves.
3. Align wall pipe and sleeves so that joints between pipes and wall pipes and between pipes and sleeves are water-tight.

3.04 SETTING APPURTENANCES

Install fittings, valves, couplings, sleeves, saddles, and other piping appurtenances, in piping as indicated on the Drawings.

3.05 CONNECTING TO EXISTING PIPE

A. General

1. Locate existing pipe horizontally and vertically and verify exact size of existing pipe.
2. Locate existing pipe sufficiently in advance of making connections to allow ample time for making changes in connection location and size.

B. Dry Connections

1. Make each dry connection with fittings and valves indicated on Drawings.
2. Provide sleeves required to complete connections.

3. Required pipe, fittings, valves, tools, and equipment shall be at connection site prior to starting connection.

4. Make connections at night and on weekends when existing piping can only be removed from service during minimum flow periods.

5. Owner will operate existing valves.

6. Inspect piping and eliminate leaks immediately after connection is completed and existing pipe is put in service.

3.06 THRUST RESTRAINT FOR EXPOSED SLEEVES AND COUPLINGS

A. General

1. Restrain sleeves and couplings in exposed piping if piping is not secured by anchors or structures.

2. Restraint of sleeves and couplings in exposed piping is not required if piping is secured by anchors, structures, or anchors and structures.

B. Restraint for Sleeve Type Couplings and Flange Adapters

1. Restrain sleeve type couplings with harness of tie rods that span across coupling, as shown on the Contract Drawings.

2. Where distance between adjacent flanges is in excess of ten feet or where harness cannot be used due to obstructions or other conditions, provide pipe supports adjacent to coupling. Provide supports adjacent to couplings that prevent linear or angular movement that results in pipe separating from the coupling or misalignment in coupling joints.

3. Tie rods and nuts shall be AISI Type 316 stainless steel.

C. Restraint for Flexible Pipe Couplings

1. Provide control units for flexible pipe couplings.

2. Install tie rods and control in accordance with the manufacturer's recommendations.

3.07 HYDROSTATIC TEST

A. The Contractor shall perform a field leakage test on all air piping joints provided under this Contract. The test procedure shall consist of operating the air piping at normal maximum air pressure and applying a soap solution to the entire joint. The test shall be witnessed by the Engineer. No air leakage is allowed.

3.10 MANUFACTURERS' REPRESENTATIVE

B. Provide services of pipe and fitting manufacturers' representatives as required to obtain correct piping installation, jointing, connections to structures, connections to existing piping systems, and piping supports.

C. Provide assistance of pipe and fitting manufacturers' representatives at no additional cost to the Owner.

END OF SECTION

SECTION 15290

INSULATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install insulation as shown on the Contract Drawings or otherwise specified. Insulation shall not be installed until piping has been field tested and approved by the Owner. The Contractor shall protect the insulation from moisture at all times.

PART 2 -- PRODUCTS

2.01 INSULATED AIR PIPING

A. Fiberglass insulation shall be provided for all new and modified exposed blower discharge piping as shown on the Drawings and as specified herein. Insulation shall be a roll of semi-rigid fiberglass board insulation. The fibrous insulation is adhered to the ASJ jacket with the end grain of the insulation perpendicular to the jacket surface. Each section of insulation may be secured on the longitudinal seam by using staples and mastic or vapor barrier ASJ pressure sensitive tape. Adjacent sections shall be butted together and sealed with vapor barrier ASJ tape. The insulation shall be 2-1/2 inches thick with a fiberglass density of at least 3 pounds per cubic foot.

B. Insulation for fittings and flanges shall be mitered segments of nominal 6 pounds per cubic foot density fiberglass pipe covering. Cover with a coat of insulating cement then embed a 20 x 20 weave white glass reinforcing cloth between two 1/16 inch coats of Benjamin Foster 30-36. The glass cloth and second coat shall overlap adjacent covering by two inches. Insulation shall be Fiberglass Pipe Wrap Series 705 as manufactured by Owens-Corning, Johns Mansfield, or equal.

C. The insulation shall be covered with a smooth, weatherproof, embossed aluminum jacket with integral Kraft-polyethylene vapor barrier separating the insulation from the metal. The factory applied aluminum jackets shall be at least .016 inches thick for interior installation and at least .031 inches thick for exterior installation. They shall be at least 36" long as measured along the pipe.

D. Circumferentially, the width of the sheets shall be 1/2" to 2" greater than the circumference of the pipe insulation, with a Pittsburgh locktype on the longitudinal edge.

E. The metal jackets shall be held in place by .020" thick, 3/4 inch wide, metal bands on 9" centers.

F. Special care shall be taken to make all exterior insulation jackets completely waterproof by the use of an appropriate silicone base sealant at all joints, etc.

PART 3 -- EXECUTION

(NOT USED)

END OF SECTION

SECTION 16035

ACCEPTANCE TESTS 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. The testing firm shall send directly to the engineer a copy of all individual test documentation within 48 hours of performing the tests. Documentation being sent to the engineer shall not be contingent on contractor's approvals. 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.

B. 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.

C. 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 the switchgear 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.

D. An itemized description of existing equipment to be inspected and tested is as follows:

1. Provide testing of existing feeders that are relocated, extended or disturbed in any way by this project.
2. Provide testing of existing breakers that are re-fed, relocated, re-cabled or disturbed in any way by this project.

E. 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" X 11" paper bound with all field test data in appendix form. 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. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    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.

G. Pre-qualified testing firms for this project are:

1. Emerson Electrical Reliability Services, Inc.
2. Industrial Electrical Testing, Inc.
3. Electric Power Systems

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 job 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
   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 SWITCHGEAR & MOTOR CONTROL CENTER (modifications to existing)

A. Visual and Mechanical Inspection

1. Inspect for physical, electrical, and mechanical condition.
2. Compare equipment nameplate information with latest one-line diagram.
3. Check for proper anchorage, required are clearances, physical damage and proper alignment.
4. Inspect all doors, panels, and sections for paint, dents, scratches, fit and missing hardware.
5. Verify that fuse and/or circuit breaker sizes and types correspond to drawings.
6. Verify that current and potential transformer ratios correspond to drawings. Inspect all bus connections for high resistance. Use low resistance ohmmeter, or check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.
7. Test all electrical and mechanical interlock systems for proper operation and sequencing. Closure attempt shall be made on locked open devices. Opening attempt shall be made on locked closed devices. Key exchange shall be made with devices operated in off normal positions.
8. Clean entire switchgear using manufacturer's approved methods and materials.
9. Inspect insulators for evidence of physical damage or contaminated surfaces.
10. Verify proper barrier and shutter installation and operation.
11. Lubrication: Verify appropriate contact lubricant on moving current carrying parts. Verify appropriate lubrication on moving and sliding surfaces.
12. Exercise all active components.
13. Inspect all mechanical indicating devices for proper operation.

B. Electrical Tests

1. Perform tests on all instrument transformers.
2. Perform ground resistance tests.
3. Perform insulation resistance on each bus section, phase-to-phase and phase-to-ground for three (3) minutes. Test voltages and minimum resistances shall be in accordance with NETA recommendations.
4. Perform an overpotential test on each bus section, each phase-to-ground, for three (3) minutes at values indicated in ANSI/IEEE C37.20.2. or

manufacturer's recommended potential.

5. Perform insulation-resistance test on control wiring except where connected to solid state components.
6. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.
7. Perform secondary voltage energization test on all control power circuits and potential circuits as detailed in this specification. Check voltages levels at each point on terminal boards and at each terminal on devices.
8. Perform current injection tests on the entire current circuit in each section of switchgear. Perform current test by primary injection where possible; secondary injection if not.
9. Determine accuracy of all meters and calibrate watthour meters. Verify multipliers.
10. Perform phasing check on double-ended switchgear to ensure proper bus phasing from each source.
11. Control Power Transformers - Dry Type

    a. Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
    b. Verify proper primary and secondary fuse ratings or circuit breakers.
    c. Verify proper interlock function and contact operation.
    d. Perform insulation-resistance test. Perform measurements from winding-to-winding and windings-to-ground.
    e. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check potential at all devices. Verify proper secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

12. Potential Transformer Circuits

    a. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check for proper potential at all devices.
    b. Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

C. Test Values: Verify Bolt-torque values, Insulation resistance, overpotential levels in conformance to NETA standards or specified by manufacturer.

2.02 CABLES - LOW VOLTAGE - 600V MAXIMUM (all except 20 and 30amp lighting and receptacle circuits)

A. Visual and Mechanical Inspection

1. Inspect cables for physical damage and proper connection in accordance with drawings.
2. Test cable mechanical connections to manufacturer's recommended values

or NETA Standards using a calibrated torque wrench.

3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests

1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 3 minutes.
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.

2.03 CIRCUIT BREAKERS (all breakers affected except 20 and 30amp 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 case for cracks or other defects.
d. Check tightness of connections using calibrated torque wrench. Refer to manufacturer's instructions or NETA standards for proper torque levels.

2. Electrical Tests

a. Perform a contact-resistance test.
b. Perform an insulation-resistance test at 1000 volts dc 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.

2.04 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.

B. Electrical Tests

1. Determine accuracy of meters at 25/50/75/100% of full scale.
2. Calibrate watthour 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

2.05 GROUNDING SYSTEMS (new and upgraded grounding systems)

A. Visual and Mechanical Inspection

B. Inspect ground systems for compliance with drawings and specifications.

C. Electrical Tests (Small Systems)

D. 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 of calculating system resistance.

E. Electrical Tests (Large Systems)

F. When sufficient spacing of electrodes is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)

G. Equipment Grounds

H. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode of system.

I. 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.

J. 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.

2.07 MOTORS (5hp 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 Std. 43.
2. Motors 200Hp 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 horsepower 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.

2.08 MOTOR CONTROL (all motors)

A. Visual and Mechanical Inspection

1. Inspect for physical damage, proper anchorage, and grounding.
2. Inspect equipment for compliance with drawings and specifications.
3. 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 three (3) minutes. 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. Test motor overload units by injecting current through overload unit and monitoring trip time at three hundred percent (300%) of motor full-load current.
3. 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.

2.09 TRANSFORMERS – DRY TYPE TRANSFORMERS – SMALL DRY TYPE, AIR-COOLED (600 Volt and Below)

A. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.

B. Thoroughly clean unit prior to making any tests.

C. Perform insulation-resistance test.

D. Energize primary winding with system voltage. Measure secondary voltage with the secondary load disconnected. Record results.

2.10 THERMOGRAPHIC SURVEY (all new or modified switchgear, bus ducts, transformers, points of power connection equal to or greater than 40amps, 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 100amps 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 (new or existing disconnect switches, manual & automatic transfer switches associated with this project)

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 installaitn.
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

SECTION 16040

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:
Section 16050-Basic Electrical Materials and Methods; Section 16035 Acceptance Testing; Section 16120 Wires and Cables; Section 16950 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 brass or stainless steel screws.

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.

2.04 Safety Signs: 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.

A. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils with red and black letters and graphics on a white background.

B. Size: Provide 7-inch by 10-inch signs or smaller if larger size cannot be applied.

C. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.

D. 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.

E. All receptacles and switches shall be identified on the inside of the cover plate by circuit number and panelboard.

F. 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.

G. 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.

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 screws. 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. Rework or reuse of existing equipment will require new identification tags for some existing equipment.

G. 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.
    a. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings
    b. On control circuits terminated in motor control centers, switchgears, control panels and alike: The field device and terminal number of the opposite end connection.
    c. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.
2. 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.

H. Raceway Tags

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 brass tags and nylon straps for attachment.

I. 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.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 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 16 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.

1.2 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 as defined by the NEC as Class I, Division 1, Group D, or Class I, Division 2, Group D; hazardous areas as follows:

1. Class 1, Division 1, Group D
   a. Wet Wells without 12 air changes/min.
   b. Pretreatment

2. Class 1, Division 2, Group D
   a. Pump Rooms and Dry Well
   b. Odor control

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Design requirements are specified in the applicable sections.

B. Performance Requirements: Performance requirements are specified in the applicable sections.

1.4 SUBMITTALS

A. General: Provide submittals for all electrical material and devices. Including the following.

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. Provide an adequately sized, hard-cover, 3-ring binder for 8-1/2" X 11" for all submittal sheets. Provide correct designation on outside cover and on end of binder. First sheet in the brochure shall be a photocopy of the Electrical Index pages used as a table of contents and tabbed accordingly. The second tab shall be the electrical cost breakdown "Schedule of Values" for electrical work. Cost of material and labor for each major item shall be shown. Provide reinforced separation sheets tabbed with the appropriate specification reference number. Provide Technical Information consisting of marked catalog sheets or shop drawings shall be inserted in the brochure in proper order on all items herein specified or shown on drawings.

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 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. 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. A complete listing of As left programmable parameters for all drives, soft-starters and other microprocessor controlled equipment.

7. System schematic drawings "As Built", illustrating all components, piping and electric connections of the systems supplied under this Section.

1.5 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.

1.6 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 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. 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.

1.7 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

3.1 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.

3.2 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.
   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.
2. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer for resolution.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install access panel or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Furnish and install reinforced concrete pads for transformers, switchgear, and motor control centers, of size as shown on the drawings or required. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by three (3) inches on all sides, except when equipment is flush against a wall, then the side or sides against the wall shall be flush with the equipment. Chamfer top edges 1". Trowel all surfaces smooth. Reinforce pads with 6" X 6" X 6/6 welded wire fabric. Conduit stub up area within the pad area shall remain void. Coordinate with equipment shop drawings stub up areas.
14. Provide rubber insulation mats on floor in front of electrical equipment extending 18” beyond. Mats to be minimum 3 feet wide or equal to isle width. Provide OSHA approved insulating mats meeting OSHA regulation 1910.137 with 20,000 volt insulating strength. Ranco Industries or equal Phone: (800) 228-5543 Corrugated Switchboard matting. Bottom knurled with certification engraved. ASTM D-178, Type II, Class 1, 20,000VAC Dielectric Test Voltage, Maximum use voltage 7,500VAC.

3.3 CUTTING AND PATCHING

A. Perform cutting and patching as specified in Division 1. In addition to the requirements specified in Division 1, the following requirements apply:

1. *Perform cutting, fitting, and patching of electrical equipment and materials* required to:

    a. Uncover Work to provide for installation of ill-timed Work.
    b. Remove and replace defective Work.
    c. Remove and replace Work not conforming to requirements of the Contract Documents.
    d. Remove samples of installed Work as specified for testing.
    e. Install equipment and materials in existing structures.
    f. Locate existing structural reinforcing where core drilled penetrations are required so as not to cut the steel reinforcing.
    g. Provide non-destructive imaging methods (radar, x-ray) to locate embedded conduit in concrete prior to demolition, saw cutting and core drilling. Relocate and reconstruct affected conduit and wire per electrical specifications.

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 16051

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 Collier 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. Complete distribution system for power including feeders, and connections to motors and other power loads. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under this and other Divisions of these specifications.
2. 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. Install vendor furnished cables specified under other Divisions of these specifications.
3. Provide and install Lightning and surge protection equipment for process instrumentation transmitters and supply power circuits.
4. Power wiring for all heating, ventilating, and air conditioning (HVAC) equipment furnished under other divisions of the specifications, including power wiring for 120 volt motors, thermostats, fan motors, dampers and other HVAC in line unit wiring.
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 vendor 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 Instrumentation and control conduit and wiring systems and installation of field instrumentation.
9. Provide Electrical testing of equipment.
10. Provide Motor Control Centers and MCC modifications.
11. Provide fiber optic communications systems and SCADA integration.

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 x 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 panelboards, main breakers, transformers, disconnect switches, etc.

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 QUALIFICATIONS

A. The electrical contractor shall have regularly engaged in the installation of industrial electrical power systems for a minimum period of fifteen (15) years. Provide a list of 10 project installations acceptable to the engineer of similar size and with similar equipment demonstrating compliance with this requirement.

B. Provide a field superintendent who has had a minimum of fifteen (15) years previous successful experience on projects of comparable size and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected. A resume of the Superintendent's experience shall be submitted to Engineer before starting work.

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-2012)
14. Florida Building Code.
15. 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 for all outdoor locations, rooms below grade (buried vaults), "DAMP" and "WET" locations.
4. NEMA 4X 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.

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. Obtain all necessary permits and pay all fees required for permits and inspections.

1.07 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 16000 and other divisions supplying electrical equipment. Repair or replace all defective work and equipment. Refer to 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 the individual Sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing.

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 16 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-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background. Attach with brass 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" 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 ¼” 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

In general the symbols used on the drawings conform to the Standard Symbols of the Institute of Electrical and Electronic Engineers with the exception of special systems or agencies as hereinafter noted or as shown in schedules or legends. The following abbreviations or initials are 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
ASA	American Standards Association
ATS	Automatic Transfer Switch
AUX	Auxiliary
AWG	American Wire Gauge
b.c.	Bare Copper
BIL	Basic Impulse Level
BKR	Breaker
^{o}C	Degrees Centigrade
CAB	Cabinet
C.	Conduit or Conductor
C.B.	Circuit Breaker
CBM	Certified Ballast Manufacturers
CFM	Cubic Feet per Minute
CKT.	Circuit
Clg.	Ceiling
COND.	Conductor
Conn.	Connection
CPU	Central Processing Unit
C.T.	Current Transformer
CU.	Condensing Unit

D.C.	Direct Current
Deg.	Degree
Disc.	Disconnect
D.O.	Draw Out
DN.	Down
DPST	Double Pole Single Throw
E.C.	Electrical Contractor
EMT	Electric Metallic Tubing
E-Net	Ethernet Network
E.O.	Electrically Operated
^{o}F	Degrees Fahrenheit
FFB	Foundation Field Bus Network
FLA	Full Load Amperes
FM	Factory Mutual
FPS	Feet per Second
FT.	Feet
GFI	Ground Fault Interrupting
gnd.	Ground
hp.	Horsepower
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMC	Intermediate Metallic Conduit
in.	Inches
J.B.	Junction Box
KV	Kilovolt
KVA	Kilo-Volt-Amps
KW	Kilowatts
LBS	Pounds
LED	Light Emitting Diode
max.	Maximum
MCB	Main Circuit Breaker
MCP	Motor Circuit Protector
min.	Minimum
M.L.O.	Main Lugs Only
MTD	Mounted
MTS	Manual Transfer Switch
MVA	Mega Volt Amps
N.	Neutral
NEC	National Electric Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIC.	Not in Contract
NF	Non Fused
No.	Number
OCU	Odor Control Unit
O.L.(OLS)	Overloads
OSHA	Occupational Safety and Health Act
PB	Pullbox
Ph.	Phase
PNL	Panel
PR	Pair
PWR	Power

PF	Power Factor
Pri.	Primary
psi	Pounds Per Square Inch
P.T.	Potential Transformer
PVC	Polyvinyl Chloride
RMS	Root-Means-Square
RPM	Revolutions Per Minute
Recept.	Receptacle
RTD	Resistance Temperature Device
SCA	Short Circuit Amps
SCCR	Short Circuit Current Rating
Sec.	Secondary
S/N	Solid Neutral
SPST	Single Pole Single Throw
SW.	Switch
SWBD	Switchboard
SWGR	Switchgear
TSP	Twisted Shielded Pair
TYP	Typical
temp.	Temperature
U.L.	Underwriters Laboratories
UNO (U.N.O.)	Unless Noted Otherwise
V	Volt
VFC	Variable Frequency Controller
VFD	Variable Frequency Drive
W	Wire
W.P.	Weatherproof

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 16110.

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 09902, at no additional cost to the Owner.

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 manufacturers 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.

3.05 The work under this Division shall include a two-year warranty. 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 two years from the date of substantial completion of the System. 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

SECTION 16110

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. Only heavy wall PVC (Schedule 80) shall be used for all raceways trapped underground 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 rigid galvanized conduit or 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; a black mastic coated rigid steel conduit elbow shall be used for all conduits.

C. Minimum conduit size for all systems shall be 3/4". 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 316 stainless steel hardware in all areas except air conditioned spaces.

1.02 SUBMITTALS

A. Product Data:
   1. Product data shall be submitted on:
      a. Conduit, raceways, wireways.
      b. Conduit fittings, boxes, enclosures and cabinets.
      c. Surface metal raceway

PART 2 - PRODUCTS

2.01 ELECTRIC METALLIC TUBING

A. 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

2.02 RIGID METALLIC CONDUIT

A. Rigid Galvanized Steel (RGS); Hot dipped galvanized rigid steel with chromated protective layer. Federal Specification WW-C-581, ANSI C80.1 and UL6.

2.03 FLEXIBLE CONDUIT

A. Flexible, Nonmetallic, Liquid-Tight Conduit:
   1. Material: PVC core with fused flexible PVC jacket. UL 1660 listed for:
      a. Dry Conditions: 80 degrees C insulated conductors.
      b. Wet Conditions: 60 degrees C insulated conductors.
   2. Manufacturers and Products:
      a. Carlon; Carflex or X Flex.;
      b T & B; Xtraflex LTC or EFC.

B. 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.

2.04 PVC CONDUIT

A. 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:
   1. Carlon
   2. Cantex
   3. J.M. Plastics
   4. Queen City Plastics

2.05 PVC-Coated Rigid Galvanized Steel Conduit:

A. Meet requirements of NEMA RN 1.

B. Material: Meet requirements of NEMA C80.1 and UL 6.

C. Exterior Finish: PVC coating, 40 mil nominal thickness; bond to metal shall have tensile strength greater than PVC.

D. Interior finish: Urethane coating, 2 mil nominal thickness.

E. Threads: Hot-dipped galvanized and factory coated with urethane.

F. Bendable without damage to interior or exterior coating.

2.06 Rigid Aluminum Conduit

A. 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.

B. 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.

C. 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. Do not use aluminum conduit in chemical areas or near odor control units.

2.07 CONDUIT FITTINGS

A. 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.

B. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

C. Fittings for EMT: Steel compression type.

D. Fittings, surface boxes and conduit bodies for RGC shall be heavy cast ferraloy malleable iron with external raised hubs and mounting lugs; cadmium plated and enamel finish - Appleton, Crouse Hinds or approved substitution. Cover plates cast iron ferraloy.

E. 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.

F. Conduit locknuts shall be aluminum throughout except steel is acceptable within air conditioned spaces.

G. 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.

H. 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. Insulated bushings shall be used on all rigid steel conduits terminating in panels, wire gutters, or cabinets, and shall be impact resistant plastic molded in an irregular shape at the top to provide smooth insulating surface at top and inner edge. Material in these bushings must not melt or support flame.

I. 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" round X 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

J. 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.

K. Raceways which do not have conductors furnished under this Division of the specifications shall be left with an approved nylon pullcord in raceway.

L. Rigid Metallic Conduit, electrical metallic tubing, flexible steel conduit and PVC conduit shall be manufactured within the United States.

M. 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" nor more than 20” 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” unless specifically approved by the engineer.

N. 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.

O. 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.

P. Electric metallic tubing (thin wall) where installed inside air conditioned buildings above grade shall be joined with steel fittings and steel compression connectors.

Q. Rigid metallic conduit installed underground shall be coated with waterproofing black

mastic before installation, and all joints shall be recoated after installation.

R. 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.

S. 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" to 8" below finished grade. Delete this requirement under building slabs.

T. 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 6" if metallic grounded separation is provided (steel conduit).

END OF SECTION

SECTION 16120

LOW VOLTAGE WIRES AND CABLES

1.01 GENERAL

A. Referenced Standards

1 Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI):
2. Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.
3. National Electrical Manufacturers Association (NEMA): ICS 4, Industrial Control and Systems: Terminal Blocks.
4. 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 2000 Volts or Less for the Distribution of Electrical Energy.
5. National Fire Protection Association NFPA-70, National Electrical Code (NEC).
6. 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.

B. Definitions

1. Building Wire: Copper single conductor, cross link polyethylene insulated; type XHHW-2;
2. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
3. 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.
4. 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.
5. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 12 AWG and larger. Rated XHHW-2
6. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc. Common Types: Ethernet UTP-unshielded twisted pair.

1.02 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 ft. 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 polyolefin insulation system and neoprene outer jacket, type TC cable as manufactured by Rockbestos-Surprenant Cable Corp. 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 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 degree 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.

1.03 Instrumentation and Control Cable

A. Multiconductor and Multi pair Process instrumentation cable shall be #16 AWG stranded, twisted pair, 600 V, (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. Connections

1. All conductor connections shall be on terminal strips including all spare conductors. Provide terminal strips in all cabinets; motor control centers; etc.
2. 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.
3. 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.
4. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
5. 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.
6. Cabinets: All cabinets shall be labeled with an engraved plastic laminate label riveted to the door.
7. No splices shall be made within a conduit run or in manholes.

1.04 Data Network Signal Cable

1. Ethernet Data Cable: Provide field cable that is Multi paired Data Signal cable, TIA 5638B Cat 5e, #22 AWG, twisted pair, 600V, PVC insulated, aluminum tape pair shielding, thermoplastic (PVC) overall sheathed and shielded, industrial ethernet cable as manufactured by the Allen Bradley 1585-C8HB or equal. Option to provide pre-molded M12 and RJ45 patch-cords Allen Bradley 1585D and 1585J is acceptable at contractor’s option.

B. Ethernet Cable Connections

1. All conductor connections shall be to RJ45 and M12 compatible jacks.
2. 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.
3. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
4. 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.
5. No splices shall be made within a conduit run or in manholes.

C. Foundation Fieldbus (FFB) Cable: Provide Type-A-H1 cable with a UL 13 and UL 2250 listing. Provide FFB shielded twisted pair with Maximum resistance of 23.5Ω/km @ 20oC (16 AWG) and with a Characteristic Impedance of 100Ω +/- 20Ω @ 31.25 kHz and a Signal Attenuation < 3 dB/km @ 39 kHz. FFB cables shall be continuously supported and protected against physical damage using mechanical protection such as dedicated struts, angles, or channels. The cable shall be secured at intervals not exceeding two (2) ft. The FFB cables shall be UL83 rated for direct burial and Long Time Insulation Resistance to Water. Provide Sunlight Resistant 16AWG twisted shielded cable with 60% tinned copper braid over 14AWG drain wire over 100% AL/Polyester foil shield.

D. PROFIBUS cable: Provide Type-A Profibus cable in all installations. Type-A is recommended for high transmission speeds.
Type A Technical specification:
•Impedance: 35 up to 165 Ohm at frequencies from 3 to 20 Mhz.
•Cable capacity: < 30 pF per meter.
•Core diameter: > 0.34 mm², corresponds to AWG 22.
•Cable type: twisted pair cable. 1x2 or 2x2 or 1x4 lines.
•Resistance: < 110 Ohm per km.
•Signal attenuation: max. 9 dB over total length of line section.
•Shielding: CU shielding braid or shielding braid and shielding foil.
•Max. Bus length: 200 m at 1500 kbit/s, up to 1-2 km at 93,75 kbit/s.

E. Fiber Optic Cable: Fiber optic cable shall contain a minimum of six (6) optical tubing pairs or more as indicated on the drawings. Fiber optic tubing shall be multi fiber; 62.5/125 micron, tight-buffered, riser rated multi-fiber breakout type, with an Aramid strength member. Maximum attenuation through the fiber shall not exceed 3.0 dB/km at 850nm. Bandwidth shall be 200 Mhz-km at 850 nm. Cable shall be suitable for duct or aerial applications with a UV resistant black PVC sheath. Maximum tensile load shall be 3000 N short term and 1200 N long term. Minimum bend radius shall be 20X outside diameter under installation tensile load and 10X outside diameter long term tensile load. Operating temperature range shall be -40 to +85º c. Fiber optic cable shall be UL-listed OFNR rated as manufactured by Optical Cable Corporation, B-Series Ultra Fox. Fiber optic cable shall utilize mechanically spliced,

field installable, LC compatible connectors. Connections shall have a typical loss of 0.2 dB or better. Heat or UV cured connections shall not be acceptable. Contractor shall terminate and test the fiber optic cable. Contractor shall measure the dB loss of each fiber over the cable length and provide a report of the test results to the Engineer for approval.

1.05 Cable Labeling and Separation

A. 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).

E. Provide for separation of Data, Instrumentation, Control Cables from power conductors. Provide a minimum of 24" inch separation for parallel run of power conduit and Data, Instrumentation or control conduit. This separation can be reduced to 8" if metallic grounded separation is provided.

1.04 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" with exterior sheath clearly marked.

B. Submit sample of all cable identification systems products.

END OF SECTION

SECTION 16130

OUTLET BOXES

1.01 GENERAL

A. Surface outlet boxes and conduit bodies shall be the heavy cast ferraloy malleable iron with external raised hubs and mounting lugs; cadmium plated and enamel finish - Appleton, Crouse Hinds or approved substitution. Trim rings shall also be of one piece construction.

B. Outlet boxes shall be of such form and dimensions as to be adapted to the specific use and location, type of device or fixtures to be used, and number and size of conductors and arrangement, size and number of conduits connecting thereto.

C. Ceiling outlet boxes shall be 4" octagonal or 4" square X 1-1/2" deep or larger as required for number and size of conductors and arrangement, size and number of conduits terminating at them.

D. Switch, wall receptacle, telephone and other wall outlet boxes in drywall shall be 4" square X 1-1/2" deep. For furred-out block walls, provide 4" square box with required extension for block depth and required extension for drywall depth.

E. All flush outlets shall be mounted so that covers and plates will finish flush with finished surfaces without the use of shims, mats or other devices not submitted or approved for the purpose. Add-a-Depth rings or switch box extension rings (Steel City #SBEX) are not acceptable. Plates shall not support wiring devices. Gang switches with common plate where two or more are indicated in the same location. Wall-mounted devices of different systems (switches, thermostats, etc.) shall be coordinated for symmetry when located near each other on the same wall. Outlets on each side of walls shall have separate boxes. Through-wall type boxes shall not be permitted. Back-to-back mounting shall not be permitted. Trim rings shall be extended to within 1/8" of finish wall surface.

F. Outlet boxes mounted in metal stud walls, are to be supported to studs with two (2) screws inside of outlet box to a horizontal stud brace between vertical studs.

G. All outlet boxes that do not receive devices in this contract are to have blank plates installed matching wiring device plates.

H. Covers for cast boxes (flush and surface) installed in damp or wet locations shall be UL approved for weatherproof locations (UL standard 498 and 514; OSHA standard Subpart "S"; NEMA Standard WD-1) with plug inserted and shall comply with NEC-410-57b; shall be heavy cast copper free aluminum with 2 coat baked epoxy finish; self closing door with stainless steel hinge and springs; EPDM gaskets. Provide Crouse Hinds, Appleton or equal. This requirement includes outlets mounted flush in exterior lighting poles.

1.02 MOUNTING HEIGHT

A. Height of wall outlets to bottom above finished floors shall be as follows, unless specifically noted otherwise. Verify with the Architectural plans and shop drawings for installing.

Switches 4'-0" Maximum to centerline
Receptacles 1'-4"
Lighting Panels (top of Panel Trim) 6'-6"
Phone Outlets 1'-4"

B. Bottoms of outlets above counter tops or base cabinets shall be minimum 2" above counter top or backsplash, whichever is highest. Outlets may be raised so that bottom rests on top of concrete block course, but all outlets above counters in same area shall be at same height. It is the responsibility of this Division to secure cabinet drawings and coordinate outlet locations in relation to all cabinets as shown on plans, prior to rough-in, regardless of height shown on Division 16 drawings.

C. Height of wall-mounted fixtures shall be as shown on the drawings or as required by Architectural plans and conditions. Fixture outlet boxes shall be equipped with fixture studs when supporting fixtures.

1.03 SPECIAL PURPOSE OUTLETS

A. Locate special purpose outlets as indicated on the drawings for the equipment served. Location and type of outlets shall be coordinated with appropriate trades involved. The securing of complete information for proper electrical roughing-in shall be included as work required under this section of specifications.

1.04 SUBMITTALS

A. Submit product data on all different types of outlet boxes, floor boxes and associated trim/plaster rings.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 – GENERAL

1.01 Scope

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

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.

A. NEC (NFPA 70) National Electrical Code
B. NETA International Electrical Testing Association - Acceptance Testing specifications
C. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum)
D. Local Building Codes and Standards
E. UL 1449 3rd edition Standard for Surge Protection Devices
F. UL 498 Standard for Safety Attachment Plugs and Receptacles

1.03 Furnish submittals in accordance with Section 26 05 00.

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.

1.07 TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 05 11.
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 120-277 VAC, 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, 120-277 VAC, 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 125VAC, 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.

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 125 V, 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 125 VAC.

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

2.03 PLUG CAPS & CORDS

Provide and install a matching plug cap and properly sized cord for equipment items noted on the drawings.

2.04 DEVICE PLATES

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. Plates shall be of stainless steel.

PART 3 – EXECUTION

3.01 GENERAL

Perform work in accordance with the National Electrical Code.

3.02 CONNECTION

Rigidly attach wiring devices in accordance with National Electrical Code. Coordinate installation avoiding interference with other equipment.

3.03 GROUNDING

Ground all devices, including switches and receptacles, in accordance with NEC, ART 250.

A. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

B. Ground flush receptacles and their metal plates through grounding jumper connections to outlet box and grounding system.

END OF SECTION

SECTION 16170

DISCONNECTS & SAFETY SWITCHES

1.01 GENERAL

A. All disconnect switches and safety switches shall be heavy-duty type. Switches shall be fusible or non-fusible and sized as noted on the drawings.

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 30amp (10hp) 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 Provide Switches rated for the available short circuit current at the location. Provide molded case type high SCCR switches where required to meet available short circuit current ratings.

1.02 Construction

A. Switch blades and jaws shall be visible and plated copper
B. Switches shall have a handle that is easily padlockable in any position
C. Switches shall have defeatable door interlocks that prevent the door from opening when the handle is in the ON position. Defeater mechanism shall be front accessible
D. Switches shall have deionizing arc chutes
E. Switch assembly and operating handle shall be an integral part of the enclosure base.
F. Fusible switches shall have reinforced fuse clips
G. Switch blades shall be readily visible in the ON and OFF position
H. Switch operating mechanism shall be positive quick-make/quick-break type.
I. Fusible switches shall be suitable for service entrance equipment
J. Switches shall have line terminal shields
K. Switches shall be suitable for systems capable of 200 kA at 600 volts when the auxiliary circuit is equipped with a factory-installed fusible pullout switch, or 100 kA at

208 or 240 volts when the auxiliary circuit is equipped with a factory-installed circuit breaker and Class J, L, R, or T fusing is utilized.

L. Embossed or engraved ON-OFF indication shall be provided

M. Double-make, double-break switch blade feature shall be provided.

N. Enclosures shall be provided with draw-pull latches.

O. Provide Factory installed fuse pullers in fused switches.

P. Provide Factory installed crimp lug pad kits (200A and above), Factory installed copper lugs, Factory installed ground lug kits and Factory installed auxiliary contacts.

1.01 QUICK-MAKE/QUICK-BREAK FUSIBLE SWITCHES

A. 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.

1.02 SUBMITTALS

A. Submit product data on all major types of safety switches.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

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. All supporting devices and hardware exterior of buildings or interior of structures except in air conditioned spaces shall be stainless steel. Aluminum and non metallic 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

Applicable provisions of Division 1 govern work under this Section. Section 26 05 51 – Conduit Systems

1.03 SUBMITTALS

Product Data: Provide data for support channel.

1.04 QUALITY ASSURANCE

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”.

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 free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

SECTION 16450

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 DESCRIPTION

The terms “connect”, “ground” and “bond” are used interchangeably in this specification and have the same meaning.

A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

B. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, perimeter counterpoise ground, lightning protection system grounding electrodes.

1.2 RELATED WORK

A. Section 16050 Common material and methods: General electrical requirements.

B. Section 16120, Conductors & Cables

1.3 SUBMITTALS

A. Submit in accordance with Section 16050.

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.

1.4 APPLICABLE PUBLICATIONS

A. American Society for Testing and Materials (ASTM)

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. National Fire Protection Association (NFPA)
National Electrical Code (NEC) 2008

D. Underwriters Laboratories, Inc. (UL)
Thermoset-Insulated Wires and Cables
Thermoplastic-Insulated Wires and Cables
Grounding and Bonding Equipment
Wire Connectors

PART 2 – PRODUCTS

2.1 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.

D. Utilize insulated flexible cable in above grade areas exposed to corrosion from hydrogen sulfide. Use Portable Power cable Type-W or approved equal.

2.2 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).

2.3 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.
3. All ground terminations shall be coated with corrosion protection paint; Glyptal or equal.

PART 3 – EXECUTION

3.1 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.

3.2 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.

3.4 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.

3.5 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 (Glyptal).

3.6 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system.

3.7 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.

3.8 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 16709

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. Metal Enclosed Drawout Switchgear

B. Switchboards

C. Panelboards

D. Motor Control Centers

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 3rd 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 3rd 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. PRODUCTS

1.07 MANUFACTURERS

A. Eaton / Cutler-Hammer products
B. Square-D products
C. General Electric products
D. EDCO
E. APT

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 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% 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 3rd 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.
   b. 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.

c. 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.

d. 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.

e. 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. 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.

1.09 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.

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

B. 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.

1.10 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.

1.11 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).

1.12 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% of their continuous electrical load. Suppressors for cord connected equipment shall be equipped with standard NEMA cord sets 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% of nominal phase-to-ground RMS voltage.
7. Initial breakdown voltage: 200% of nominal phase-to-ground RMS voltage.

1.13 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. Provide Foundation Field Bus surge suppression on all FFB controlled motor operated valves. Provide SPD rated for FFB circuits equal to ABB NGV210-NO and NGV211-NO with over voltage protection for two separate floating signal circuits (Foundation Fieldbus-H1), consisting of a base element and a plug-in module. The unit provides a protection element with a low voltage threshold (40VDC/28VAC) in conjunction with fast response. Surge arresting capacity rated for nominal discharge surge current (8/20 micro-sec pulse) at 10kA and Max discharge current at 20kA via use of gas-filled surge voltage arresters from each wire to a common reference. SPD response time line-line ≤ 1 ns, Line to ground ≤ 100 ns.

A. 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% 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 manufacturer's 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 2 EXECUTION

2.01 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" 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.

2.02 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.

2.03 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.

2.04 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 16850

PLC/HMI CONTROLS INTEGRATION

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install, complete with all accessories, modifications to an existing programmable logic control based monitoring and control system as described herein and shown on the contract drawings.

B. All system construction and programming will be the responsibility of the controls integrator (PLC/HMI) system supplier. All materials and labor shall be provided for a fully functional system including any items which are required for system operation but are not specifically addressed in this document or on the contract drawings.

C. This specification is intended to be used in conjunction with all drawings supplied and is not intended to be complete without reference diagrams on system configurations, etc. All bidders must conform to all areas of the documentation. It is the intent of this specification that the system integrator has single source responsibility for the complete (PLC/HMI) system package for the project; PLC software and hardware modifications, HMI screen development and modifications, HMI report generation and coordination with the field instrumentation and interconnecting conduit and control wiring for total system responsibility.

D. The Turbo Blower Manufacturer will provide an Allen Bradley Compact Logix Master Control Unit (MCU) PLC with Ethernet/IP communications. Provide a fibler optic link from the MCU back to the SCADA system. This contract includes the integration of the MCU Compact Logix PLC to the Plant SCADA system. Coordinate with provided shop drawings of the MCU PLC project.

E. The Contractor shall assume total systems responsibility for all aspects of this system including installation, commissioning and start-up of the system, training of operating personnel and coordinating interfaces between this system and equipment provided by others. This responsibility shall include all modifications within the existing PLC cabinets including but not limited to, termination of field cables, terminal blocks, power supplies, surge suppression, interposing relays, communications modules and other control devices as required forming a complete system.

1.2 PLC/HMI SYSTEMS INTEGRATOR

A. The Contractor shall utilize the services of one of the following PLC/HMI system integrators for this project:

1. Rocha Controls (813)-628-5584
2. BCI Technologies (239) 433-9600

The integrator shall have experience and show capabilities in programming Allen Bradley PLCs with Ethernet/IP communications.

1.3 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Section 01330 and Section 16050, Shop Drawings, Product Data and Samples. These drawings shall include:

1. A cover sheet consisting of a Bill of Material, purchase order number, manufacturer's job number, Owner's name, location, application and shipping address.

2. Modifications to mechanical layout drawings detailing the overall external dimensions of all enclosures. Include all pertinent information such as location of door handles, windows, lifting lugs and enclosure mounted items such as pump controller chassis and I/O modules (show cable connections on modules), relays, cooling fans, etc.

3. Details for mounting of the processor, I/O racks, relays, motor starters, disconnect switch, fuse blocks, wireways, etc. All materials shall be labeled to provide easy cross-reference to the Bill of Material listing.

5. Electrical drawings detailing all hardwiring, done by the supplier, to devices such as relays, disconnect switches, fuse blocks, etc. Provide individual wire numbers and relay contact cross-reference designations.

6. A description of all input and output modules by name, rack, module and terminal location.

7. Modifications to the existing input/output listing indicating, PLC number, drawing number, tag number, function description, I/O type, loop number and PLC address number.

8. The last sheet(s) in the set shall describe all terminal block designations and individual terminal numbers.

B. SOFTWARE SUBMITTALS

1. The programmer of the software shall have a minimum of 5 years experience with software programming applications dealing with serial communication of the type to be used. Provide resume of project programmer. The resume shall demonstrate that the programmer has experience and capabilities in programming Allen Bradley PLCs and IFIX SCADA

2. The system integrator shall submit modifications to the existing graphic screens and proposed new graphic screens and plant reports to be provided under this contract.

D. O&M Manuals; Existing plant PLC/HMI O&M manuals shall be updated for the changes and modifications in this contract.

1. As-Built drawings of the Control Panels

2. Bill of Material listing for all components provided within the PLC/termination cabinet (and any other panels provided) as well as provided external instrumentation devices, with cut sheets and operator's manual/user's reference books.

3. Description of Operation, Local. Describe the control that takes place locally -- through the use of the local control panels and operator interface. The written description should be supported with pictorial representations such as the operator interface screens or portion of an electrical drawing.

4. Description of Operation, SCADA. Describe the control that takes place at the Plant SCADA Server, similar to the local Operation description listed above. Support the written description with pictorial representations -- screens from the Intellution, or pictures/images.

5. Update documentation for the PLC and its programming. Processor Information listing, I/O configuration, channel configuration, program file list, data file list, complete ladder-logic printout, address assignment listings for all Data Files/Bits (digital input, digital output, S2 hex Status, B3 Binary, T4 Timer, C5 Counter, R6 Control, N7 Integer, F8 Float, others as utilized).

6. Complete documentation of the Intellution Screens and its database/address assignment, similar to that above for the operator interface. Include configuration/setup listings that were used for the SCADA programming.

7. Complete electronic copy (disk or CD-ROM) of the PLC ladder logic Program changes. Complete electronic copy (disk or CD-ROM) of the Intellution Screen files and any other configuration files that are specific to the configuration/setup.

PART 2 - PRODUCTS

2.0 PLC/HMI SOFTWARE INTEGRATION

A. The control system integrator will completely integrate the proposed field monitoring and control points into the existing SCADA control system. A full functional modified graphic screen development will be included in the integration improvements project by this system integrator.

B. Provide modifications and additions to the Intellution computer software to support the proposed listed alarms, status and control signals associated with the project. Create internal registers and signals as required to link real signals to graphics for monitoring and keyboard for control. Each new signal shall be individually defined and assigned to a new device file.

C. Provide Turbo Blower graphic screens on the SCADA HMI. Modify existing graphics for the proposed point list. Integrate the proposed screen graphics to be comparable to the existing graphics screens with full use of dynamic colors, levels and numeric values and tied to real time data. All analog values shall be displayed in engineering units. Graphic levels shall be animated in blue with levels that raise or lower in proportion to their signal values. Critical analog and digital values shall flash amber when outside normal limits or when in an alarm state. The existing screens will be modified to incorporate background pop-up screens for individual control panels.

D. Incorporate all required signals into the database and set limits and alarm values based on Owner requests and operational testing. All modifications to the software shall be compatible with the existing format.

E. Add values to existing reports as directed by the Owner. Create new and modify existing reports for all proposed changes.

F. Provide virtual alarms as directed.

2.1 BLOWER CONTROL

A. The amount of airflow to the aeration basins is controlled manually or automatically by adjusting the number of blowers in operation and by modulating the position of the air inlet valve to each existing blower.

B. The existing control includes a PID loop for automatic air flow control. The operator sets a ratio of SCFM air flow per MGD basin influent flow to yield a total air demand setpoint. The blower header air flow transmitter signal is compared with the setpoint. The PID loop automatically stops and starts blowers and modulates the running blower inlet valves to achieve the total air flow setpoint balance.

C. Under this Contract remove the blower start and stop signals and air flow modulating signals for blowers 7-8 (Phase1) and blowers 5-6 (Phase 2) and blowers 3-4 (Phase 3) as the new turbo blowers are brought on line.

D. Provide the air demand PID loop output signal to the new blower vendor-provided MCU controller. The MCU PLC control will start and stop and modulate the new blowers' VFD speeds to achieve increased or decreased demand as dictated by the Plant SCADA PID air demand output. The old blowers will remain on automatic control or manual operator control. Remove blowers from the existing blower lead/lag scheduler as the new blowers are put on line. Remove all tags associated with the old blower I/O and replace with the new blower I/O originating from the MCU PLC via the plant Ethernet network.

E. Modify the blower lead/lag scheduler for the remaining old blowers are directed by the Owner. Initially and unless directed otherwise, the old blowers will be lag blowers and not started unless the new turbo blowers are not capable of satisfying the air demand.

2.2 HMI SCADA FIELD INPUTS/OUTPUTS

A. The PLCs and HMI SCADA systems shall be modified and programmed to monitor and control the proposed Turbo Blower Systems. The Allen Bradley PLC with Ethernet/IP network connection will be provided and configured by the Turbo Blower Vendor. Provide coordination between the Blower Vendor and SCADA system monitoring and control.

B. Provide SCADA monitoring integration for each Turbo Blower; Turbo blower parameters are:

Actual Flow Volume	%
Output pressure	psi
Inlet pressure	psi
Operating time in hours	HH,hh
Operating time in days	PP,pp
MWh counter	MWh

Differential pressure at motor cooling air filter	psi
Reference flow volume	%
Turbocompressor type	20HSTxx
Program version	xx
Motor supply frequency	Hz
Current	Amps
Inverter temperature	ºC
Motor temperature	ºC
Inlet temperature	ºC
Heater Pressure	psi

C. Provide SCADA alarm/shutdown notification for each Turbo Blower; Alarm & Shutdown parameters:

a. Power Supply Status:
   1) Over voltage in main power supply
   2) Under voltage in main power supply
   3) One phase missing
   4) Over/under voltage in auxiliary power supply

b. Process Air Inlet and Outlet:
   1) Blockage in the inlet or outlet air piping
   2) Overpressure
   3) Inlet air temperature too high (surge)

c. Cooling Air Inlet and Outlet:
   1) Blockage in the inlet or outlet air piping
   2) Cooling air over temp.
   3) Motor temperature
   4) VFD temperature
   5) Magnetic bearing controller temperature

2.3 Network Switch

A. Provide an Allen Bradley Stratix 8000 Ethernet managed 100Base-FX fiber port expansion module in the existing Stratix 8000 switch in the PLC3 control panel. Install the fiber expansion module into the existing Stratix 8000 100baseT main frame. Provide Allen Bradley Stratix-8000 Switch 1783-MX08F expansion module. Connect and configure the new Blower MCU PLC into the existing plant Ethernet network through the fiber optic link.

B. Provide an Allen Bradley 1783-ETAP1F network switch at the new MCU PLC cabinet for conversion from fiber optic to copper RJ45 cable. Provide a din rail mounted Allen Bradley 24VDC power supply type 1606.

2.4 Network Cable

A. Ethernet Data Cable: Provide field cable that is Multi paired Data Signal cable, TIA 5638B Cat 5e, #22 AWG, twisted pair, 600V, PVC insulated, aluminum tape pair shielding, thermoplastic (PVC) overall sheathed and shielded, industrial ethernet cable as manufactured by the Allen Bradley 1585-C8HB or equal. Option to provide pre-molded M12 and RJ45 patch-cords Allen Bradley 1585D and 1585J is acceptable at contractor's option.

B. Ethernet Cable Connections

1. All conductor connections shall be to RJ45 and M12 compatible jacks.
2. 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.
3. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
4. 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.
5. No splices shall be made within a conduit run or in manholes.

C. PROFIBUS cable: Provide Type-A Profibus cable in all installations. Type-A is recommended for high transmission speeds.

Type A Technical specification:

1 Impedance: 35 up to 165 Ohm at frequencies from 3 to 20 Mhz.
2. Cable capacity: < 30 pF per meter.
3. Core diameter: > 0.34 mm^2, corresponds to AWG 22.
4. Cable type: twisted pair cable. 1x2 or 2x2 or 1x4 lines.
5. Resistance: < 110 Ohm per km.
6. Signal attenuation: max. 9 dB over total length of line section.
7. Shielding: CU shielding braid or shielding braid and shielding foil.
8. Max. Bus length: 200 m at 1500 kbit/s, up to 1-2 km at 93.75 kbit/s.

D. Fiber Optic Cable: Fiber optic cable shall contain a minimum of six (6) optical tubing pairs or more as indicated on the drawings. Fiber optic tubing shall be multi fiber; 62.5/125 micron, tight-buffered, riser rated multi-fiber breakout type, with an Aramid strength member. Maximum attenuation through the fiber shall not exceed 3.0 dB/km at 850nm. Bandwidth shall be 200 Mhz-km at 850 nm. Cable shall be suitable for duct or aerial applications with a UV resistant black PVC sheath. Maximum tensile load shall be 3000 N short term and 1200 N long term. Minimum bend radius shall be 20X outside diameter under installation tensile load and 10X outside diameter long term tensile load. Operating temperature range shall be -40 to +85º c. Fiber optic cable shall be UL-listed OFNR rated as manufactured by Optical Cable Corporation, B-Series Ultra Fox. Fiber optic cable shall utilize mechanically spliced, field installable, LC compatible connectors. Connections shall have a typical loss of 0.2 dB or better. Heat or UV cured connections shall not be acceptable. Contractor shall terminate and test the fiber optic cable. Contractor shall measure the dB loss of each fiber over the cable length and provide a report of the test results to the Engineer for approval.

2.5 Thermal Dispersion Flowmeter Indicating Transmitter **(provided by others under separate contract for installation and integration under the Contract for Phase 1).**

A. Unload, store, install and start-up Mass Flowmeter with Thermal Flow Sensing Element and a separately mounted Smart Flow Transmitter. Sensor shall sense

mass flow of the air flowing through the pipes. The electronic unit shall be designed to accept signals from the sensor element and provide a linear, isolated, 4-20 mA (with HART network protocol), 24 VDC output signal proportional to mass flow and reported as SCFM of the air flow as indicated in mechanical sections. Accuracy shall be within ± 1 percent of range. Repeatability shall be ± 0.5 percent of full signal range at constant temperature and pressure. Power supply shall be 120 VAC, 60 hertz. The flowmeter system shall be FM approved. The electronics unit shall be furnished with an integral LED or LCD type flow rate indicator calibrated in SCFM. Enclosures shall be NEMA 4X.

B. Flowmeters shall be factory calibrated with gas equivalent in composition to the gas anticipated for the specified service. A complete portable flowmeter calibration kit shall be furnished to calibrate flowmeter performance (Veri-Cal).

C. The system shall include a means of removing the probe with the system in service via a low pressure packing gland and ball valve.

D. The sensor element shall be fitted with platinum 100 ohm RTD, a mass equalizer and a constant current 2-watt heater.

E. Process connection shall be 1" Male NPT, with all wetted parts in 316-stainless steel, with nickel braze filler on thermo-well assemblies, isolating value and insertion assembly. Insertion length shall be sufficient to position the sensor element at the center of the pipe.

F. Provide thermal dispersion mass flowmeter with remote transmitter for permanent installation, Model ST110 with Veri-Cal in-situ calibration system as manufactured by FCI Fluid Components, Intl. Provide multi-conductor cable between air flow element and air flow transmitters.

G. Provide 4-20ma analog signal from flow transmitter to PLC. Provide Hart signals for flow rate, flow totalization, air pressure at flow element, analog flow signal calibration drift, and fault alarm.

H. Install one air flow meter system in each of two air header pipes. Provide one complete spare ST110 air flow meter system with Veri-Cal attachment for Owner spare parts. Provide one complete calibration gas cylinder and required quick connect flexible gas lines of minimum six feet in length. **(provided by others under separate contract for installation and integration under the Contract for Phase 1).**

2.6 Cable Labeling and Separation

A. 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).

B. Provide for separation of Data, Instrumentation, Control Cables from power conductors. Provide a minimum of 24" inch separation for parallel run of power

conduit and Data, Instrumentation or control conduit. This separation can be reduced to 8" if metallic grounded separation is provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The work included in this section consists of furnishing, installing and placing in operation the instruments and appurtenances, including all conduit, wiring and circuitry, necessary to provide the Owner with a fully operable system properly calibrated and installed.

B. Include the services of a factory trained, qualified service engineer of the equipment manufacturer to inspect the complete equipment installation to assure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished.

C. 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.

3.2 START UP SUPERVISION

A. The system supplier shall provide a qualified service technician to inspect all final connections and check the system prior to start-up of the system. The service technician shall coordinate with the Owner's representative for functional check-out of the complete system.

B. A system software engineer shall be provided on site during start up of the plant to make adjustments to the Control Computer/ Operator Interface and tune the system as deemed necessary by the Engineer.

C. System verification marking end of suppliers on-site start-up obligations will be issued after system functionality can be demonstrated for a period of 168 continuous hours without interruptions.

3.3 FIELD TESTING

A. Conduct a field test of all the instrumentation equipment in the presence of the Engineer, Owner, or their designated representative(s).

B. Verify that each instrument has been properly installed, connected, grounded and calibrated.

C. Verify that the inputs/outputs functions of each instrument conform to the requirements of the application.

D. Provide continuous protection of the installed instrumentation equipment from the elements, moisture, construction damage, dust, debris, paint spatter or other conditions which will adversely affect the unit operation until such time as the equipment scheduled for start up testing.

E. Exercise each system as defined by each loop description through operational tests to demonstrate that it performs as intended on a continuing basis and to demonstrate the integrity of the system.

F. Make all necessary replacements, repairs, correction and/or adjustments including but not limited to labor, parts and freight at no additional cost to the owner to demonstrate a fully operational system.

G. The service technician shall calibrate all gauges and instruments. A documented calibration and settings report shall be included in the O&M manuals.

3.5 START UP TESTING

A. After the field testing has been successfully demonstrated, a date for system start up involving the Owner's operating personnel will be scheduled as agreed to by the Owner.

B. Start up and test the instrumentation equipment with the entire system operational.

C. Provide manufacturer's representative as directed by the Engineer for instruction of Owner's operating personnel.

D. Refer to Section 11380 for additional information and requirements.

3.7 WARRANTY AND TRAINING

A. All products and systems herein must be warranted by the supplier for a period of Two (2) years from the date of final completion.

B. The system supplier shall provide (1) day of training instruction to the Owner’s personnel to include; operator training.

END OF SECTION