Collier County Public Utilities
NCWRF EQ Odor Control Improvements – Phase 2

BID Technical Specifications

Project:
Collier County EPMD Project
Number #70148.12.4.2

January 05, 2024

Prepared for:

Collier County Public Utilities
Engineering and Project Management Division

Prepared by:

Stantec Consulting Services Inc.

COLLIER COUNTY

NCWRF EQ ODOR CONTROL IMPROVEMENTS
PHASE 2

TECHNICAL SPECIFICATION SIGNATURE PAGE

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paul r duquette

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NO TEXT FOR THIS PAGE

Collier County Public Utilities
NCWRF EQ Odor Control Improvements – Phase 2

TABLE OF CONTENTS

All materials and construction methods used for the proposed project shall conform with the Collier County Water-Sewer District Utilities Standards Manual. The specifications sections identified below have been prepared by Stantec as Supplemental Specifications to the County Water-Sewer District Utilities Standards Manual. In the case of a conflict, the more stringent requirement that results in a higher quality finished product shall govern.

Technical Specifications

Permits Obtained by Collier County

1. Collier County Growth Management and Community Development Department
   Site Development Plan Insubstantial Change No. PL20230013848
   Collier County North County Water Reclamation Facility #: 88322
   Issued: 09/18/2023

2. Florida Department of Environmental Protection
   Revision to North County Water Reclamation Facility Permit #: FL0141339-034-DW1P
   Revision Date: 10/26/2023

3. Florida Department of Environmental Protection
   Permit #: 189294-010 EM
   Minor Modification of Permits 189294-009-EM and 189294-008-EI

SECTION 00 00 00
SUPPLEMENTAL CONDITIONS

A. Through out the duration of the project, the Contractor shall adhere to the following requirements:

1. **No offsite odors** 24 hours per day, 7 days per week, 365 days per year.
2. **No (Sanitary Sewer Overflows) SSOs-Spills**, 7 days per week, 365 days per year.
3. **No offsite fugitive-dust emissions**, 7 days per week, 365 days per year.
4. **No offsite Noise**, 7 days per week, 365 days per year. Noise to be mitigated prior to fence line per Code.
5. **No offsite Light emissions**. Light emissions to be mitigated prior to fence line per Code.

SECTION 01 10 00
SUMMARY OF WORK – CONTRACTOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work

B. CONTRACTOR's use of Site

C. Materials

D. Start-up, Testing and Training

E. Warranty

F. Work sequence

G. Salvaged Equipment and Materials

H. County occupancy

I. Protection of Existing Utilities

J. Definitions

1.2 DESCRIPTION OF WORK

A. General: The Work to be done under this Contract is shown on the drawings and specified in Contract Documents. The project intent is for Owner to pre-purchase the odor control equipment identified in the Vendor Provided Equipment List below, and as specified in Specification Section 01 10 00.1 – Summary of Work – Vendor. Furthermore, the Contractor shall be responsible to lead coordination for delivery, receiving, handling, installation, start-up and testing (with manufacturer's service), and providing all other equipment, materials, labor, or services as required for a complete odor control system installation that operates as intended.

B. The Work includes:

1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary for: removing existing asphalt surface, concrete stairs, and concrete pad; installing new odor control equipment consisting of two (2) custom Carbon Scrubbers with two (2) 30 hp duty fan and integrated exhaust (as specified and shown on the plans); installing and connecting all process drains including duct and fan drains; relocating hose bib and rack; new plant water service; installing two (2) new 28-inch FRP ducts; connections to existing ducts, installing vehicular guard posts; forming and placing concrete for concrete pads, steps and ramp; installing duct pipe supports to existing building; installing all necessary raceways, junction boxes, wires, grounding, lightning protection, etc. for power distribution and instrumentation and control devices, sensors, transmitters and wiring; point-to-point and functional testing of all I/Os with the process control equipment and instrumentation; integration of vendor provided equipment and control panels with PLC-8, and Plant SCADA system; PLC hardware modifications; relocate existing exterior air conditioning unit, relocate site lighting, restore building

finishes; site improvements and restoration necessary to complete the Work as intended and in accordance with the Contract Document requirements.

2. Procurement of all permits and payment of all permitting fees that may be required for completion of the work, unless noted otherwise.

3. Sole responsibility for adequacy of plant and equipment.

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

5. Maintaining existing facilities in service at all times.

6. Protection of finished, unfinished Work, and existing facilities.

7. Repair and restoration of Work or existing facilities damaged during construction.

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

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

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

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

1.3 CONTRACTOR'S USE OF SITE

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

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

2. COUNTY occupancy and access to operate existing facilities.

3. Coordination of site use with ENGINEER.

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

5. Providing additional off-site storage at no additional cost to the COUNTY as needed.

B. Access to Site: Limited to work areas as shown on the Drawings.

C. Construction Operations: Limited to work areas as shown on the Drawings.

D. Time Restrictions for Performing Work: Operation of construction equipment is only permitted Monday through Friday, 7:00 AM to 7:00 PM. Contractor must receive written approval from the County Project Manager for work on Saturdays.

1.4 MATERIALS

A. The COUNTY has pre-purchased two (2) RJC-1013DR - Dual Bed Rectangular Carbon Adsorbers and associated equipment listed in the Vendor Provided Equipment list below). The CONTRACTOR shall provide all necessary labor and equipment for:

1. Receiving, inventorying, photo documenting conditions of equipment and materials to confirm all equipment and material make and model numbers match those ordered; confirming all ordered quantities have been delivered; thoroughly reviewing all items for damage and defects; storing and protecting the equipment and materials in accordance with the manufacturer's recommendations and requirements, and in the same manner as if the CONTRACTOR has purchased the material themselves; and notifying the COUNTY Project Manager and ENGINEER of any discrepancies in quantity, make, model, or damage and defects of equipment and material received.

2. CONTRACTOR shall immediately notify the COUNTY Project Manager and ENGINEER in the event any damages or defects are observed while the equipment and/or materials are still on the delivery truck. CONTRACTOR shall also provide photos of these damaged and defects to the COUNTY Project Manages and ENGINEER. CONTRACTOR shall provide the ENGINEER with a copy of the equipment/material delivery ticket(s) immediately upon receipt.

B. CONTRACTOR shall be responsible to review the vendor provided equipment list with the equipment manufacturer within 3 working days to assure that all equipment and materials to be furnished by the manufacturer have been delivered. Equipment manufacturer and contractor shall both provide positive confirmation that all materials and equipment have been delivered to the project site. Contractor shall furnish and install any materials or equipment necessary to complete the Work that is not specifically identified on the Vendor Provided Equipment List that are pre-purchased by the COUNTY.

Vendor Provided Equipment List		
Item	**Quantity**	**Title**
1	2	Exhaust Fan
2	2	Exhaust Fan Outlet Transition
3	2	28" ID Isolation Damper with Chain-Wheel Gear Operator
4	2	36" ID Exhaust Stack (with Bird Screen)
5	2	24" ID Access Manway
6	2	Differential Pressure Guage
7	4	1" Carbon Sample Valves
8	12	2" Vessel Drain

9	2	Carbon Bed Grounding Rod
10	4	ID Tag
11	2	Caution Tag
12	2	Logo
13	2	Anchor Lugs
14	16	Lifting Lugs
15	16	Inlet Air Sample Port
16	2	Outlet Air Sample Port
17	4	NFPA Label
18	2	12” ID Access
19	2	Fan Outlet Flexible Connector
20	2	28” Inlet Isolation Dampener with Chain-Wheel Gear Operator
21	2	Vessel

1.5 START-UP, TESTING AND TRAINING

A. CONTRACTOR shall be responsible for coordinating Vendor, COUNTY, and EOR to attend and witness start-up and testing, as well as provide all testing and start-up services for equipment and material pre-purchased by the COUNTY, unless otherwise noted.

B. CONTRACTOR shall video record equipment vendor’s training and provide electronic copies to COUNTY and EOR.

1.6 WARRANTY

A. All material and equipment to be furnished and/or installed by the CONTRACTOR under their contract shall be guaranteed for a period of at least one year from substantial completion against defective materials, design, and workmanship, unless otherwise specified herein.

B. The CONTRACTOR shall not tamper with or take any actions while handling, storing, or installing any equipment and/or material that would void the manufacturer’s warranty.

C. The CONTRACTOR shall provide all equipment, labor, and tools required to repair or replace any equipment or material during the project warranty period or equipment/material warranty, whichever is greater.

D. Contractor shall notify the Owner, Engineer of any damages to County pre-purchased equipment, and coordinate with the manufacturer to determine an appropriate repair method that does not affect the manufacturer’s warranty of the equipment.

1.7 WORK SEQUENCE

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

B. Contractor shall prepare and submit a sequence of construction to the ENGINEER for review before commencement of work. The initial project schedule shall reflect the sequence of construction and shall indicate all anticipated tie-ins and/or shutdowns.

C. Coordinate work of all subcontractors.

D. The North County Water Reclamation Facility shall remain in service at all times during construction.

1. Coordinate plant downtime for tie-ins with plant operations well in advance of the work with minimum 10-business day notice. Reschedule tie-ins as required by COUNTY based on plant operational needs, weather events, etc.

2. Work requiring a partial plant shutdown, flow diversion, or piping cut-in shall not be allowed on Fridays or a day before a holiday.

E. Existing equipment and structures are to remain in service until new equipment, materials, and equipment necessary to complete the installation are delivered to the Site and are ready to be installed.

F. Provide temporary power to existing and proposed structures and equipment when work sequence dictates.

1.8 SALVAGED EQUIPMENT AND MATERIALS

A. Salvaged materials, equipment or supplies are the property of the COUNTY and shall be delivered as directed by the COUNTY. Should the COUNTY choose to not accept these materials, they shall be removed from the project site as soon as practical. The CONTRACTOR shall dispose of materials in accordance with State and Local laws in a legal manner at no additional cost to the COUNTY.

1.9 COUNTY OCCUPANCY

A. The COUNTY will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with the COUNTY's Manager or designee in all construction operations to minimize conflict, and to facilitate COUNTY usage.

B. Conduct operations with the least inconvenience to the general public.

1.10 PROTECTION OF EXISTING UTILITIES

A. In case of damage to existing utilities caused by construction activities, contact the owner of the utility or appropriate COUNTY department (Water or Wastewater) immediately. Repair any damage to existing utilities caused by construction activities in coordination with or as directed by the owner of the utility.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

A. Starting Work: Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of

the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract.

B. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

SECTION 01 10 00.1

SUMMARY OF WORK - VENDOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scope of Supply and Services

B. Background Information

C. Description of Equipment and Services to be Provided

D. Definitions

1.2 SCOPE OF SUPPLY AND SERVICES

A. This Section describes the project in general and provides an overview of the extent of the equipment and services to be provided under this Contract. Detailed requirements and extent of services is stated in the applicable Specification sections. The VENDOR shall, except as otherwise specifically stated herein or in any applicable parts of the Contract Documents, provide and pay for all labor, materials, equipment, tools, fabrication equipment, and other facilities and services necessary for proper executions, shipping and storage, testing, training and final completion of the equipment specified and provided under this Contract.

1.3 BACKGROUND INFORMATION

1. For the North County Water Reclamation Facility (NCWRF) Equalization Tank (EQ) Odor Control Improvements Phase 2 project, the OWNER is contracting the construction of a Carbon Adsorber Odor Control System for EQ. at the NCWRF, which is owned and operated by the Collier County Board of County Commissioners, and located at 10500 Goodlette-Frank Rd, Naples, FL 34109. The work for the construction of the odor control system will be performed by a General CONTRACTOR under a separate contract.

2. As part of the (EQ) Odor Control Improvements Phase 2 project, new Carbon Adsorber Odor Control System shall be provided through this Contract, which will be pre-purchased by the OWNER and installed by the CONTRACTOR under a different contract. The WORK under this Equipment Pre-Purchase contract consists of furnishing all materials, labor, and equipment necessary to provide a complete Carbon Adsorber Odor Control System with all ancillary equipment.

1.4 DESCRIPTION OF EQUIPMENT AND SERVICES TO BE PROVIDED

1. The VENDOR shall furnish two custom Carbon Scrubbers, as manufactured by Evoqua Water Technologies, with two 30 hp duty fan, exhaust stack with bird screen, control panel and all other services, supplies, parts and equipment shown and specified in these contract documents. The CONTRACTOR will install all equipment supplied by the VENDOR.

2. Start-up and Training services will be provided by the VENDOR and coordinated through the CONTRACTOR awarded.

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

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

5. VENDOR and CONTRACTOR shall coordinate the delivery of all equipment and materials, as well as start-up, Warranties, and training services as if the CONTRACTOR directly purchased the odor control system from the VENDOR.

6. VENDOR RESPONSIBILITIES:

    a. VENDOR shall provide the services of a local representative no farther than 50 miles away from the NCWRF job site. No out of State representatives will be allowed.

    b. VENDOR shall provide all pertinent drawings and specifications (instructions) necessary for the contractor to properly receive, store, protect, and install the new odor control equipment and appurtenances.

    c. VENDOR shall include heaters in all odor control units.

    d. VENDOR shall have all fan motors/blowers balanced at the factory prior to shipment to the job site and provide certification to the OWNER.

    e. VENDOR shall perform all startups, functional, performance testing, certifications, training, troubleshooting and resolution of deficiencies prior to substantial completion.

    f. VENDOR shall balance air flow to both units, as specified.

    g. VENDOR shall provide 96-hour notice to the ENGINEER, CONTRACTOR, and OWNER prior to shipment of any and all equipment.

    h. VENDOR shall provide input and comments on all contractor-provided submittals related to all odor control equipment and appurtenances, as detailed on Section 44 31 16 – Carbon Adsorber Odor Control Equipment.

    i. VENDOR shall be responsible for providing all testing and start-up services for equipment and material pre-purchased by the COUNTY in accordance with Specification Section 44 31 16 – Carbon Adsorber Odor Control Equipment.

1.5 DEFINITIONS

See Specification Section 01 10 00 – Summary of Work Contractor for definitions.

END OF SECTION

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SECTION 01 20 00
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Explanation and definitions.

B. Measurement.

C. Payment.

D. Schedule of values.

E. Applications for payment.

F. Change procedures.

1.2 EXPLANATION AND DEFINITIONS

A. The following explanation of the Measurement and Payment for the Bid Schedule items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the Bid Schedule or relieve the CONTRACTOR of the necessity of furnishing such as a part of the Contract. Measurement and payment for all Contract Items shall made be in accordance with this section or as modified by the Supplemental Terms and Conditions.

1.3 MEASUREMENT

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

1.4 PAYMENT

A. Make payment for the items listed on the Bid Schedule on the basis of the work actually performed and completed, such work including but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, clean up, restoration of disturbed areas, and all other appurtenances to complete the construction and installation of the work as shown on the drawings and intended by the specifications.

B. Unit prices are used as a means of computing the final figures for bid and Contract purposes, for periodic payments for work performed, for determining value of additions or deletions and wherever else reasonable.

1.5 SCHEDULE OF VALUES

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

B. Format: Utilize a format similar to the Table of Contents of the Project Specifications. Identify each line item with number and title of the major specification items. Identify site

mobilization, bonds and insurance. Include within each line item, a direct proportional amount of CONTRACTOR's overhead profit.

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

1.6 APPLICATIONS FOR PAYMENT

A. Submit the number of copies of each application as required by the COUNTY on an Application for Payment form with format approved by COUNTY.

B. Content and Format: Utilize schedule of values for listing items in Applications for Payment.

C. Payment Period: Monthly.

D. For payments for materials and equipment furnished and installed, furnish evidence that manufacturer's installation instructions were delivered with the material or equipment.

E. Include an updated construction progress schedule.

F. Include an updated schedule of Shop Drawing and Sample submittals.

G. Include all other affidavits, certifications, and documentation as required by the COUNTY and the General Conditions.

1.7 CHANGE PROCEDURES

A. ENGINEER will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time as authorized by the General Conditions by issuing supplemental instructions in a Field Order.

B. OWNER may issue a request for a change which includes a detailed description of the proposed change with supplementary or revised Drawings and Specifications. CONTRACTOR will prepare and submit within 30 days, a statement describing the effect on the Contract Price and Contract Time with full documentation.

C. CONTRACTOR may propose changes by submitting a request for change to ENGINEER, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation. Document any requested substitutes and "or-equals".

D. Work Directive: ENGINEER may issue a Work Directive signed by OWNER, instructing CONTRACTOR to proceed with a change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Price or Contract Time. Promptly execute the change.

E. Change Order: ENGINEER will issue Change Orders for signatures of parties as provided in the conditions of the Contract.

F. Cost of the Work Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the conditions of the Contract. ENGINEER will determine the change allowable in Contract Price and Contract Time as provided in the Contract Documents.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Measurement and Payment shall be made on the basis of work actually performed completing each item in the Bid, such work including, but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, cleanup, and all other appurtenances to complete the construction and installation of the work to the configuration and extent as shown on the drawings and described in the specifications. Payment for each item includes compensation for project layout, cleanup and restorations. Monthly payment will not be made until cleanup and restorations have been completed and as-builts have been prepared and submitted to the EOR and County PM as required.

3.2 PAY ITEMS

A. Mobilization / Demobilization (Bid Item No. 1): Payment for mobilization / demobilization will be made at the Contract lump sum price for all activities associated to Contractor's mobilization and demobilization. This price shall be full compensation for all costs incurred for preparatory work and operations including, but not limited to those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; daily cleanup and incidentals to the project site; site safety and security; utility locates, construction photographs and videos; fees for bonds and insurance; for all other work and operations including submittals and obtaining construction permits, which must be performed prior to beginning work on various items; and for removal of all equipment, materials, and tools after the project has been completed. This item amount shall not exceed of 5% of the Bid Subtotal, and shall be payable as follows:

1. Up to 15% Can be invoiced by contractor in the first application for payment.

2. Up to 50% Can be invoiced by the Contractor in the application for payment proceeding the Contractor's approved application for payment for at least 50% of the value of work completed.

3. Up to 75% Can be invoiced by the Contractor in the application for payment proceeding the Contractor's approved application for payment for at least 75% of the value of work completed.

4. 100% Can be invoiced by the Contractor in the final application for payment once he has demobilized from the site.

The value of work completed shall not include any amounts due or paid for mobilization.

B. Erosion and Sedimentation Control (Bid Item No.2): Payment for erosion and sedimentation control will be made at the Contract lump sum price for all items and activities associated to erosion and sedimentation control for the duration of the project. Payment shall include all erosion and sedimentation control per Collier County, South Florida Water Management District, and FDOT standards and as specified herein. Includes silt fence around entire disturbed area throughout the duration of the project. Payment for this item shall be invoiced monthly and shall be equally divided over the monthly duration of the project based on the amount of contract days.

C. Demolition and Removal (Bid Item No. 3): Payment for demolition and removal will be made at the Contract lump sum price for all activities associated with demolition of existing asphalt surface, existing bollard, existing concrete step, and capping existing drain pit piping. This item also includes the removal and replacement of the existing plant service water, exterior luminare,

relocation of existing air conditioning exterior unit by licensed HVAC contractor, and relocation of existing light pole; relocation of existing hose bib and rack. This item includes cutting, removal, and disposal of pipes; electrical equipment; FRP pipe; for all equipment and all other work necessary to complete the work; for preparing, filing and obtaining all permits necessary for all demolition and disposal activities; all clearing, hauling and disposal, disposal fees; and all other incidentals necessary to complete the demolition and removal as intended in the contract documents.

D. Site Work (Bid Item No. 4): Payment for site work will be made at the Contract lump sum price for all activities associated with grading; excavation, backfill and compaction; replacing of sod and landscaping; cutting and replacing asphalt drive; furnishing of all equipment labor, and material for installation of vehicular guard posts; installation of 2-inch drain pipe to existing manhole with P-trap; and coating of concrete pads and steps, as intended by the Contract Documents. This item includes furnishing all equipment, labor, and material to place sod and watering until it has established roots to the underlying soil; all equipment and personnel to grade area affected by demolition and construction activities; and any other item that involves restoring the project site to pre-construction or better conditions. Contractor shall provide all water at no additional cost to the County.

E. Mechanical Equipment and Piping (Bid Item No. 5): Payment for mechanical equipment and piping will be made at the Contract lump sum price for all activities associated with installing the Carbon Scrubber equipment (pre-purchased by County); furnishing and installation of two new 28-inch fiber-reinforced piping; furnishing and installation of all drain piping; and connection of PVC duct and fan drains as intended by the Contract Documents. This item includes furnishing all equipment, labor, material, delivery, start-up and performance testing of two Carbon Scrubbers w/30 hp duty fans and exhaust stacks; furnishing of all materials, labor and equipment to install and connect all new piping and drains.

F. Electrical System (Bid Item No. 6): Payment for construction and installation of the electrical system, as shown in the Contract Documents shall be made at the appropriate contract lump sum price. Payment shall include all necessary labor, materials, equipment, services, testing, permitting, and coordination with the owner for furnishing and installing all conduit, conductors, disconnects, junction boxes, support racks, electrical equipment racks, sunshields, penetrations, terminations to new and existing equipment and instruments, existing electrical equipment modifications, PLC panels, cabinets, panels, cabinet and panel supports, instrumentation, switches, fiber optic work, surge protection, IO Cards, grounding and bonding, labels, nameplates, and any other equipment required for turnkey installation as intended by the Contract Documents. Contractor shall be responsible for coordinating with the County all programming and integration with existing plant network architecture.

G. Structural Work (Bid Item No. 7): Payment for structural work, as shown in the Contract Documents shall be made at the appropriate contract lump sum price. Payment shall include all necessary labor, materials, equipment, services, testing, permitting, and coordination with the owner for construction of new concrete work (except bollards), ductwork offset brackets and pipe supports, repair of any damage to existing building including stucco and paint.

H. 2-inch Plant Service Water Line (Bid Item No. 8): Payment for furnishing and installation of 2-inch polytube plant water line, as shown in the Contract Documents, shall be made at the appropriate contract lump sum price. Payment shall include all necessary labor, materials, equipment, services, testing, permitting and coordination with the owner for furnishing and installation of all necessary piping and appurtenances, necessary adapters, and connections to existing water main. The new plant water service line shall be installed from point of connection to the relocated hose bib and rack, as shown on Sheet C-103.

I. Owner Directed Allowance (Bid Item No. 9): Owner Directed Allowance shall be 10% of the Sum of Bid Item Nos. 1 through 8 (i.e. Bid Subtotal) and will be used only at the Owner's written

direction to accomplish work due to unforeseen conditions and/or as directed by the Owner. **No additional payment shall be made for rock excavation, replacement of fill material or dewatering.** Use of Owner Directed Allowance must be approved by Collier County through a Work Directive prior to commencing execution of the work. Contractor shall be required to provide Time and Material back-up showing the change in labor, equipment, material, and services associated with completing changes identified in the Work Directive.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 01 32 17
PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scheduling Responsibilities

B. Submittals

C. Network Requirement

D. Cost Loading

E. Progress of the Work

F. Schedule Updates

1.2 SCHEDULING RESPONSIBILITIES

A. Format: Use the Critical Path Method to schedule and monitor job progress. Provide all information concerning sequencing logic and duration of all activities as well as the initial CPM logic network diagram and tabulated report data. Contractual Notice to Proceed, Substantial Completion, and Final Completion dates shall be identified on the schedule, as shall anticipated Substantial and Final Completion dates based on actual conditions at the time of preparing the schedule.

B. Initial Submittal: Within 10 days after the Notice to Award, submit the initial logic network diagram to the ENGINEER for review. Within 7 days after the Notice to Proceed, submit the final network diagram.

C. Updates: On a monthly basis, furnish to the ENGINEER updated information on logic, percent complete, actual start and finish date and direction changes. Distribute copies at Progress Meetings.

D. Adherence: Schedule and direct forces in a manner that will allow for completion of the Work within the Contract time specified.

E. Accuracy: Provide initial schedule and subsequent update information to reflect the best efforts of the CONTRACTOR and all subcontractors as to how they envision the Work to be accomplished. Similarly, all progress information must be an accurate representation of the CONTRACTOR's and subcontractor's actual performance. Complete Work under this Contract in accordance with the established CPM schedule.

F. Cost of Revisions: At no additional cost to the OWNER, revise schedule when in the judgement of the ENGINEER, it does not accurately reflect the actual prosecution of the Work.

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1 and the General Conditions.

B. CPM Schedule:

1. Within 30 days after the date stated in the Notice to Proceed, submit to the ENGINEER a PDF copy and Microsoft Project File of a proposed CPM network diagram and tabular reports for the first 90 days of the Work. Include both procurement and construction activities. Schedule a review meeting with the ENGINEER and the OWNER (or OWNER's Consultants) within 2 weeks of its submission. Revise and resubmit the 90 day schedule until it is acceptable to the ENGINEER.

2. Within 60 Days after the Notice to Proceed, submit to the ENGINEER a PDF copy and Microsoft Project File of the proposed CPM logic diagram and tabular reports for the entire Contract duration. Include both procurement and construction activities. Sort these tabular reports by total float and activity number. Provide a predecessor/successor report, resource loading report, and project calendar. Draw logic diagram as described.

3. Schedule review meeting with the ENGINEER and the OWNER within 2 weeks of its submission. If a review of the submitted CPM Schedule indicates a work plan which will not complete the Work within the time requirements stated in the Contract, reallocate resources, revise the CPM Schedule and resubmit it until it is acceptable. Failure by the CONTRACTOR to submit an acceptable schedule may, at the OWNER's sole discretion, be cause for the withholding of any partial payment otherwise due under the Contract.

4. Review of the Schedule by the ENGINEER will not constitute ENGINEER's representation that the Work can be completed as shown on the Schedule.

1.4 NETWORK REQUIREMENTS

A. Diagram: Show in the network diagram the order and interdependence of activities and the sequence in which the Work is to be accomplished. The purpose of the network analysis diagram is to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of succeeding activities. Follow a time scaled precedence format. Time scale the detailed network diagram showing a continuous flow from left to right.

B. Develop the schedule activities into two major groups; procurement activities; and construction activities:

1. Include the following procurement activities as a minimum:

a. Permits

b. Easements

c. Submittal items

d. Approval of submittal items

e. Fabrication and delivery of submittal items.

Tie each of the above procurement items logically to the correct construction activity in the overall CPM construction schedule.

2. Under construction activities section utilize physical work activities to describe how the job will be constructed, and include the following activities as a minimum:

a. Receipt of Owner purchased equipment

b. County Building Inspections

c. Connections to existing systems

d. Readiness Rebar and Form Review prior to placing concrete

e. Setting odor control vessels

f. Conductor pulling

g. Start-up and Testing

C. Activity Durations: Break the work into activities with durations in days, except for non-construction activities, such as procurement of materials and delivery of equipment, and other activities which may require longer durations. To the extent feasible, group activities related to a specific physical area of the project on the network for ease of understanding and simplification. The ENGINEER and OWNER will review the selection and number of activities.

1. For each activity on the network indicate the following:

a. A single duration (i.e., the single best estimate of the expected elapsed time considering the scope of work involved in the activity) expressed in Days. Include normal holidays and weather delay. Show critical path for the schedule.

b. Assign an activity I.D. number to each activity. The I.D. number will be numeric with a maximum of 5 digits.

c. Include a brief description of the activity. If this description is not definitive, a separate listing of each activity and a descriptive narrative may be required.

d. Load each activity with the estimated work hours to be expended on each activity.

D. Incomplete Schedule: Failure to include on the network any element of work required for the performance of this Contract does not excuse the CONTRACTOR from completing all Work required within the applicable completion time, notwithstanding the network review by the ENGINEER or the OWNER and OWNER's Authorized Representative.

1.5 PROGRESS OF THE WORK

A. Delays to Critical Path: Whenever it becomes apparent from the current monthly CPM Schedule update that delays to the critical path have resulted and these delays are through no fault of the OWNER, and hence, that the Contract completion date will not be met, or when so directed by the OWNER, take one or more of the following actions to improve the Completion Date at no additional cost to the OWNER.

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

2. Increase the number of working hours per shift, shifts per day, or days per week; the amount of construction equipment; the forms for concrete work; etc., or any combination of the foregoing to substantially eliminate the backlog of Work.

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

4. Submit to the ENGINEER, the OWNER or OWNER's Authorized Representatives for review, a written statement of the steps proposed to be taken to remove or arrest the delay to the schedule. Failure to submit a written statement of the steps to be taken or failure to take such steps as required by the Contract, may result in the OWNER directing the level of effort in labor (trades), equipment, and work schedule (overtime, weekend and holiday work, etc.) to be employed by the CONTRACTOR in order to

remove or arrest the delay to the critical path in the accepted schedule. Promptly provide such level of effort at no additional cost to the OWNER. In addition, should schedule delays persist, the CONTRACTOR's surety will be asked to attend meetings at which schedule is updated.

5. If the requirements of this provision are not complied with, the OWNER at the OWNER's sole discretion, will withhold, partially or in total, payments otherwise due for work performed under this Contract. Any withholding of monies is not a penalty for noncompliance, but is an assurance to the OWNER that funds will be available to implement these requirements should the CONTRACTOR fail to do so.

1.6 SCHEDULE UPDATES

A. Monthly Meetings: If determined by the OWNER, a monthly Schedule Update Meeting will be held 1 week prior to the progress meeting at the construction site to review and update the CPM Schedule. The Schedule Update Meeting will be chaired by the ENGINEER and attended by the OWNER and the CONTRACTOR. Actual progress of the previous month will be recorded and future activities will be reviewed. The duration of activities and their logical connections may be revised as needed. Decisions made at these meetings and agreed to by all parties are binding with the exception that no contract completion dates will be modified without formal written requests and acceptance as specified herein. In the event a monthly Schedule Update Meeting is not required by the ENGINEER, the CONTRACTOR shall submit the update information to the OWNER and the update worksheets provided with each previous update. In either case the CONTRACTOR must provide the following information for each update at a minimum:

1. Actual start and finished dates for all completed activities.

2. Actual start dates for all started but uncompleted activities including remaining durations.

B. Withholding of Payments: Failure to provide specified updated information or failure to attend progress meetings may result in the withholding of progress payments.

C. Time Extensions: If in accordance with the provisions of Article 9 of the General Conditions, the OWNER or ENGINEER finds that the CONTRACTOR is entitled to any extension of the Contract completion date under the provisions of the Contract, the OWNER's determination as to the total number of Days extension will be based upon the current accepted and updated CPM Schedule and on all data relevant to the extension. Such data shall be included in the next monthly updating of the schedule. Actual delays in activities which, according to the CPM Schedule, do not affect any contract completion date shown by the critical path in the network, do not have any effect on the Contract completion date or dates and therefore, will not be the basis for a change in Contract completion time.

D. Schedule Adjustments: From time to time it may be necessary for the Contract schedule and completion time to be adjusted by the OWNER to reflect the effects of job conditions, acts or omissions of other contractors not directly associated with this Contract, weather, technical difficulties, strikes, unavoidable delays on the part of the OWNER or OWNER's representatives, and other unforeseeable conditions. Under such conditions, the OWNER will direct the CONTRACTOR to reschedule the Work to reflect the changed conditions and will grant, in writing, schedule extensions affecting the Contract completion time. No additional compensation will be made to the CONTRACTOR for such schedule adjustments.

E. Acceleration Costs: Additional compensation will be made to the CONTRACTOR in the event the OWNER requires the project completion prior to the completion date shown on the CONTRACTOR's accepted schedule. The OWNER, therefore, has the right to accelerate the schedule and the CONTRACTOR will be compensated for such acceleration as long as such acceleration is not required through fault of the CONTRACTOR. Available total float in the CPM Schedule may be used by the OWNER and OWNER's representatives as well as by the CONTRACTOR.

F. Float: Without obligation to extend the overall completion date or any intermediate completion dates set out in the CPM network, the OWNER may initiate changes to the Contract Work that absorb float time only. OWNER-initiated changes that affect the critical path on the CPM network shall be the sole grounds for extending (or shortening) said completion dates. CONTRACTOR initiated changes that encroach on the float time identified in the CPM network may be accomplished with the OWNER's concurrence. Such changes, however, shall give way to OWNER-initiated changes competing for the same float time.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00
SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements.

B. Submittal procedures.

C. Construction progress schedule.

D. Shop drawings.

E. Certificates.

F. Manufacturer’s instructions.

1.2 REQUIREMENTS

A. The types of submittals controlled by these general requirements include shop drawings, product data, samples, construction schedule and miscellaneous work-related submittals. The individual submittal requirements are specified in applicable sections for each unit of work.

1. Unless otherwise noted, each item of submittal shall be submitted to the Engineer for review prior to construction or installation.

2. Engineer’s review is for general conformance with the design concept and Contract Documents.

B. The submittal will not be accepted for review unless it is clear, legible and contains complete information and complies with the specifications. Submittals that are not accepted will be returned with attached notations of requirements necessary for acceptance. Resubmit after the material has been amended to comply with the comments.

C. If submittals show deviations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall clearly describe such deviations in his letter of transmittal. If the Contractor fails to describe such deviations, he shall not be relieved of the responsibility of executing the work in accordance with the Contract, even though such submittals have been reviewed.

1.3 DEFINITIONS

A. The work-related submittals of this section, in addition to the definitions of the General Conditions and elsewhere in the Contract Documents, are defined as follows:

1. Substitution or "Or Equal" Items includes material or equipment CONTRACTOR requests ENGINEER to accept, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of particular supplier.

2. Shop drawings include custom-prepared data of all forms, including drawings, diagrams, pipe laying schedule, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form applicable to other projects.

3. Product data includes standard printed information on materials, products and systems not custom-prepared for this project, other than the designation of selections from available choices.

4. Samples include both fabricated and un-fabricated physical examples of materials, products and work; both as complete units and as smaller portions of units of work; either for limited visual inspection or (where indicated) for detailed testing and analysis.

5. Mock-ups are a special form of samples, which are, because of size, usually constructed on the project site.

6. Construction schedule includes custom-prepared data for the construction of said project. All stages of work shall be included. Contractor shall revise during the course of construction as needed, and submit to the Engineer with monthly application payment.

B. Miscellaneous submittals related directly to the work, (non-administrative) include extended warranties or guarantees, maintenance agreements, project photographs (DVD format), survey data and reports, physical work records, statements of applicability, quality testing, calculation and certifying reports, copies of industry standards, record drawings, operating and maintenance materials, overrun stock and similar information, devices and materials applicable to the work.

1.4 CONSTRUCTION PROGRESS SCHEDULE

A. Submit four copies of preliminary progress schedule at pre-construction conference. Development of progress schedule shall be in accordance with the requirements of the General Conditions and Section 013217 – Progress Schedule.

B. Revise and resubmit as required.

C. Submit revised schedule with each Application for Payment, identifying changes since previous version.

D. Submit a computer-generated horizontal bar chart with separate line for each portion of Work or operation, identifying first work day of each week, or submit a computer-generated network analysis diagram using the critical path method, as outlined in Associated General Contractors of America (AGC) publication “The use of CPM in Construction - A Manual for General Contractors and the Construction Industry”.

E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

F. Indicate estimated percentage of completion for each item of Work at each submission.

G. Submittals Schedule: In addition to the above scheduling requirements, submit a complete and detailed listing of anticipated submittals during the course of the Contract. Coordinate these submittals with those of subcontractors and suppliers. Identify each submittal by Contract drawing number and Specification section number. Show the anticipated submission due date for each submittal along with the date on which its return is required. For planning purposes, average turn-around time for shop drawings will be 14 Calendar Days after receipt. Longer durations for review may be required and will not be considered a basis for a claim for additional time or compensation. For submittals on the critical path, at the time of submission mark transmittal in red with the words "Critical Path".

1. Submit Submittal schedule within 10 Days from the Notice to Proceed. Revise as required and incorporate the dates and review durations into the CPM Schedule.

1.5 SHOP DRAWINGS

A. The CONTRACTOR shall review, approve, and submit, with reasonable promptness and in such sequence as shown on the Shop Drawing Submittal Schedule so as to cause no delay in the Contract Work or in the Work of the OWNER or any separate contractor, all shop drawings, product data, working drawings and samples required by the Contract Documents.

B. Submittals shall be electronic in *.pdf format of descriptive or product data submittals to complement shop drawings for the ENGINEER. The ENGINEER will review the submittal and return to the CONTRACTOR a set of marked-up reproducibles with appropriate review comments. If in the opinion of the ENGINEER a submittal is nonreproducible, the CONTRACTOR shall submit four (4) additional sets of blueline shop drawings. Once submittals are approved and require no additional submittal, electronic copies of each submittal will be forwarded to the OWNER.

C. All submittals shall be made directly to the ENGINEER with a copy via email to the OWNER.

D. Shop drawings, product data, working drawings and samples shall be furnished with the following information:

1. Number and title of the drawing.

2. Date of drawing or revision.

3. Name of project building or facility.

4. Name of contractor, subcontractor, and manufacturer submitting drawing.

5. Clear identification of contents, location of the work, and the sheet numbers where the product is found in the contract drawings.

6. Contractor Certification Statement.

7. Submittal Identification Number.

8. Contract Drawing Number Reference.

E. In accordance with subparagraph 1.7A below, each shop drawing, working drawing, sample, and catalog data submitted by the CONTRACTOR shall have affixed to it the following Certification Statement, signed by the CONTRACTOR:

"Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers, and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all contract requirements."

F. The CONTRACTOR shall utilize a 10-character submittal identification numbering system in the following manner:

1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/ Maintenance Manual (M), or Request for Information (R).

2. The next five/six digits shall be the applicable Specification Section Number.

3. The next three digits shall be the numbers 001-999 to sequentially number each initial separate item or drawing submitted under each specific Section Number.

4. The last character shall be a letter, A-Z, indicating the submission, or resubmission of the same drawing, i.e., A=1st submission, B=2nd submission, C=3d submission, etc. A typical submittal number would be as follows:

   D-033504-008-B

D	=	Shop Drawing
330504	=	Specification Section for Ductile Iron Pipe (DIP) & Fittings
008	=	The eighth initial submittal under this specification section
B	=	The second submission (first resubmission) of that particular shop Drawing

G. The CONTRACTOR shall submit a copy of each submittal transmittal sheet (for shop drawings, product data, working drawings and samples) to the Resident Project Representative simultaneously with the CONTRACTOR'S submission of said drawings, data, samples or manual packages to the ENGINEER and OWNER.

H. All items specified are not necessarily intended to be a manufacturer's standard product. Variations from specified items will be considered on an "or equal" basis. If submittals show variations from Contract requirements because of standard shop practice or for other reasons, the CONTRACTOR shall describe such variations in his letter of transmittal and on the shop drawings along with notification of his intent to seek contract adjustment. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the CONTRACTOR fails to describe such variations he shall not be relieved of the responsibility for executing the work in accordance with the Contract, even though such drawings have been reviewed. Variations submitted but not described may be cause for rejection. Any variations initiated by the CONTRACTOR will not be considered as an addition to the scope of work unless specifically noted and then approved as such in writing by the ENGINEER.

I. Data on materials and equipment shall include materials and equipment lists giving, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, material, size, finish, and all other pertinent data.

J. For all material furnished, the CONTRACTOR shall provide a list including the material name, address, and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained.

K. The CONTRACTOR shall use the color "green" to make his remarks on the Submittals. Only the ENGINEER will utilize the color "red" in marking submittals.

L. Before final payment is made, the CONTRACTOR shall furnish to ENGINEER one (1) set of record shop drawings as described in Section 017839 – Project Record Documents. These record shop drawings shall be in conformance with the approved documents and should show any field conditions that may affect their accuracy.

M. Submit working drawings of piping; detail drawings of steel reinforcing, both bars and mesh, showing size and arrangement; details of machinery, apparatus and materials; dimensional drawings, ladder-type schematic diagrams, connection diagrams and other data for all electrically operated equipment, and all communication, instrumentation, control, and related equipment; and layout drawings of the complete electrical work. Drawings shall designate the complete installation and shall be suitable for coordinating work of the various trades.

N. Layout drawings for electrical work shall include all underground, concealed, and exposed conduits, and shall show locations and sizes of conduit runs, sizes and number of wires, pull and junction boxes, outlets, lighting fixtures, panelboards, motor starter switchboards, motor controls, switches, control stations, disconnects, etc., and will be used by ENGINEER to verify the location and size of conduit, wire and equipment. Layout drawings shall be submitted early. No Work shall proceed until such drawings have been returned (with review stamp affixed) by ENGINEER.

O. Shop Drawings shall include all information on electrical components and characteristics, appropriate curve data at various operating and efficiency levels, manufacturer's motor data sheets, hardware and accessories. Electrical characteristics include electrical power supply required and electrical loading information. Shop Drawings will not be reviewed and returned until all such information is received.

P. CONTRACTOR may utilize Contract Drawings with necessary details marked thereon for electrical conduit layout drawings. However, the Drawings must have CONTRACTOR's title block in lieu of ENGINEER's title block.

1.6 SPECIFIC SUBMITTAL REQUIREMENTS

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

B. Requests for Substitution or "Or Equal"

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

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

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

C. Shop Drawings:

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

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

3. Include on each drawing or page:

a. Submittal date and revision dates.

b. Project name, division number and descriptions.

c. Detailed specifications section number and page number.

d. Identification of equipment, product or material.

e. Name of CONTRACTOR and Subcontractor.

f. Name of Supplier and Manufacturer.

g. Relation to adjacent structure or material.

h. Field dimensions, clearly identified.

i. Standards or Industry Specification references.

j. Identification of deviations from the Contract Documents.

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

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

4. Provide 8-inch by 3-inch blank space for CONTRACTOR and ENGINEER stamps.

5. Submittals:

a. Submit a PDFcopy.

6. Distribution:

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

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

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

D. Miscellaneous Submittals:

1. Inspection and Test Reports:

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

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

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

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

3. Survey Data:

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

1) Survey Copies: Furnish 2 copies. Provide 10 copies of final property survey (if any).

2) Condition Surveys: Furnish 2 copies.

1.7 CERTIFICATES

A. When specified in individual Specifications Sections, submit certification by the manufacturer, installation/application subcontractor, or CONTRACTOR to ENGINEER, in quantities specified for Shop Drawings.

B. Indicate material or equipment conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or equipment but must be acceptable to ENGINEER.

1.8 MANUFACTURER'S INSTRUCTIONS

A. Keep one copy of manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing on Site. Maintain with Record Documents as required under Section 017839 – Project Records and Documents.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.9 RE-SUBMITTAL REVIEW

A. Cost of Subsequent Reviews: Shop Drawings and Operation and Maintenance Manuals submitted for each item will be reviewed no more than twice at the OWNER's expense. All subsequent reviews will be performed at times convenient to the ENGINEER and at the CONTRACTOR's expense based on the ENGINEER's then prevailing rates including all direct and indirect costs and fees. Reimburse the OWNER for all such fees invoiced to the OWNER by the ENGINEER.

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

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 03 31 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnishing all labor, materials, equipment and incidentals required for all cast-in-place concrete, including reinforcing steel, forms, water stops and miscellaneous related items such as sleeves, reglets, anchor bolts, inserts and embedded items specified under other Sections.

1.2 REFERENCE STANDARDS

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 305 - Recommended Practice for Hot Weather Concreting.

C. ACI 315 - Details and Detailing of Concrete Reinforcement.

D. ACI 347 - Recommended Practice for Concrete Formwork.

E. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

F. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

G. ASTM C33 - Concrete Aggregates.

H. ASTM C94 - Ready-Mixed Concrete.

I. ASTM C150 - Portland Cement.

1.3 SUBMITTALS

A. Shop Drawings: Submit completely detailed working drawings and schedules of all reinforcing required in accordance with Section 013000. Do not fabricate reinforcement until shop drawings have been reviewed and accepted by the ENGINEER.

1.4 QUALITY ASSURANCE

A. Concrete work shall conform to all requirements of ACI 301 and ACI 347, except as modified herein.

B. Protection: Store concrete reinforcement in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond breaking coatings.

PART 2 PRODUCTS

2.1 CEMENT

A. Cement: ASTM C150, Portland Type Il Type II if concrete will be in contact with wastewater.

2.2 AGGREGATES

A. Fine Aggregate: ASTM C33.

B. Coarse Aggregate: ASTM C33, 3/4-inch maximum size.

2.3 ADMIXTURES

A. Air Entraining: "Darex AEA" by W.R. Grace, or equal.

B. Water Reducing: "WRDA with Hycol" by W.R. Grace, or equal.

C. No other admixtures are permitted without prior acceptance by the ENGINEER.

2.4 CONCRETE

A. Air Entraining: "Darex AEA" by W.R. Grace, or equal.

B. Water Reducing: "WRDA with Hycol" by W.R. Grace, or equal.

C. No other admixtures are permitted without prior acceptance by the ENGINEER.

2.5 REINFORCING

A. Reinforcing Steel: ASTM A615, Grade 60 deformed bars.

B. Welded Wire Fabric: ASTM A185.

C. Fabricate reinforcing steel in conformance with ACI 315.

2.6 FORMS AND ACCESSORIES

A. Lumber: All form lumber shall be in accordance with ACI 347.

B. Form Ties: Removable metal of fixed length; cone type, 1-1/4 inch maximum diameter; 1 inch break back dimension; and waterproofing washer. Wire ties and wood spreaders not permitted.

C. Form Release Agent: Colorless material which will not stain concrete nor absorb moisture nor impair natural bonding or color characteristics of coating intended for use on concrete.

D. Dovetail Anchor Slots: Galvanized steel; easily removed foam filler; bent tab anchors; securable to concrete formwork.

E. Waterstop: Waterstop shall be extruded polyvinyl chloride or cold joint waterstop (volclay) as shown on the Drawings.

F. Supports and Accessories: Provide bar supports and other accessories and, if necessary, additional supports to hold bars in proper position while concrete is being placed.

1. Use side form spacers against vertical or sloping forms to maintain prescribed side cover and cross position of bars.

2. Use individual hi-chairs with welded cross ties or circular hoops to support top bars in slabs thicker than 8 inches.

3. Bolsters, chairs and other accessories:

a. Use hot-dipped galvanized or provide plastic coated legs when in contact with forms for surfaces of concrete other than architectural surfaces.

b. Use stainless steel when in contact with forms for architecturally exposed surfaces.

c. Use epoxy coated bolsters, chairs and accessories including wire ties for epoxy coated reinforcing bars.

d. Use chairs of an approved type and space them properly to support and hold reinforcing bars in position in all beams and slabs including slabs placed directly on the subgrade or work mat. Do not use continuous hi-chairs for supporting of top bars in slabs over 8 inches in thickness.

PART 3 EXECUTION

3.1 GENERAL

A. Design, and construct formwork, fasework, shoring, and bracing to meet all loads during placement and curing, so that cast-in-place concrete conforms to required finishes, shapes, lines, and dimensions.

B. Provide for inserts, openings, sleeves, offsets, recesses, anchorage, blocking, and other penetrations and embedments.

C. Embedded Items: Set required steel frames, angles, bolts, inserts, and other items required to be anchored in the concrete before the concrete is placed.

D. Form Release Agent: Do not apply form release agent where concrete surfaces are scheduled to receive special finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water and keep surfaces wet prior to placing concrete. Apply form release agent in accordance with manufacturer's instructions.

3.2 REINFORCING

A. Fabrication:

1. Fabricate all reinforcement in strict accordance with the reviewed and accepted shop drawings.
2. Do not use bars with kinks or bends not shown on the Drawings or on the reviewed and accepted shop drawings.
3. Do not bend or straighten steel in a manner that will damage the material.

B. Placement:

1. Accurately place all concrete4 reinforce4menbt, positively securing and supporting by bolsters, metal chairs or spacers, or other approved support.

2. Splicing:

a. Place bars with minimum 36 bar diameter overlap at splices.

b. Lapped ends of bars may be placed in contact and securely wired or may be separated 1-1/2 inches minimum to permit the embedment of the entire surface of each bar in concrete.

c. Stagger the splices of adjacent bars.

d. Splice wire fabric at least 1-1/2 meshes wide.

C. Dowels: Place all required steel dowels and securely anchor them into position.

D. Obstructions: If conduits, piping, inserts, sleeves, or any other items interfere with placing reinforcement as indicated on the Drawings or as otherwise required, immediately consult the ENGINEER for proper placement before placing concrete.

E. Steel reinforcement shall be free from rust scale, loose mill scale, oil, paint, and all other coatings which will destroy or reduce bond between steel and concrete.

3.3 INSPECTION

A. Verify that all formwork, reinforcing and work of other trades are complete and ready for placement of concrete.

B. Notify ENGINEER at least 48 hours before placing concrete. Do not proceed without notifying ENGINEER.

3.4 CONCRETE MIXING AND PLACEMENT

A. All cast-in-place concrete shall be transit-mix concrete in accordance with ASTM C94.

B. Retempering of concrete is not permitted.

C. Weather Conditions: Do not place concrete when weather conditions are not suitable for the proper placing, finishing or curing of the concrete. Unless otherwise accepted by the ENGINEER, place concrete only during dry weather. In the event of sudden rainstorms, cover exposed, freshly placed concrete and protect from damage. When cold or hot weather concreting is authorized by ENGINEER, comply with ACI 305 and ACI 306.

D. Conveying and Placing Concrete: Convey concrete to the forms as rapidly as practicable, utilizing methods which will not cause segregation or loss of ingredients. Free fall from mixer or truck to conveyance shall not exceed 3 feet. When placing concrete in final position, the free fall shall not exceed 5 feet. Place concrete in horizontal layers approximately 2 feet thick and avoid the formation of cold joints and poorly bonded sections between layers. The horizontal distribution of concrete by spading or vibration is prohibited.

E. Vibration: Unless otherwise specified or directed by ENGINEER, vibrate all reinforced concrete. Use only approved mechanical vibrators operated by experienced operators. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Vibrate concrete sufficiently to produce satisfactory consolidation without causing segregation. Do not use vibrators to transport concrete in the forms or insert them into lower layers of concrete that have begun to set.

3.5 CONCRETE TESTING

A. CONTRACTOR shall prepare, cure and have tested by an independent laboratory, one (1) set of four (4) test cylinders for each concrete placement in accordance with Chapter 16 of ACI 301.

B. CONTRACTOR shall pay for all concrete testing including all supplemental testing required if the cylinders break at lower than the required strength.

C. A minimum of one slump test shall be performed by the CONTRACTOR for each batch of concrete and when additional water is added.

3.6 CURING

A. Concrete shall be water cured, or cured using curing compounds or waterproof paper and sheeting, or other acceptable methods. Minimum curing period shall be 7 days.

3.7 REMOVAL OFR FORMS

A. Forms shall be removed in accordance with ACI 347 only after concrete has attained sufficient strength to support its own weight, construction live loads placed thereon, and lateral loads, all without excessive deflection or damage to the structure.

B. CONTRACTOR shall be fully responsible for the proper removal of forms, installing all shoring and reshoring, and removal of shores and reshores. The CONTRACTOR shall, at no additional cost to OWNER, replace any work damaged due to improper or early removal of forms, shores and reshores.

C. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.

3.8 FINISHING CONCRETE

A. Provide finishe4s in accordancfe with ACI 301 as follows:

1. Rough Form Finish: All concrete surfaces not exposed to view.

2. Grout Cleaned Finish: All vertical concrete surfaces exposed to view.

3. Floated Finish: Concrete floor slabs.

4. Light Broom Finish: Concrete equipment slabs.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 05 05 19
POST-INSTALLED ANCHORS IN CONCRETE

PART 1 GENERAL

1.1 THE SUMMARY

A. Provide post-installed anchors and appurtenances, complete and in place, as indicated in accordance with the Contract documents.

B. Unless otherwise indicated, drilled concrete anchors shall be adhesive anchors.

C. Section includes:

1. Adhesive anchors
2. Expansion anchors
3. Screw anchors
4. Undercut anchors (dynamic loading)

1.2 DEFINITIONS AND REFERENCES

A. Definitions

1. Epoxy anchors are considered to be adhesive anchors.
2. Expansion anchors, screw anchors, and undercut anchors are considered to be mechanical anchors.)

B. References

1. 2020 Florida Building Code, 7th Edition
2. ACI 318 – Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary
3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary (ACI 350-06)
4. ACI 355.2 – Qualification of Post Installed Mechanical Anchors in Concrete and Commentary (ACI 355.2-07)
5. ASCE 7 – ASCE Standard ASCE/SEI 7-10Minimum Design Loads for Buildings and Other Structures
6. ICC ES AC 193 – Mechanical Anchors in Concrete Elements
7. ICC ES AC 308 –Post Installed Adhesive Anchors in Concrete Elements
8. NSF 61 – NSF/ANSI 61-2016 Drinking Water System Components – Health Effects

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00.

B. Submit the following:

1. Product data and technical information

2. Safety Data Sheets (SDS) for adhesives

3. Manufacturer’s literature containing installation instructions and appropriate uses for each type of post-installed anchor and location of use

4. Current ICC-ES or IAPMO-UES Evaluation Reports

5. Certification for each installer demonstrating that they have been qualified in accordance with the Quality Assurance requirements below

C. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

1.4 QUALITY ASSURANCE

A. Special inspection for all post-installed anchor installations shall be provided:

1. As required by the enforceable building code.

2. As otherwise indicated in the Contract Documents.

B. The most stringent of the above requirements shall be used. The cost of Special Inspection of post-installed anchors shall be paid for by the OWNER.

C. Before installing adhesive anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading if required.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

D. Before installing adhesive anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, and torqueing.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

E. Defective anchors noted by the Special Inspector shall be replaced and re-installed by the CONTRACTOR without any additional compensation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

C. Anchoring adhesives shall be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

1.6 SITE CONDITIONS

A. Post-installed anchors shall be installed in concrete having a minimum age of 21 days at time of anchor installation.

B. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed. Anchors, nuts, and washers in the locations listed below shall be fabricated from type 316 or 304 stainless steel:

1. buried locations

2. submerged locations

3. locations subject to seasonal or occasional flooding

4. inside hydraulic structures below the top of the structure

5. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

6. chemical handling areas

7. inside trenches, containment walls, and curbed areas

8. locations indicated or designated by the ENGINEER to be provided with stainless steel anchors.

PART 2 PRODUCTS

2.1 ADHESIVE ANCHORS

A. General

1. The adhesive anchor system shall consist of: 1) adhesive product; and 2) threaded rod or reinforcing bar insert. The complete system shall be compatible as required by the adhesive manufacturer.

2. Adhesives shall be injectable, two-component, cartridge-type systems dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the adhesive anchor for the intended purpose and location.

4. Adhesive anchors shall be permitted when regular ambient temperatures are consistent with manufacturer's recommendation for long and short term temperatures.

5. Adhesive anchors shall not be used where anchors are subject to vibration or fire.

6. Adhesive anchors shall not be used in overhead applications.

7. Where required, adhesive shall be capable of being used in submerged applications once cured.

8. Adhesive shall meet the requirements of NSF/ANSI Standard 61.

B. Adhesive Anchors in Concrete

1. Adhesive anchors for concrete shall be HIT-RE 500 V3 by Hilti, SET-XP by Simpson Strong-Tie or approved equal. Threaded rod shall be stainless steel as indicated on the project documents.

2. Reinforcing dowel inserts shall meet the material requirements of 03 30 00– Cast-in-Place Concrete.

3. Adhesive for use in concrete adhesive anchors shall be certified for use in accordance with ICC-ES AC 308.

4. Where not detailed on the drawings, adhesive anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC 308.

5. Adhesive anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and shall have been tested and qualified for performance in cracked and uncracked concrete in accordance ICC-ES AC308 to resist static, wind, and earthquake (Seismic Design Categories A through F).

2.2 EXPANSION ANCHORS

A. General

1. Expansion anchors are post-installed torque-controlled mechanical expansion anchors used to resist structural loads.

2. Expansion anchors shall be an imperial sized, threaded stud with an integral cone expander, expansion clip, nut and washer.

3. Lead caulking anchors will not be permitted.

4. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

5. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the expansion anchor for the intended purpose and location.

6. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Expansion Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318, which requires post-installed mechanical anchors to be qualified according to ACI 355.2.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193.
3. Expansion anchors shall be Strong-Bolt 2 by Simpson Strong-Tie, Kwik-Bolt TZ by Hilti or approved equal.

2.3 SCREW ANCHORS

A. General

1. Screw anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

2. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the screw anchor for the intended purpose and location.

3. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Screw Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ICC-ES AC193.

3. Screw anchors for concrete shall be Titen HD by Simpson Strong-Tie, Kwik HUS-EZ (KH-EZ) by Hilti or approved equal.

2.4 UNDERCUT ANCHORS

A. General

1. Undercut anchors are post-installed mechanical anchors that require pre-drilling and a special undercut notch configuration cut into the concrete before installation.

2. Self-undercutting anchors are post-installed torque-controlled mechanical anchors that cut their own undercut notch by application of a setting torque that forces a sleeve over a cone.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the undercut anchor for the intended purpose and location.

4. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

5. Undercut anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

B. Undercut Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been

tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193.

3. Undercut anchors for concrete shall be HDA by Hilti or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Post-installed anchors shall be installed in strict accordance with the manufacturer's instructions, the ICC-ES or IAPMO-UES report, and project specific design requirements indicated on the Contract Documents.

B. Where holes are drilled in concrete, holes shall be accurately and squarely drilled, and the holes shall be cleaned in accordance with the manufacturer’s recommendations.

C. Post-installed anchors shall not be installed until the concrete has reached the required 21 days or per manufacturer’s requirements, whichever is longer.

D. Acceptable installation and performance temperature ranges shall be verified with manufacturer’s literature prior to installation. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.

E. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

F. The CONTRACTOR shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

G. Core drilling of holes is not allowed.

H. Identification of reinforcing steel and/or embedded items, relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the WORK and shall be provided at no additional cost to the OWNER.

I. All abandoned drilled holes shall be repaired in accordance with Section 037500 Concrete Repair and Rehabilitation at no additional cost to the OWNER.

END OF SECTION

SECTION 05 11 00
STRUCTURAL STEEL

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnishing all structural steel and accessories to support exterior FRP Ductwork.

B. Erecting all structural steel.

C. Inspection and testing of high strength bolted connections and welded connections.

1.2 REFERENCE STANDARDS

A. AISC - Manual of Steel Construction.

B. AISC - Code of Standard Practice for Steel Buildings and Bridges.

C. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

D. AISC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.

E. ASTM A27 - Steel Castings, Carbon, for General Application.

F. ASTM A36 - Structural Steel.

G. ASTM A992- Structural Steel.

H. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

I. ASTM A325 - High-Strength Bolts for Structural Steel Joints.

J. ASTM A490 - Heat-Treated, Steel Structural Bolts 150 ksi (1035 MPa) Tensile Strength.

K. ASTM E165 - Liquid Penetrant Inspection.

L. ASTM E709 - Magnetic Particle Examination.

M. AWS A2.4 - Symbols for Welding and Nondestructive Testing.

N. AWS D1.1 - Structural Welding Code - Steel.

O. SSPC - Steel Structures Painting Council; Manual - Volume 2, Systems and Specifications.

P. SSPC SP2 - Paint System Guide No. 2.00.

1.3 SUBMITTALS

A. Submit shop drawings, prepared under supervision of a registered professional engineer, in accordance with Section 01 33 00. Do not fabricate structural steel until shop drawings have been reviewed and accepted by the ENGINEER.

1. Indicate sizes, spacing, and locations of structural members, connections, attachments, fasteners, and cambers.

2. Indicate welds by standard AWS A2.4 symbols, and show size, length and type of each weld.

B. Submit certification sufficient to verify that welders, welding operators and tackers to be employed for welding structural steel have been qualified in accordance with AWS D1.1.

C. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed.

D. Submit manufacturer's certifications and laboratory test reports for the following items to show compliance with specifications:

1. Structural steel (each type) certified copies of mill reports covering chemical and physical properties.

2. High strength bolts (each type) including nuts and washers.

3. Structural steel primer paint.

4. Nonshrink grout.

1.4 QUALITY ASSURANCE

A. Comply with all applicable requirements of the following standards and specifications, except as modified in this Section:

1. AISC Code of Standard Practice for Steel Buildings and Bridges, except delete from Section 4.2.1: "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."

2. AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, including "Commentary" and Supplements thereto as issued.

3. AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.

4. AWS D1.1 Structural Welding Code - Steel.

B. Qualify welding procedures, welders, welding operators and tackers in accordance with AWS D1.1.

C. Keep copies of AISC Manual of Steel Construction and AWS D1.1 in field office for duration of project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site at such intervals to insure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to prevent delay of that work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Do not store materials in a manner that might cause distortion or damage to the steel members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rolled Steel Plates, Shapes and Bars: ASTM A36, unless otherwise indicated.

B. Rolled Steel Shapes: ASTM A992.

C. Anchor Rods: ASTM F1554 Grade 55, unless otherwise indicated.

D. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers complying with ASTM A325 Type 1.

E. Electrodes for Welding: Comply with AWS D1.1.

F. Structural Steel Primer Paint: SSPC - Paint 13 Red Iron Oxide Metal Primer.

2.2 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of all structural steel shall be new and acceptable to the ENGINEER.

2.3 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC specifications and as indicated on the final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match-mark materials for field assembly.

2. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated on Drawings.

1. Bolt field connections, except where welded connections or other connections are indicated.

2. Provide high-strength threaded fasteners for all bolted connections.

C. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC Specifications for Structural Joints using ASTM A325 or A490 Bolts.

D. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welded work.

E. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members, as shown on the final shop drawings. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.4 SHOP PAINTING

A. General : Shop paint all structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint the exposed portions of embedded steel and the initial 2 inches of embedded areas only.

1. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections or surfaces scheduled to receive spray-on fireproofing.

2. Painted steel to be exposed to weather shall be painted according to SSPC-SP2.

3. Apply 2 coats of paint to surfaces which will be inaccessible after assembly or erection, or steel embedded in exterior masonry walls. Change color of second coat to differentiate it from the first.

B. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose rust, loose mill scale and spatter, slag or flux deposits. Clean steel in accordance with SSPC as follows:

1. SP-6 Commercial Blast - for steel exposed to weather.

C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness of 2.0 mils. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

PART 3 EXECUTION

3.1 INSPECTION

A. Erector must examine the areas and conditions under which structural steel work is to be installed and notify the CONTRACTOR in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Erector.

3.2 WELDING

A. General: Follow all applicable sections of the AWS specifications.

B. Types of welds:

1. Make all fillet welds ¼-incfh minimum.

2. Make all butt welds full penetration welds.

3.3 ERECTION

A. Comply with AISC specifications and AISC Code of Standard Practice, and as specified.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete Work.

D. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

E. Setting Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

2. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with grout manufacturer's instructions.

F. Field Assembly: Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure within specified AISC tolerances.

2. Splice members only where indicated and accepted on shop drawings.

G. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

H. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

I. Do not enlarge holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

J. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to the ENGINEER. Finish gas-cut sections equal to a sheared appearance when permitted.

3.4 TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and areas where shop paint is abraded. Apply same paint as used for shop painting to cleaned, exposed areas. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

3.5 FIELD QUALITY CONTROL

A. OWNER will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

1. The testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state any deviations therefrom.

2. The testing agency may inspect structural steel at the plant before shipment; however, the ENGINEER reserves the right, at any time before final acceptance, to reject material not complying with specified requirements. Provide access for the testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

3. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated not to be in compliance with requirements at no additional cost to the OWNER and with no additional time under the Contract. Additional tests as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work will be at the CONTRACTOR'S expense.

B. Bolted Connections (Shop and Field): Inspect or test in accordance with AISC specifications.

C. Welding (Shop and Field): Inspect and test during fabrication of structural steel assemblies, as follows:

1. The testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state any deviations therefrom.

2. The testing agency may inspect structural steel at the plant before shipment; however, the ENGINEER reserves the right, at any time before final acceptance, to reject material not complying with specified requirements. Provide access for the testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

3. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated not to be in compliance with requirements at no additional cost to the OWNER and with no additional time under the Contract. Additional tests as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work will be at the CONTRACTOR'S expense.

a. Liquid Penetrant Inspection: ASTM E165.

b. Magnetic Particle Inspection: ASTM E709; performed on the root pass and on the finished weld. Cracks or zones of the incomplete fusion or penetration are not acceptable.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnishing all joint sealants as shown on the Drawings and as specified herein.

B. Installation.

1.2 SUBIMTTALS

A. Submit manufacturer's product data and installation instructions in accordance with Section 01340.

B. Submit list of products to be used, the location where each of the products will be used and the conditions required for use.

C. Submit charts for color selection.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications: Based on materials manufactured by Tremco and Pecora.

B. Substitutions: Products of equal quality, detail, function, and performance may be proposed for substitution by following the procedures in Section 01 61 00.

2.2 SEALANTS

A. Tremco Dymeric 3-Part epoxidized polyurethane terpolymer sealant, TT-S-00227E, Class A.

1. Masonry control joints.

2. Expansion joints.

B. Joint Backing Bond Breaker:

1. Adhesive backed polyethylene bond breaker tape.

2. Expanded polyethylene joint backing: flexible, compressible, nonstaining, closed-cell polyethylene in round or square shape of not less than 10 psi compressions deflection (25%); except provide higher compression deflection strength as may be necessary to withstand installation forces and provide proper support for sealants; surface water absorption of not more than 0.1 lbs. per square foot.

C. All sealants to be in color selected and to match adjacent surfaces where applicable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Clean joint surfaces and prime as recommended by sealant manufacturer.

1. Concrete and Masonry Surfaces: Wire brush surface; air blow clean; wipe with clean, dry rag.

B. Support sealant from back with construction as shown, or with joint filler, or with backer rod where necessary to provide joint configuration as shown on the Drawings or as required by the sealant manufacturer.

C. Provide bond breaker where backing is not required.

D. Nontraffic joints: Depth equal to 50% of normal joint width, but not more than 1/2 inch and not less than 1/4 inch.

E. Bond or "weld" ends of gasket members to form a continuous, uninterrupted seal; miter corners or use molded corner units.

F. Spread sealant over entire contact surface of door saddles.

G. Apply with gun nozzle opening so bead will fill the joint completely. Tool bead immediately after application of bead.

H. Install sealants in compliance with the manufacturer's recommendation.

I. Immediately after application of sealant, tool joint using materials and techniques recommended by manufacturers. Immediately remove all excess sealant and smears from surfaces adjacent to joint using solvents recommended by manufacturer.

END OF SECTION

SECTION 09 24 00
PORTLAND CEMENT PLASTERING

PART 1 GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Exterior Portland cement plasterwork (stucco) on solid bases. To repair areas damaged by construction activities.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of matching finish coat indicated; 12 by 12 inches, and prepared on rigid backing.

1.3 QUALITY ASSURANCE

A. Mockups: Before plastering, install mockups of at least 5 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install mockups for each type of finish indicated.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial completion.

1.4 PROJECT CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Exterior plasterwork: Apply plaster when ambient temperature is greater than 40 deg F (4.4 deg C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in portland cement plaster.

C. Bonding Compound: ASTM C 932.

2.3 PLASTER MATERIALS

A. Portland Cement: ASTM C150, Type II.
   1. Color for Finish Coats: To match existing.

B. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match existing.

C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

D. Sand Aggregate: ASTM C 897.
   1. Color for Job-Mixed Finish Coats: To match existing.

E. Ready- Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.
   1. Products:
      a. California Stucco Products Corp.; Conventional Portland Cement Stucco.

      b. ChemRex; Thoro Stucco.

      c. Florida Stucco Corp.

      d. Highland Stucco & Lime Products, Inc.

      e. United States Gypsum Co.; Oriental Exterior Finish Stucco.

   2. Color: To match existing.

2.4 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.
   1. Fiber content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. ft. (16 kg of fiber/cu. m) of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

B. Portland Cement:
   1. Over Concrete Unit Masonry: Single base coats for two-coat plasterwork as follows:
      a. For cementitious material, mix 1-part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4-parts aggregate per part of cementitious material (sum of separate volumes of each component material).

C. Port Cement Job-Mixed Finish-Coat Mixes: For cementitious materials, mix 1-part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3-parts aggregate per part of cementitious material (sum of separate volumes of each component material).

D. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters, comply with manufacturer's written instructions.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid-plaster bases that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.2 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

B. Bonding Compound: Apply on unit masonry plaster bases.

C. If various finishes are required, indicate locations of each on Drawings or by inserts in first paragraph below.

D. Plaster Finish Coats: Apply to provide finish to match existing.

E. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

3.3 CUTTING AND PATCHING

A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing (check cracking), dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 09 96 00
HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall provide protective coatings, complete and in place, in accordance with Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means Dry Film Thickness.

C. The following surfaces shall not be coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.

2. Stainless steel

3. Machined surfaces

4. Grease fittings

5. Glass

6. Equipment nameplates

7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

8. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

The coating system schedules summarize the surfaces to be coated, the required surface preparation. And the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

01 33 00	Submittal Procedures
01 61 00	Material and Equipment

B. Reference Standards

ASTM International (ASTM)	
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D3276	Standard Guide for Painting Inspectors (Metal Substrates)
ASTM D4060	Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
American Water Works Association (AWWA)	
AWWA D102	Coating Steel Water-Storage Tanks
ANSI/AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
NACE International (NACE)	
NACE RP0287-02	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
Occupational Safety and Health Administration (OSHA)	
OSHA 29CFR1910.1200	Hazard Communication
Society for Protective Coatings (SSPC)	
SSPC Guide 12	Guide for Illumination of Industrial Painting Projects
SSPC PA 1	Shop, Field, and Maintenance Coating of Metals
SSPC PA Guide 11	Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
SSPC SP 1	Solvent Cleaning
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 5/NACE No. 1	White Metal Blast Cleaning

SSPC SP 6/NACE 3	Commercial Blast Cleaning
SSPC SP 7/NACE 4	Brush-off Blast Cleaning (NACE No. 4)
SSPC SP 10/NACE 2	Near-White Blast Cleaning
SSPC SP 11	Power Tool Cleaning to Bare Metal
SSP SP 13	Surface Preparation of Concrete

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittals.

B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating Work:

1. Materials List: A copy of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.

2. Manufacturer's Information: For each coating system to be used, the following data:

a. Manufacturer's data sheet for each proposed product

b. Manufacturer’s statements on the suitability of the proposed products for the intended use. Include in the statement confirmation that the coating manufacturer’s technical engineering representative inspected all existing substrate and/or surfaces with existing coatings and confirmed that the proposed products, application procedures and surface preparation requirements are compatible with the coatings required by this Section.

c. Technical and performance information that demonstrates compliance with the system performance and material requirements.

d. Paint manufacturer's instructions and recommendations on surface preparation and application.

e. Colors available for each product (where applicable).

f. Compatibility of shop and field applied coatings (where applicable).

g. Safety Data Sheet for each product proposed.

C. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

D. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating Work:

1. Materials List: A copy of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.

2. Manufacturer's Information: For each coating system to be used, the following data:

a. Manufacturer's data sheet for each proposed product

b. Manufacturer’s statements on the suitability of the proposed products for the intended use. Include in the statement confirmation that the coating manufacturer’s technical engineering representative inspected all existing substrate and/or surfaces with existing coatings and confirmed that the proposed products, application procedures and surface preparation requirements are compatible with the coatings required by this Section.
c. Technical and performance information that demonstrates compliance with the system performance and material requirements.

d. Paint manufacturer's instructions and recommendations on surface preparation and application.

e. Colors available for each product (where applicable).

f. Compatibility of shop and field applied coatings (where applicable).

g. Safety Data Sheet for each product proposed.

E. Quality Assurance Plan

1. Submit for review the written project-specific Quality Control Program to be followed. Primary duties and responsibilities of the QCS as outlined in the Quality Control Program shall include but are not limited to the following:

a. Ensuring that qualified personnel perform the Work on the project.

b. Ensure that proper inspection forms and recording procedures are used for job quality monitoring (including those required herein).

c. Ensure correct and properly operating and calibrated equipment is used.

d. Review and sign off on Daily Inspection Reports (DIRs) on a timely basis (QCS must sign off or authorize review of DIRs by other competent QC personnel).

e. Ensure that Work is inspected for conformance with the contract requirements, good painting practice, and internal Quality Control (QC) procedures.

f. Ensure that nonconforming work and rework is properly documented.

g. Develop and/or review Inspection and Test Plans.

h. Conduct and/or review internal audits.

2. Submit for documentation written project-specific procedures for all production processes to be used on the project. The procedures shall include, but are not limited to the following:

a. Standard company or contract specific procedures are available to and used by on-site personnel for verifying that coating and related operations are performed in accordance with contract requirements and industry best practices.

b. Inspection procedures or project specific inspection plans ensuring that all work is properly performed and documented daily during coating operations or documented in accordance with contract requirements, are available to site personnel, and are used to perform in-process inspections of work at key hold points.

c. Abrasive blasting (dry or wet) and related processes

d. Water jetting and related processes

e. Hand and power tool cleaning and related processes

f. Coating mixing and related processes

g. Coating application (e.g., brush, roller, spray, mitt) and related processes

h. Top coating procedures (e.g., conditions when meeting and exceeding recoat windows)

i. Curing process for materials applied

j. Erecting, moving, and tearing down containment.

k. Field audits performed on site confirming equipment is in good operating condition.

3. Submit for review and documentation Daily Inspection Reports (DIRs) to ENGINEER on a weekly basis. All DIRs and testing results shall be maintained on file for the duration of the project. DIRs must be signed and dated by the Contractor and formally reviewed by the QCS. DIRs and other daily reports shall record project relevant observations including:

   a. Compressed air cleanliness

   b. Air temperature (dry and wet bulb)

   c. Relative humidity

   d. Dew point

   e. Substrate surface temperature

   f. Abrasive cleanliness

   g. Surface preparation cleanliness specified and achieved.

   h. Surface profile specified and achieved.

   i. Illumination of work area (foot candles for surface preparation, coating application, and inspection) in accordance with SSPC Guide 12 recommendations or contract requirements.

   j. Batch numbers of coatings and thinners

   k. Mixing of coatings (in accordance with coating manufacturer's mixing instructions)

   l. DFT readings for each applied coating meeting specification requirements.

   m. Inspection instruments used (manufacturer, model, and serial number)

   n. Storage temperature and storage conditions to include min/max daily, or as required.

1.4 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. Nonconforming work, identified by CONTRACTOR, OWNER, ENGINEER or OWNER'S REPRESENTATIVE performing QA on behalf of the Owner shall be documented and repaired.

B. Inspection: An inspection may be conducted during the eleventh month following completion of coating Work. The Contractor and a representative of the coating material manufacturer shall attend this inspection. Defective Work shall be repaired in accordance with these specifications and to the satisfaction of the Owner. The Owner may, by written notice to the Contractor, reschedule the inspection to another date within the one-year correction period or may cancel the inspection altogether. The Contractor is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

1.5 COMPLIANCE WITH VOLATILE ORGANIC COMPOUND (VOC) LIMITS

A. All paint and coating products shall comply with the applicable limits on volatile organic compounds (VOCs) as established by the United States Environmental Protection Agency and by state and local air quality regulating agencies. It shall be the Contractor's responsibility to verify compliance of all paints and coatings.

B. Listed products in this specification are based on a maximum VOC level of 450 g/L. If local limits on VOCs are higher or lower, the Contractor shall propose substitute products that are compliant with local limits and equivalent in performance to the listed product. The Engineer shall determine if the proposed product is equivalent or equal to the named product in accordance with the requirements of Section 01 61 00 - Material and Equipment.

PART 2 PRODUCTS

2.1 GENERAL

A. Suitability: The Contractor shall use suitable coating materials as recommended by the manufacturer.

B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the Contractor shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

E. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the Owner. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the Owner.

F. Substitute or "Or-Equal" Products

1. To establish equality under Section 01 61 00 – Material and Equipment, the Contractor shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
   a. Suitability for the intended service
   b. Compatibility with other coatings
   c. Resistance to chemical attack
   d. Minimum and maximum recoat times
   e. Minimum and maximum cure time for immersion
   f. Abrasion resistance per ASTM D4060 using CS17 Wheel
   g. Maximum and minimum dry film thickness per coat
   h. Temperature limitations during application and in service
2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the Contractor shall provide the Engineer with the names of not less than 10 successful applications and case histories of the proposed manufacturer's products that comply with these requirements.
3. If a proposed substitution requires changes in the Work, the Contractor shall bear such costs involved as part of the Work.

2.2 INDUSTRIAL COATING SYSTEMS

A. System 1 - Acrylic Polymer

1. Materials

Primer	Manufacturer's recommendation
Finish Coat	1 component water-based acrylic
Type	Pure acrylic emulsion
Demonstrated suitable for	ferrous and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance
VOC Content, max (g/L)	450

2. Application and manufacturers

Prime Coat (DFT = 2 to 4 mils)	**Finish Coat (DFT = 2 to 4 mils)**	**Total System DFT**
PPG Pitt Tech Plus	PPG Pitt Tech Plus	4 to 8 mils
Tnemec Series 115 Unibond	Tnemec Series 1028 Enduratone for Gloss finish (use Series 1029 for Semi-Gloss finish)	
Carboline Sanitile 120	Carbocrylic 3359 Series	

Sherwin Williams Pro Industrial Procryl	Sherwin Williams Pro Industrial Acrylic	

B. System 4 - Epoxy/Polyurethane

1. Materials

Primer type	2 component epoxy
VOC Content, max (g/L)	450
Finish type	2 component aliphatic polyurethane
VOC Content, max (g/L)	450
Demonstrated suitable for	ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	**Finish Coat (DFT = 3 - 4 mils)**	**Total System DFT**
Carboline Carboguard 890	Carbothane 134 HG	6 - 9 mils
Tnemec Hi-Build Epoxoline II Series L69	Tnemec Endura-Shield Series 1094 for Gloss finish (use Series 1095 for Semi-Gloss finish)	
PPG Amerlock 2/400	Amershield	
Sherwin Williams Macropoxy 646	S W Hi-Solids Polyurethane	

A. System 8 - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max (g/L)	450
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max (g/L)	450

2. Application and manufacturers

Prime Coat (DFT = 4 – 5 mils)	Finish Coat (DFT = 4 – 5 mils)	Total System DFT
PPG- Amerlock 2/400	PPG Amerlock 2/400	8-10 mils
Tnemec Series N69	Tnemec Series N69	
Carboline Carboguard 890 Series	Carboline Carboguard 890 Series	
Sherwin Williams Macropoxy 646	Sherwin Williams Macropoxy 646	

B. System 10 - Acrylic, Concrete

1. Materials

Filler-Sealer Type	Epoxy or acrylic masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	as recommended by manufacturer
VOC Content, max (g/L)	450
Finish Type	single component waterborne pure acrylic emulsion, industrial grade, high molecular weight
VOC Content, max (g/L)	450
Demonstrated suitable for	concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Prime Coat (Filler-Sealer)	Finish Coat (DFT = 5 - 7 mils) (2 or more coats)	Total System DFT
Tnemec EnviroFill Series 130	Tneme-Crete 180 Series	5 - 7 mils plus primer
PPG- Amerlock 400BF and/or Amercoat 965	PPG Pitt-Tech Plus Series	
Carboline Sanitile 500	Carboline - Carbocrylic 3359 DTMC	
Sherwin Williams Pro Industrial Heavy Duty Block Filler	Sherwin Williams Pro Industrial Acrylic	

2.3 SPECIAL COATING SYSTEMS

A. System 208 - Aluminum Metal Isolation

1. Material

Type	high build polyamide epoxy with chemical and abrasion resistance
Demonstrated suitable for	concrete and aluminum substrates, to isolate aluminum from contact with concrete and the resulting chemical degradation
VOC content, max (g/L)	450

2. Application and manufacturers

Coating (DFT = 16 - 20 mils)
PPG Sigmashield 880
Sherwin Williams Macropoxy 646
Tnemec Epoxoline Series N69
Carboline - Carboguard 890 Series

PART 3 EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The Contractor shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

B. The Contractor shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 2 hours of on-site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating Work.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the Work shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations**:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.

B. Coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The Contractor shall examine surfaces to be coated and shall correct

surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.

B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent Work during blasting operations. Spraying shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any and all damage to adjacent Work or adjoining property occurring from blasting or coating operations.

E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.5 ENVIRONMENTAL REQUIREMENTS

A. No coating work shall be performed under the following conditions:

1. Surface or ambient temperatures exceed the manufacturer’s recommended maximum or minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid conditions, where the relative humidity is above the manufacturer’s maximum allowable.

4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

5. Ambient temperature that is expected to drop below 50 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.

3.6 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC SP 5/NACE 1): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC SP 6/NACE 3): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC SP 7/NACE 4): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP 10/NACE 2): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. Power Tool Cleaning to Bare Metal (SSPC 11) When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than 1 mil (25 microns).

9. Surface Preparation of Concrete (SSPC-SP 13/NACE 6): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.7 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. The Shop Painting Facility shall use a minimum blast material mixture of 75 percent grit and 25 percent shot material to achieve the proper surface profile.

C. The Field Coating Applicator shall abrasive blast the shop coated surfaces per SSPC SP 7/NACE 4. The previously shop-painted surfaces shall be abraded prior to the application of the final coats. Special attention shall be given to uncoated steel weld joints, coating holdbacks, and bare metal.

D. Grease, oil, and welding fluxes shall be removed by wiping with MEK or naphtha cleaning or with trisodium phosphate detergent per SSPC SP 1.

E. All sharp edges shall be rounded or chamfered and all burrs, rust, scale, welding slag, and spatter shall be removed and the surface prepared by SSPC SP 2 hand tool cleaning, and SSPC SP 3 power tool cleaning.

F. The Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any blasted surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter ($\mu g/cm^2$). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

G. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate's surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

H. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

I. The Contractor shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

J. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.

K. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

L. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

M. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

N. If the required abrasive blast cleaning will damage adjacent Work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP 2 or SSPC SP 3 may be used.

O. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP 1 before the abrasive blast cleaning has been started.

P. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.8 FERROUS METAL SURFANCE PREPARATION (GALVANIZED)

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP 7/NACE 4.

B. Any high spots, sharp protrusions, and rough edges, such as the metal drip line, shall be smoothed to avoid paint film gaps in the areas of the high spots. Surfaces shall be hand tool cleaned per SSPC SP 2 and power tool cleaned per SSPC SP 3.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

D. The surfaces of galvanized steel exposed to chemical splashing or within a wastewater head space shall be abraded per SSPC SP 11 or SP 7 prior to coating.

3.9 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

A. General: Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. Abrasive Blast Cleaning: The Contractor shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP 6/NACE 3. Areas of tightly adhering coatings shall be cleaned to SSPC SP 7/NACE 4, with the remaining thickness of existing coating not to exceed 3-mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the Contractor shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.10 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 Days after the concrete or masonry has been placed. All water retaining structures shall be successfully leak tested prior to coating application.

B. At the discretion of the Inspector, the Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter (µg/cm2). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

C. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate’s surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

D. In accordance with ASTM D4262, test to determine the pH of the concrete surface after the surface has been thoroughly blasted and cleaned. If the pH is outside the range recommended by the coating manufacturer, then the surface must be neutralized by removing concrete until the surface pH of 7 or greater is obtained prior to any coating application. One pH test shall be performed every 200 square feet, or less, and at locations determined by the Inspector.

E. The Contractor shall test for capillary moisture in accordance with ASTM D4263. Moisture tests shall be taken every 200 square feet or less and at locations determined by the Inspector. If capillary moisture is present, the coating manufacturer shall be consulted to determine primer requirements and special coating application criteria.

F. For below grade structures with surface areas greater than 2,000 square feet, the Contractor shall install three anhydrous calcium chloride test kits on bare concrete to measure the Moisture Vapor Transmission Rate (MVTR) on a flat horizontal surface. Testing and calculations shall be performed according to ASTM F1869. The MVTR shall be less than 3 lbs per 1,000 square feet per 24 hours. If the MVTR is greater than 3 lbs per 1,000 square feet per 24 hours, the Contractor shall apply a concrete sealant to reduce the MVTR through the concrete. The test kits shall be undisturbed for a minimum of 60 hours.

G. Surface Voids: Bugholes, honeycomb, or other surface voids greater than 1/4 inch in depth or 1/4 inch in diameter shall be filled in with a resurfacing mortar prior to the application of any primer or finish coat.

H. Holes or other joint defects in masonry shall be filled with mortar and repainted. All voids and cracks shall be repaired as specified. Loose or spatter mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.

I. Coating Pipe Penetrations: A 1/4-inch wide by 3/8-inch deep saw cut shall be made around the circumference of the pipe as it penetrates the concrete. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

J. Coating Floor/Wall Joints: A 1/4-inch wide by 3/8-inch deep saw cut shall be made on the vertical and horizontal concrete surfaces around the perimeter of the floor. The saw cut shall be 2 inches from the joint on both sides. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

K. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP 1 before abrasive blast cleaning.

L. New concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, and deteriorated concrete, and to roughen the surface equivalent to 80 Grit sandpaper or ICRI No. 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays Concrete Surface Profile No. 4.

M. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

3.11 PLASTIC, FIBER GLASS AND NONFERROUS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP 1 followed by sanding or brush-off blast cleaning SSPC SP 7/NACE 4.

C. Surfaces shall be clean and dry prior to coating application.

3.12 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.

B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.

C. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning all surfaces as necessary in accordance with SSPC SP 1 and SP 2. Damaged shop coating shall be cleaned in accordance with SSPC SP 3, Power Tool Cleaning, and recoated with the primer specified.

D. For every 500 square feet, or less, of steel surface blasted, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other RP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, one replica tape test shall be performed. For each test area, the three replica tape thickness values shall be recorded and must be within 10 percent of the coating manufacturer’s recommended profile. If the surface profile does not meet the manufacturer’s recommended profile, two additional tests will be performed within a 12-inch diameter of the initial test. If the values are not satisfactory, the Contractor shall reblast the affected areas.

E. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

F. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

G. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated or less time if recommended by the coating manufacturer.

H. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

I. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.13 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA 1 - Paint Application Specification No. 1.

B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The Contractor shall schedule such inspection with the Engineer in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Contractor shall use an independent stripe coat per SSPC PA Guide 11 for these areas. Particular care shall be used to ensure that the specified coverage is secured on the edges and corners of all surfaces.

F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.

2. Concrete surfaces will be in direct sunlight during application or within 3 hours after application.

3. Dust or smoke laden atmosphere.

4. Damp or humid weather.

5. Substrate or air temperature is less than 5 degrees F above the dew point.

6. Air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.

7. Wind conditions are not calm.

I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

K. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.14 CURING OF COATINGS

A. The Contractor shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.15 IDENTIFICATION OF PIPING

A. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per OSHA Occupational Safety and Health Standards 29CFR1910.1200.

B. Unburied pipes in structures and in chemical pipe trenches shall be color-code painted. Colors shall be as selected by the Owner or as indicated.

3.16 SHOP AND FIELD INSPECTION AND TESTING

A. General: The Contractor shall give the Engineer a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

B. Such Work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such Work in its absence.

C. Inspection by the Engineer, or the waiver of inspection of any particular portion of the Work, shall not relieve the Contractor of its responsibility to perform the Work in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the Engineer to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.

E. Inspection Devices: The Contractor shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for the Engineer's use while coating is being done, until final acceptance of such coatings. The Contractor shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the Engineer.

F. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as **Mikrotest Model FM, Elcometer Model 111/1EZ,** or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

G. Surface Preparation: Confirm proper surface profile with Testex Press-O-Film replica tape in accordance with NACE RP0287-02.

3.17 COATING SYSTEM SCHEDULE, FERROUS METAL – NOT GALVANIZED

	Item	**Surface Prep.**	**System No.**
FM-1	Surfaces of outdoor equipment, exposed or covered.	Commercial blast cleaning SSPC SP 6/NACE 3	(4) epoxy/ polyurethane
FM-2	Structural steel and miscellaneous metalwork supports for odor	Commercial blast cleaning SSPC SP 6/NACE 3	(4) epoxy/ polyurethane

	control piping, ductwork and equipment.		
FM-17	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP 6/NACE 3	(8) epoxy, equipment

3.18 COATING SYSTEM SCHEDULE, FERROUS METAL – GALVANIZED

A. Galvanized surfaces shall be coated as required.

B. Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer.

	Item	**Surface Prep.**	**System No.**
FMG-1	Exposed surfaces indoors and outdoors.	Solvent cleaning SSPC SP 1	(4) epoxy/ polyurethane

3.19 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the Contractor shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	**Surface Prep.**	**System No.**
NFS-1	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC	(208) aluminum metal isolation
NFS-2	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC	(1) Acrylic Polymer

3.20 COATING SYSTEM SCHEDULE – CONCRETE

	Item	**Surface Prep.**	**System No.**
C-1	Perimeter surfaces of odor control equipment concrete mat. Color to be safety yellow for high visibility.	Per paragraph 3.10	(10) acrylic, concrete
C -2	Surfaces of stucco	Per paragraph 3.10	(10) acrylic, concrete

END OF SECTION

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SECTION 23 31 16
FRP DUCTWORK

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide fiberglass-reinforced plastic (FRP) ductwork systems including duct and appurtenances, complete and operable, as indicated and in accordance with the Contract Documents.

B. The WORK includes design calculations to determine duct wall thickness and reinforcements.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 013300 – Submittals.

B. Shop Drawings

1. Submit detailed layout drawings, including details keyed to the layout.

2. Show main and branch runs, fittings, offsets, takeoffs, accessories, supports, anchorage, point loads and seismic restraints.

3. Show dimensions of sub-assemblies to be shipped.

C. Submit specifications, descriptive drawings, catalog cuts, and descriptive literature with physical and mechanical properties, including hanging weight for each size duct.

D. Submit engineering calculations, material selection, wall thickness, pressure, vacuum, and temperature ratings.

E. Submit a letter from the resin supplier stating that the material used for this project will comply with the indicated requirements and shall meet or exceed the indicated corrosive conditions.

F. Submit the following information regarding the laminate component:

1. construction type

2. laminate thickness

3. ply sequence

4. glass content range

5. resin identification

6. types and amounts of fillers

7. corrosion liner

8. thickness, ply sequence, and width of interior and exterior secondary overlays

G. Submit the manufacturer's Certification of Compliance with smoke-developed and flame spread criteria.

H. Submit the following information regarding dampers:

1. name of manufacturer
2. type, model, and materials of construction
3. pressure rating
4. dimensions and weight including operator
5. AMCA leakage test results for isolation dampers

I. Submit the following information regarding expansion joints:

1. name of manufacturer
2. type, model, materials of construction, and force required for expansion and contraction

J. Submit the following information regarding supports:

1. type, details, and materials of construction
2. stamped and signed design calculations by a registered engineer licensed in the State of Florida for custom-designed supports

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

AMCA 500	Test Methods for Louvers, Dampers, and Shutters
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2310	Standard Classification for Machine-Made “Fiberglass” (Reinforced Thermosetting Resin) Pipe
ASTM D 2563	Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
ASTM D 2992	Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D 2996	Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
SMACNA	Thermoset FRP Duct Construction Manual

1.4 FACTORY TESTING

A. Inspection by ENGINEER

1. The ENGINEER shall be given the right to inspect the ductwork at the factory at any stage of fabrication, without prior notice.

2. The ENGINEER shall be provided 72 hours prior notice of the start of fabrication.

B. The ENGINEER may select from the following test methods:

1. Magnification

2. ultrasonic, magnetic, or other non-destructive technique

3. photographic

4. Barcol hardness testing

5. acetone sensitivity testing

6. acoustic emission testing

1.5 QUALITY ASSURANCE

A. Qualifications

1. Ductwork shall be fabricated and installed by experienced workers who have experience with lay-up, fabrication, and installation of ductwork.

B. Resin

1. The resin manufacturer shall approve the resin for the intended application.

2. The resin shall be applied in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

PART 2 --

2.1 GENERAL

A. Service Conditions

1. The FRP ductwork shall be designed and fabricated for odor control service to carry warm, moisture-laden air containing hydrogen sulfide, mercaptans, and other organic and inorganic compound typically associated with wastewater treatment facilities.

2. Internally, duct systems will be exposed to air saturated with water vapor containing foul odors, primarily hydrogen sulfide.

3. Externally, duct systems will be exposed to odorous air from outside and sunlight.

B. Seismic Restraints

1. Duct supports and restraints shall be provided and designed for static, dynamic, and seismic loads in Zone 1 in accordance with the Uniform Building Code.

2. Seismic restraints shall not introduce stresses in the ductwork from thermal expansion and contraction.

C. Manufacturer / Model Number

1. RPS pipe support Model D4 or approved equal, as manufactured by RPS. Pipe support shall have a hot dip galvanized finish.

2.2 DESIGN REQUIREMENTS

A. Standards

1. The ductwork system shall be in accordance with the latest editions of the ASHRAE Handbook, the SMACNA Manual, and the International Mechanical Code.

2. Where conflicts between these standards arise, the most stringent criteria shall be used.

B. Duct, Adapters, Transitions, and Expansion Joints

Internal positive pressure, inches wc	20
Internal vacuum inches wc	10
Temperature, degrees F	0 to 120

C. Dampers

Differential pressure, inches wc	10
Temperature, degrees F	0 to 120

D. Dimensions

1. Indicated dimensions are net inside, i.e., the clear space inside the duct.

E. Laminates shall have the following minimum properties:

Property	Standard	3/16-inch thick	1/4-inch thick
Ultimate Tensile Strength, psi	ASTM D 638	9,000	12,000
Flexural Strength, psi	ASTM D 790	16,000	19,000
Flexural Modulus of Elasticity, psi (tangent)	ASTM D 790	700,000	800,000

F. Reinforcement

1. Bends, fittings, and special sections shall be reinforced or shall have their thickness increased at those locations where the combined stresses due to internal pressure and bending will exceed the maximum stress recommended by the manufacturer.

2. The duct manufacturer shall determine and provide reinforcements or additional thicknesses as required to keep the combined stresses within the recommended maxima.

G. Structural Criteria

1. Round duct shall have a safety factor of 10-to-1 for pressure and 4-to-1 for vacuum service.

2. The minimum wall thickness shall be 0.139 inch.

3. After installation, the maximum sag of horizontal round duct shall not exceed 2 percent of the duct diameter.

H. Chemical Resistance

1. The duct shall provide chemical resistance to acids, caustic, water, hydrogen sulfide and other sulfide and disulfide compounds, mercaptans, and other materials commonly encountered in odorous air streams from wastewater treatment plants.

I. Flame Spread

1. Ducting and fabrications shall not exceed a flame spread index of 25 and smoke development rating of 50, when tested in accordance with ASTM E 84.

J. FRP Defects

1. Ductwork shall be in accordance with ASTM D 2563 and the following requirements:

Defect	Inside Surface	Outside Surface
Blister	None	Maximum dimension: 1/4-inch diameter x 1/8-inch high Maximum density: one blister per square foot Minimum separation: 2 inches
Chips	None	Maximum dimension of break: 1/4 inch Thickness: less than 10 percent of wall thickness Maximum density: one chip per square foot
Crazing	None	Maximum length: 2 inches Maximum density: 5 crazings per square foot Minimum separation: 2 inches
Cracks	None	None
Exposed Glass	None	None
Scratches	None	Level III
Burned Areas	None	None

Surface Porosity	None	None
Foreign Matter of any kind	None	None
Sharp Discontinuity	None	None
Pits	Level II Maximum: 10 pits per square foot	Level III Maximum: 10 pits per square foot
Dry Spot	None	one square inch per square foot
Entrapped Air	None at the surface; maximum 1/16-inch diameter and maximum 10 defects per square inch within laminate	4 defects per square inch (1/8-inch diameter) or 10 defects per square inch (1/16-inch diameter)

K. Manufacturer's Label

1. Ductwork and fittings shall have the manufacturer's name printed on the exterior surface.

2.3 DUCTWORK SYSTEMS

A. General

1. FRP ductwork shall be of filament-wound construction for sizes greater than 10-inch and shall be hand lay-up or filament-wound construction for sizes 10-inch and smaller, unless indicated otherwise.

2. Cast pipe with no reinforced internal corrosion barrier or press molded fittings will not be accepted.

B. Resins

1. Fabricate the ductwork using a single corrosion-resistant resin throughout the laminates.

2. The type and amount of catalyst, promoter, and resin shall be in accordance with the resin manufacturer's recommendations.

3. Fillers, additions, and pigments will not be accepted.

4. A thixotropic agent for resin viscosity control shall be used, but not on the corrosion liner or on surfaces in contact with a corrosive environment.

5. Resin putty shall be the same resin as above but shall include not less than 15 percent milled glass fiber; no silica flour, grinding dust, or other filler will be accepted.

6. Fire Retardant

a. Antimony trioxide shall be added in the range of 3 to 5 percent for fire retardant.

b. No other fire retardant will be accepted.

c. Do not use antimony trioxide in the corrosion-resistant layer.

7. Fire Retardant Manufacturers, or Equal

a. Reichold Chemical Company, Reichold 9300

b. Ashland Chemical Company, Hetron FR 992

C. Duct

1. General

a. The maximum allowable deflection for any size ductwork shall be 1/2 inch between supports.

b. The duct nominal diameter tolerance or out-of-round shall be no greater than one percent of its diameter.

c. The length of flanged duct sections shall not vary more than plus or minus 1/2 inch at 70 degrees F.

d. Non-flanged ducts shall have square ends in relation to their center axis, within plus or minus 1/8 inch for ducts 24-inch diameter and smaller, and within plus or minus 3/16 inch for ducts greater than 24-inch diameter.

e. The ductwork shall have a corrosion resistant layer, an interior structural layer, an exterior corrosion layer, and a UV-resistant coating where installed outdoors.

2. Interior Corrosion-Resistant Layer

a. The internal corrosion barrier shall consist of one layer of "C" veil and one layer of synthetic veil, such as **Burlington Industries Type 1012 Nexus**, or equal.

b. The overall thickness of this barrier shall be a minimum of 0.020 inch and shall contain a minimum of 90 percent resin.

c. The balance of the corrosion resistant layer shall consist of 2 layers of 1-1/2-ounce per square foot Type E glass, with a ratio of approximately 75 percent resin to 25 percent glass.

d. The overall thickness, including the corrosion barrier, shall be a minimum of 0.090 inch.

3. Intermediate Structural Layer

a. Type E glass shall be provided, meeting the minimum indicated wall thicknesses.

b. The total wall thickness shall include the inner surface.

c. The contact-molded structural layer shall include alternate layers of chopped strand mat and woven roving.

d. A layer of chopped strand mat or spray chop shall precede the filament-wound structural layer.

e. The structural layer shall consist of a minimum of two complete cross-hatched layers of continuous filaments, applied in a helix angle of 55 to 65 degrees for aboveground ductwork and 75 degrees for buried ductwork.

f. The chopped strand mat shall consist of Type E glass, minimum 1-1/2-ounce per square foot mats, and shall have a 24-ounce per square yard with a 5-by-4 weave.

g. The lamination sequence shall conform to Tables 5-1 and 5-2 in SMACNA.

h. Ducts with wall thicknesses less than 0.182 inch shall be constructed of Type I laminates, and ducts with wall thicknesses greater than 0.182 inch shall be constructed of Type II laminates.

i. Materials

1) For the hand-layup process, the intermediate structural layer shall be constructed of approximately 65 percent resin and 35 percent glass.

2) For the filament-wound manufacturing process, the intermediate structural layer shall be constructed of approximately 55 to 65 percent glass.

4. External Layer of Indoor Ductwork

a. Apply minimum 15 mils of intumescent paint for fire protection.

5. External Layer of Outdoor Ductwork

a. Apply a single "A" or "C" Veil to duct exteriors.

b. The exterior UV-resistant coating shall be factory applied and shall consist of a white resin-based gel paint with UV inhibitors.

6. Duct Manufacturer, or Equal

a. Fiber-Tech Engineering

b. Belco Fiberglass

D. Fittings

1. Provide the manufacturer’s standard shop-fabricated fittings.

2. Fittings shall be of hand lay-up construction and shall be fabricated from the same resin and have the same strength as the FRP ductwork.

3. Elbow fittings 36-inch diameter and smaller shall be of smooth radius design.

4. Elbows larger than 36-inch diameter shall be of mitered bend design.

5. Provide a minimum of four (4) mitered joints (5-piece) for elbows with greater than a 45- degree bend.

6. Fittings shall be compatible with the duct, shall be as chemical resistant as the duct, and shall comply with SMACNA.

7. The internal diameter of fittings shall be the same as the adjacent duct.

E. Flanges

1. Provide the manufacturer's standard shop-fabricated flanges.

2. Flanges shall be of hand lay-up construction and shall be fabricated from the same resin and have the same strength as the FRP ductwork.

3. Flanges shall be compatible with the duct, shall be as chemical resistant as the duct, and shall comply with SMACNA.

4. Flanges shall have thicknesses in accordance with SMACNA and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

5. Flange gaskets shall be full- face, constructed of neoprene or EPDM, have a 3/16-inch minimum thickness, and have a hardness of Durometer 50 to 70 when tested according to ASTM D 2240.

F. Joints

1. Provide butt and strap joints in accordance with NBS PS 15-69.

2. Weld Kits

a. The duct manufacturer shall supply field weld kits.

b. Fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint.

c. "Build glass" rolls will not be accepted.

3. The resin, catalyst and putty shall be supplied in bulk in order to complete the field joints and allow 10 percent extra for waste.

G. Dampers

1. General

a. Round FRP dampers shall be the butterfly type.

b. Unless otherwise indicated, dampers are assumed to be for isolation.

c. The maximum leakage shall be 1.0 percent of maximum flow at a pressure differential of one-inch wc.

2. Isolation Type

a. Isolation dampers shall bear the AMCA seal.

b. Dampers shall have been tested in an AMCA laboratory for performance (pressure drop) and leakage, and test results shall be submitted and confirmed by the ENGINEER.

c. Isolation type dampers shall be manufactured from the same material as the ductwork, including a 0.090-inch corrosion-resistant layer.

d. The maximum leakage shall be 0.094 percent of maximum flow at a pressure differential of one-inch wc.

e. Isolation type dampers shall be supplied with a Type 316 stainless steel screen.

f. Flanges

1) Isolation type dampers shall have flanged connections.
2) The flanges shall have thicknesses in accordance with SMACNA and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

g. Damper Blades

1) The damper blade shall be constructed of fiberglass and shall be center pivoted with a composite or balsa core.

2) The blade seal shall be a full-circumference, double-tadpole wiper seal with an angle pin stop.

3) The axle shall be constructed of vinyl ester resin and shall be manufactured by the pultrusion process.

4) The bearings shall be constructed of molded PTFE containing 10 percent graphite.

5) The shaft seal shall be a lip-type compression type, housed in a vinyl ester retainer with a stainless-steel top plate.

h. Provide manual actuators for Valve and Gate Actuators as specified.

i. Isolation Damper Manufacturers, or Equal

1) Swartout, Model 914

3. Volume Control Type

a. Volume control type dampers shall be manufactured from same material as the ductwork, including a 0.090-inch corrosion resistant layer.

b. Volume control type dampers shall be supplied with a Type 316 stainless steel screen.

c. The maximum leakage shall be 0.094 percent of maximum flow at a pressure differential of one-inch w.c.

d. Flanges

1) Volume control type dampers shall have flanged connections.

2) The flanges shall have thicknesses in accordance with SMACNA and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

e. Damper Blade

1) The damper blade shall be constructed of fiberglass and shall be center-pivoted.

2) The shaft shall be a pultruded fiber glass vinyl ester rod and shall be fully encapsulated at the non-actuated end for zero leakage.

f. Bearings

1) Bearings shall be of FRP at both ends of the shaft.

2) Provide a neoprene gasket between the bearing and the actuator.

g. Provide a manual actuator.

h. Volume Control Damper Manufacturers, or Equal:

1) Round Ductwork: Swartout, Model 914 or Fiber-Tech Engineering, Model STD

2) Rectangular Ductwork: Swartout, Model 1108

4. Gravity Back draft Type Dampers

a. Gravity backdraft dampers shall be manufactured from same the material as the ductwork, including a 0.090-inch corrosion-resistant layer.

b. Flanges

1) Gravity backdraft dampers shall have a flanged connection.

2) Flanges shall have thicknesses in accordance with SMACNA and shall be provided complete with Type 316 stainless steel nuts, bolts, and washers.

c. Gravity backdraft dampers shall be horizontal, circular type.

d. Gravity Backdraft Damper Manufacturers, or Equal

1) Swartout, Model 426

2) Fiber-Tech Engineering, FTE-10002

3) Belco Fiberglass

5. Manual Actuators

a. Provide manual actuators for ducts less than 24-inch diameter:

b. Provide a rigid FRP locking-quadrant type hand level, allowing 90-degree movement in either direction.

6. Manual Actuators with Gear Drive

a. Manual actuators for dampers 24-inch diameter and larger shall be worm gear- driven, totally enclosed, weather-proof, and permanently lubricated in a die-cast aluminum housing.

b. The housing shall be epoxy coated at the factory with a minimum dry film thickness of 8 mils.

c. Worm gears shall be constructed of heat-treated carbon steel, and the worm wheels shall be ductile iron.

d. Shafting shall be of stainless steel, and shaft and worm wheel seals shall be of EPDM.

e. The actuator shall be bolted to the duct with stainless steel bolts.

f. Hand wheel size shall be computed assuming a maximum rim effort of 40 lbs.

g. The allowable number of turns of the hand wheel in order to rotate the blade 90 degrees shall be minimum of 4 and maximum of 12.

h. Actuators shall be provided with indicating arrows to clearly identify directions of rotation for opening and closing of the dampers, and the arrows shall be clearly legible and of substantial durability.

7. Elevated Actuators

a. Dampers with shaft centerlines more than 5 feet, 6 inches above the floor shall be provided with chain wheels and operating chains.

b. Each chain-wheel shall be equipped with a chain guide that will permit rapid handling of the operating chain without “gagging” of the wheel and will also permit reasonable side pull on the chain.

c. Suitable actuator extensions shall be provided, if necessary, in order to prevent interference of chain and adjacent piping or equipment below.

d. The operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend within 4 feet of the floor below damper.

e. Galvanized tie-back hooks shall be provided on adjacent pipe supports to hold operating chains out of walkways or maintenance access areas when the damper is not being operated.

H. Expansion Joints

1. Expansion joints shall be provided where indicated.

2. Type

a. Expansion joints shall be of the slip-on flanged type.

b. The joint shall be sized to fit tightly on the outside diameter of the duct and shall be secured in place by stainless steel worm screw type adjustable clamps in order to provide an air-tight connection.

c. Expansion joints shall have split stainless steel retaining rings and shall be of ANSI/ASME B16.1, Class 25 diameter, and drilling.

d. Expansion joints shall be suitable for service with FRP duct under the conditions specified.

3. The material of construction shall be EPDM.

4. Backing Rings shall be 3/8-inch thick, 2 inches wide, and of Type 316 stainless steel where flanged expansion joints or flex connections are indicated.

5. Extension: 3 inches

6. Compression: 2-1/2 inches

7. Lateral Offset: 2-1/2 inches

8. Thickness: 1/4 inch, minimum

9. Bolts, Nuts, and Washers: Type 316 stainless steel

10. Expansion joints shall be flanged where connecting ductwork to equipment; otherwise, slip-type expansion joints will be accepted.

11. The expansion joint material shall be sufficiently stiff to prevent sagging or contraction due to an internal vacuum.

12. Expansion Joints Manufacturer, or Equal

    a. RM-Hotz

    b. The Metraflex Company

    c. Garlock

    d. Mercer

    e. Proco Products, Inc**.**

I. Drains

1. Provide drains in the bottom of main and branch ducts larger than 12-inch diameter and at locations as indicated.

2. Locate drains at every rise in duct, every 50 feet along a continuous run, and at the heel of every drop.

J. Bolts, studs, washers, and nuts shall be Type 316 stainless steel.

PART 3 EXECUTION

PART 3 --

3.1 INSTALLATION

A. Field Measurements

1. Duct lengths shall be determined from measurements taken at the Site.

2. Indicated dimensions are approximate and are not for fabrication.

3. Exact or complete details of the ductwork are not indicated.

B. Delivery, Storage, and Handling

1. Duct, fittings, and dampers shall be protected from damage and shall be supported by 4-inch wide, minimum, strapping in order to avoid damage due to flex strains and point loading during shipping and installation.

2. Debris and other extraneous material shall not be allowed to enter the duct.

3. Duct, fittings, and dampers shall not be thrown or dropped.

C. Installation

1. Ducts shall be installed as indicated.

2. Take necessary precautions during the fabrication and installation of ductwork in order to provide for expansion and contractions.

3. The ductwork shall be free from vibration when in operation, and necessary vibration isolation devices shall be provided.

4. Apply anti-seize compound to bolt threads.

5. Smooth bends or internal turning vanes shall be installed at elbows, tees, and other points where the air flow changes direction.

6. The ductwork shall be supported in accordance with the manufacturer's recommendations and as indicated.

7. The inside of duct, specials, and fittings shall be smooth, clean, and free from blisters, sand, and dirt when installed.

8. Ductwork shall be airtight.

D. Joints

1. Joints shall be carefully and neatly made in accordance with the indicated requirements and as recommended by the manufacturer.

E. Flanges

1. Tighten flange bolts sufficiently to slightly compress the gasket and make a good seal, but not so tightly as to distort the flanges.

2. Install a flat washer under each nut and bolt head.

F. Butt and Wrap Joints

1. Prior to joining, ends shall be ground smooth and dust and debris shall be completely removed.

2. Ends shall be resin-coated to prevent corrosion, and in duct 24-inch diameter and above an interior corrosion wrap shall be provided.

3. The joint shall be of equal strength as the duct.

4. A butt and wrap sequence and thickness chart shall be shown on the fabrication drawings.

5. The laminate sequence for each size duct shall be supported by a separate section in the submitted design calculations.

6. No penetrations or defects shall be made in the duct material while aligning and making up of Butt and wrap Joints.

G. Dampers

1. Dampers shall be positioned to fit into the connecting ductwork at the locations indicated.

2. Unless necessary for the proper operation of the damper, axles shall be installed in the horizontal position.

H. Supports and Hangers

1. Supports for the FRP duct shall be in accordance with the SMACNA Standards and appropriate code requirements regarding duct installation.

2. Supports and hangers shall transmit loads into the building structural frame through a system of intermediate beams and struts.

3. Supports or hangers employing clip angles or similar devices for attachment to the duct will not be accepted.

4. Supports shall be in accordance with the requirements of Section 400507 – Pipe Supports.

I. Alignment and Elevation

1. Ductwork shall be provided to the lines and elevations indicated and shall be sloped to facilitate water drainage where indicated.

2. Laser beam equipment or surveying instruments shall be used to maintain alignment and elevation.

3. Accuracy Verification

a. If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracies.

b. If such measurements indicate thermal deflection of the laser beam due to differences between the ground temperature and the air temperature within the duct, take precautions to prevent or minimize further thermal deflections and previous alignments and elevations measured with the laser beam equipment shall be re-measured with properly calibrated equipment.

3.2 DUCT CLEANING

A. Duct shall be blown clean of dust and debris using compressed air.

B. The system fans shall not be used to provide air for duct cleaning.

NO TEXT FOR THIS PAGE

SECTION 26 00 00
ELECTRICAL WORK, GENERAL

PART 1 GENERAL

1.1 THE SUMMARY

A. Provide the electrical WORK, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all Sections in Division 26, except as otherwise indicated.

C. The WORK of this Section is required for operation of electrically-driven equipment provided under Specifications in other Divisions.

D. The CONTRACTOR'S attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment Specifications, the WORK of instrumentation Sections, and the WORK of Section 26 05 10 – Electric Motors.

E. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various Sections of Division 26 is included as a part of the WORK under the respective Sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

1.2 REFERENCE STANDARDS

NEC (NFPA 70)	National Electrical Code: 2017 Edition
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)
FBC	Florida Building Code

A. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

B. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.

C. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE AND MARKINGS

A. Identification

1. Provide danger caution, and warning signs and equipment identification markings in accordance with applicable federal, state, OSHA, and NEC requirements.

B. Local Disconnect Switches

1. Legibly mark each local disconnect switch for motors and equipment in or5der to indicate its purpose unless the purpose is indicated by location and arrangement.

C. Warning Signs

1. 600 Volts Nominal, or Less

    a. Mark entrances to rooms and other guarded locations that contain live parts with conspicuous signs prohibiting unqualified persons from entering.

2. Greater than 600 Volts

    a. Buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at greater than 600 volts nominal shall be lockable.

    b. Provide permanent and conspicuous warning signs reading as follows: DANGER – HIGH VOLTAGE – KEEP OUT.

3. Mark indoor electrical installations that are open to unqualified persons and contain metal-enclosed switchgear, unit substations, transformers, and other similar associated equipment over 600 volts nominal, with appropriate caution signs.

4. Outside Branch Circuits and Feeders over 600 Volts

    a. Post warning signs in plain view where unauthorized persons might come in contact with live parts: WARNING – HIGH VOLTAGE – KEEP OUT.

D. Isolating Switches

1. Provide isolating switches not interlocked with an approved circuit-interrupting device with a sign warning against opening them under load.

1.4 PUBLIC UTILITIES REQUIREMENTS

A. Contact the serving utility and verify compliance with requirements before construction.

B. Coordinate schedules and payments for WORK by utilities.

C. Where conduits and conductors in the WORK are indicated to be larger, heavier schedule, or have greater protective coating than utility requirements, provide the larger size, heavier schedule, or greater protection.

D. Provide electrical service as indicated and as required by the serving utility.

E. Verify and provide service conduits, fittings, transformer pad, grounding devices, and service wires not provided by the serving utility.

F. Verify with the utility the exact location of each service point and type of service, and pay charges levied by the serving utilities as part of the WORK.

1.5 PERMITS AND INSPECTION

A. Obtain permits and pay inspection fees according to the General Conditions.

B. Pay connection and turn-on service charges required by the utility company.

1.6 CONTRACTOR SUBMITTALS

A. General

1. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittals.

2. Custom-prepare Shop Drawings.

3. Drawings or data indicating "optional" or "as required" equipment will not be accepted.

4. Cross out options not proposed or delete from the Shop Drawings.

B. Shop Drawings: Include the following:

1. complete material lists stating manufacturer and brand name of each item or class of material.

2. Shop Drawings for grounding WORK not specifically indicated

3. front, side, rear elevations, and top views with dimensional data

4. location of conduit entrances and access plates

5. component data

6. connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers

7. method of anchoring, seismic requirements, weight

8. types of materials and finish

9. nameplates

10. temperature limitations, as applicable

11. voltage requirement, phase, and current, as applicable

12. front and rear access requirements

13. test reports

14. grounding requirements

C. Catalog Cuts:

1. Submit catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material.

2. Stamp the catalog data sheets in order to indicate the Project name, applicable Specifications Section and Paragraph, model number, and options.

D. Materials and Equipment Schedules

1. Within 30 Days of the commencement date in the Notice to Proceed, deliver to the ENGINEER a complete list of materials, equipment, apparatus, and fixtures that are proposed for use.

2. Include in the list the type, size, name of manufacturers, catalog number, and such other information as required to identify the item.

E. Technical Manuals

1. Submit complete information in accordance with the requirements of Section 01 33 00 – Submittals.

2. As-Built Drawings

a. Prepare as-built drawings, showing invert and top elevations and routing of duct banks and concealed below-grade electrical installations.

b. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Submittals.

1.7 AREA DESIGNATIONS

A. General

1. Designations for raceway system enclosures shall comply with the requirements of Section 26 05 33 – Electrical Raceway Systems.

2. Designations for electrical WORK specifically indicated in other Sections shall comply with the requirements of those Sections unless indicated otherwise.

3. Designations for other electrical WORK not included in the above Paragraphs shall be as follows:

AREA	NEMA ENCLOSURE CLASSIFICATION					
	1	4X	7	9	12	Notes
Indoors	X					
Outdoors		X				

4. Installations in hazardous locations shall conform strictly to the requirements of the indicated Class, Group, and Division.

A. Material Requirements

1. Construct NEMA 4X enclosures of Type 316 stainless steel.

2. Do not coat NEMA 4X enclosures.

3. Construct NEMA 7 enclosures of cast aluminum where used with aluminum conduit, and of cast iron when used with galvanized steel conduit.

4. Do not coat NEMA 7 and 9 enclosures.

5. Construct NEMA 1, 3R, and 12 enclosures of steel, and prime and coat with ANSI 61 light grey paint.

1.8 TESTS

A. The CONTRACTOR shall be responsible for factory and field tests indicated in Division 26, as required by the ENGINEER, and as required by other authorities having jurisdiction.

B. Furnish necessary testing equipment.

C. Pay the costs of the tests, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of a faulty installation.

D. Reporting

1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.

2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.

3. Submit field test reports for review prior to Substantial Completion.

E. Remove and replace equipment or material that fails a test, or, if the ENGINEER approves, repair and retested for compliance.

F. Corrections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

1.9 DEMOLITION AND RELATED WORK

A. General

1. Perform electrical demolition WORK as indicated.

2. The CONTRACTOR is cautioned that demolition WORK may also be indicated on non-electrical Drawings.

3. Coordinate with all trades regarding electrical de-energization, disconnection, and removal, and the overall sequence of construction.

B. Electrical Requirements for Removed Equipment

1. Remove dedicated wiring and exposed conduits back to the source.

2. Abandon in place wiring that shares conduits with other equipment wiring, except power wiring.

3. Remove power wiring from the power source to the first pullbox, junction box or manhole remote from the panel, and abandon in place the remaining wiring.

4. Encased Conduits

a. Abandon in place wiring routed through encased conduits.

5. Remove remote-mounted starters, disconnect switches, circuit breakers, sensors, and transmitters as indicated on drawings.

C. Where new lighting and receptacles are installed, remove old lighting, receptacles, switches, wiring, and conduits.

D. Junction Boxes

1. Wiring and conduits indicated to be extended shall be terminated in a new junction box with terminal strips.

2. Provide a junction box with a NEMA rating in accordance with the area in which it is located, and sized as required.

3. Properly identify wires and terminals before disconnection.

E. Removed materials and equipment not indicated to be returned to the OWNER shall, upon removal, become the CONTRACTOR'S property and shall be disposed of off- Site.

F. Remove and relocate material and equipment indicated to be relocated or reused, and reinstall with care in order to prevent damage.

G. Place materials indicated to be returned to the OWNER in boxes, with the contents clearly marked, and store at a location determined by the ENGINEER.

H. Identification

1. Where motor control centers and panelboards are indicated to have components, assemblies, or circuits removed and reconnected, provide the affected MCC compartments with new engraved nameplates worded as indicated and matching the existing, or modify the panelboard schedule to indicate the revised circuits.

2. Pencil or magic marker markings directly on the MCC or panelboard breaker will not be accepted.

1.10 CONSTRUCTION SEQUENCING

A. General

1. Because the continuance of plant operation is critical, the CONTRACTOR shall carefully examine the WORK to be provided in, on, or adjacent to existing equipment.

2. Schedule the WORK, subject to OWNER's approval, to minimize required shutdown time.
3. Submit a written sequencing request, including the sequence and duration of activities to be performed during plant shutdown.

4. Switching, safety tagging, and the like, as it relates to process equipment shutdown, shall be performed by the OWNER.

5. In no case shall the CONTRACTOR begin any WORK in, on, or adjacent to existing equipment without written authorization from the OWNER.

B. Modifications

1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.

2. Perform modifications to existing equipment, panels, and cabinets in a professional manner.

3. Repair coatings to match existing.

4. The costs for modifications to existing electrical facilities that are required for a complete and operating system shall be included as part of the WORK.

C. Existing Utilities

1. Exercise extreme caution when digging trenches to not damage existing underground utilities.

2. The cost of repairs of damages caused during construction shall be included as a part of the WORK.

D. Field Verifications

1. Visit the Site before submitting a Bid to become better acquainted with the WORK of this Contract.

2. The lack of knowledge will not be accepted as justification for extra compensation to perform the WORK.

3. The CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required.

4. The CONTRACTOR shall be responsible for field verifying the available space in substation switchboards to integrate new power circuit breakers.

5. The cost for the above verifications shall be included as part of the WORK.

E. Installation to Temporary Equipment

1. To facilitate the continuous operation of existing equipment, provide the temporary equipment as indicated.

2. Submit installation and connection details for review and acceptance by the ENGINEER.

3. Costs associated with these temporary installations shall be included as part of the WORK.

4. Temporary wiring and equipment shall remain the property of the CONTRACTOR unless indicated otherwise.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide equipment and materials that are new and are the products of experienced and reputable manufacturers in the industry.

B.

C. Provide equipment and materials listed by UL and bearing the UL label, where UL requirements apply.

D. Provide similar items in the WORK as products of the same manufacturer.

E. Provide equipment and materials of industrial grade standard of construction.

F. Where a NEMA enclosure type is indicated in a non-hazardous location, use that type of enclosure despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.

G. On devices indicated to display dates, display the year as 4 digits.

H. Temperature Ratings of Equipment Terminations

1. Provide terminations and lugs rated for use with 75-degree C conductors.

2. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75-degree C ratings.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. Provide nuts, bolts, and washers constructed of stainless steel.

2. Provide threaded rods for trapeze supports constructed from continuous threaded stainless steel, 3/8-inch diameter minimum.

3. Struts

a. Construct struts for mounting of conduits and equipment of aluminum or 316 stainless steel.

b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.

c. Do not use aluminum strut for free-standing support frames.

d. Strut Manufacturer, or Equal: Unistrut; B-Line

4. End Caps

a. Provide plastic protective end caps for all exposed strut ends.

b. End Caps Manufacturer, or Equal: Unistrut, Model P2860

5. Anchors

a. Provide stainless steel expansion anchors for attaching equipment to concrete walls, floors, and ceilings.

b. Wood plugs will not be accepted.

c. Anchor Manufacturer, or Equal: "Power-Bolt" or "Power-Stud" as manufactured by Power Fasteners, Inc.; similar by Star.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates

1. Fabricate nameplates from white-letter, black-face laminated plastic engraving stock, such as Formica Type ES-1 or equal.

2. Securely fasten each nameplate, using fasteners constructed of brass, or stainless steel, and screwed into inserts or tapped holes as required.

3. Provide engraved characters of the block style, with no characters smaller than 1/8 inch top to bottom.

B. Conductor and Equipment Identification

1. Provide imprinted plastic-coated cloth marking devices, such as manufactured by Brady, Thomas & Betts, or equal.

2. Alternatively, provide heat-shrunk plastic tubing, imprinted split-sleeve markers cemented in place.

PART 3 EXECUTION

3.1 GENERAL

A. Incidentals

1. Provide materials and incidentals required for a complete and operable system, even if not required explicitly by the Contract Documents.

2. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement

1. The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items.

2. Exact locations shall be determined by the CONTRACTOR in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions.

3. Follow the locations on the Drawings, however, as closely as possible.

4. Conduits

a. Where conduit development drawings or "home runs" are indicated, route the conduits in accordance with those requirements.

b. Provide exposed or encased routings as indicated, except conceal conduit in finished areas unless indicated otherwise.

c. Size conduits encased in a slab for conduit OD not to exceed 1/3 of the slab thickness, and lay out and space as to not impede concrete flow.

5. Placement

a. Install conduit and equipment in such a manner as to avoid obstructions, to preserve headroom, and to keep openings and passageways clear.

b. Locate luminaires, switches, convenience outlets, and similar items within finished rooms as indicated.

c. Where exact locations are not indicated, such locations will be determined by the ENGINEER.

d. If equipment is installed without instruction and must be moved, the cost of moving shall be included as part of the WORK.

e. Slightly adjust luminaire locations in order to avoid obstructions and to minimize shadows.

6. Circuits
   a. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR'S responsibility to provide lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated.

   b. Provide No. 12 AWG minimum wiring, and 3/4-inch minimum conduits (exposed) and one-inch minimum conduits (encased).

   c. Where circuits are combined in the same raceway, derate conductor ampacities in accordance with NEC requirements.

7. Workmanship

   a. Install materials and equipment in strict accordance with the printed recommendations of the manufacturer, and using workers skilled in the WORK.
   b. Coordinate installation in the field with other trades in order to avoid interferences.

8. Protection of Equipment and Materials

C. Provide incoming utility power equipment in conformance with the utility's requirements.

   a. Fully protect materials and equipment against damage from any cause.

   b. Cover materials and equipment, both in storage and during construction, in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint.
   c. Keep moving parts clean and dry.

   d. Replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

3.2 CORE DRILLING

A. Perform core drilling as required for the installation of raceways through concrete walls and floors.

B. Base the locations of floor penetrations, as may be required, on field conditions.

C. Verify exact core drilling locations based on equipment actually furnished as well as exact field placement.

D. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities.

E. Repair damage to encased conduits, wiring, and piping as part of the WORK.

3.3 CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for indoor floor-standing electrical equipment.

B. Extend housekeeping pads for equipment, including future units, 4 inches above the surrounding finished floor or grade, and 2 inches larger in both dimensions than the equipment, unless otherwise indicated.

C. Provide concrete housekeeping curbs for conduit stub-ups in indoor locations that are not concealed by equipment enclosures.

D. Extend housekeeping curbs to 3 inches above the finished floor or grade.

3.4 EQUIPMENT ANCHORING

A. Floor-supported, wall, or ceiling-hung equipment and raceways shall be anchored in place by methods that will meet seismic requirements in the area where the Project is located. Anchoring design by VENDOR and based on site conditions.

B. Provide wall-mounted panels that weigh more than pounds or that are within 18 inches of the floor with fabricated support pedestals.

C. If the supported equipment is a panel or cabinet enclosed within removable side plates, match supported equipment in physical appearance and dimensions.

D. Provide leveling channels anchored to the concrete pad for MCC’s, switchgear and other electrical equipment mounted on housekeeping pads.

E. Manufacturer's Recommendations

1. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract.

2. Submit such recommendations as Shop Drawings as indicated.

3.5 EQUIPMENT IDENTIFICATION

A. Provide nameplates for panelboards, control and instrumentation panels, starters, switches, and pushbutton stations.

B. In addition to nameplates, equip control devices with standard collar-type legend plates.

C. Identify control devices within enclosures as indicated and similar to the subparagraph above.

D. Provide suitable inscribed finish plates for toggle switches that control loads out of sight of switches and for multi-switch locations of more than 2 switches.

E. Use equipment names and tag numbers, where indicated, on nameplates.

F. Provide typewritten circuit directories for panelboards, that accurately reflect the outlets connected to each circuit.

G. Terminal Blocks

1. Label termination points on terminal blocks by identifiers on the blocks.

2. Provide identifiers that have been preprinted by the terminal manufacturer or custom-printed.

3. Hand-lettered markers will not be accepted.

H. Provide arc-flash labels for all distribution equipment, stand-alone disconnects, starters, and VFDs. Fill in all values as required by NFPA 70E, and as calculated as part of the Protective Device Study. Verify that all settings as prescribed by the approved Protective Device Study have been implemented in the field.

3.6 CLEANING

A. Before final acceptance, thoroughly clean the electrical WORK of cement, plaster, and other materials.

B. Remove temporary tags, markings, stickers, and the like.

C. Remove oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.

D. Apply touch-up paint to scratches on panels and cabinets.

E. Vacuum clean electrical cabinets and enclosures. Do not use compressed air to clean cabinets.

F. Clean luminaires inside and out. Replace failed lamps.

G. Properly dispose cleaning debris and refuse off-site.

END OF SECTION

SECTION 26 01 26
ELECTRICAL TESTS

PART 1 GENERAL

1.1 THE SUMMARY

A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated herein and functional testing of power and controls not tested under Division 40 - Instrumentation, shall be completed before Acceptance Tests per Section 014500 – Quality Control. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.

C. The requirements of Section 26 00 00 - Electrical Work, General, apply to the WORK of this Section.

D. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.

1.2 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American National Standards Institute (ANSI)

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

D. IEEE 400-2001, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

E. IEEE 576-2000, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

F. InterNational Electrical Testing Association (NETA)

G. NFPA 70, National Electrical Code (NEC)

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00, Submittals.

B. Submit complete system test procedures for review. Test procedures shall include but not be limited to:

1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Incorporation of the Test Record Sheets included at the end of this Section.

3. Detailed comprehensive testing schedule including:

a. Each major piece of electrical distribution equipment.

b. Each major electrical subsystem.

c. Duration of each test.

d. Milestone test completion date.

e. Ambient Conditions at time of test

f. Date of test results submittals following completion of the tests.

g. Names and qualifications of the individual(s) responsible for performing the testing.

C. Following completion of the test submit the completed test results to the Engineer for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.

D. Test result shall be submitted in one submittal

E. Test reports shall be based on NETA’s latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA’s Acceptance Testing Specifications latest edition.

1.4 COMMISSIONING

A. Commissioning during Acceptance Tests in Section 01 45 00 – Quality Control shall not be attempted until all subsystems have been found to operate satisfactorily. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters shall be considered only upon receipt of a written request by the CONTRACTOR.

B. Motor Current Tabulation

1. The motor current tabulation required by Section 26 05 73 – Protective Device Studies shall reflect the values occurring during commissioning.

2. Motors which have current/power measurement capabilities shall have this data recorded every 5 minutes while operating during commissioning.

3. Power monitored amperes, voltage, and kilowatts for each phase shall be recorded every 5 minutes during commissioning.

PART 2 TESTING & REPORTS

2.1 PRE-ENERGIZATION AND OPERATING TESTS

A. The complete electrical system shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the protective device study and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.

1. Instrument Transformers. All instrument transformers shall be tested to verify correct polarity and burden.

2. Protective Relays. Each protective relay shall be demonstrated to operate by injecting current or voltage, or both, at the associated instrument transformer output terminal and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.

3. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.

4. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.

5. Metering Circuits. All metering circuits shall be verified to operate correctly from voltage and current sources, similarly to protective relay circuits.

6. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.

7. Relays and Metering Utilizing Phase Differences. All relays and metering that use phase differences for operation shall be verified by measuring phase angles at the relay under actual load conditions after operation commences.

B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the authority having jurisdiction prior to energization. Acceptance Testing shall be in accordance with NETA ATS-2021, Acceptance Testing Specifications f*or Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association.

2.2 TEST REQUIREMENTS

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching, include remote control, if present in system. Circuitry is in accordance with panel schedules. Lighting shall be checked for proper operation.

2. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.

3. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current

sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.

4. Low Voltage Cables-600 volts Maximum

   a. Visual and Mechanical Inspection

      1) Compare cable data with drawings and specifications.

      2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

      3) Inspect bolted electrical connections for high resistance using one of the following methods:

         a) Use of low-resistance ohmmeter

         b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS- 2021, Table 100.12.

      4) Inspect compression-applied connectors for correct cable match and indentation.

      5) Inspect for correct identification and arrangements.

      6) Inspect cable jacket insulation and condition.

   b. Electrical Tests

      1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.

         a) Motor feeders tested with motors disconnected and controller open.

         b) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.

         c) Panelboard feeders tested with feeder breaker open and panel-board connected. If a lighting transformer is associated with the panelboard, it shall be connected and the test made for both primary and secondary sides.

         d) Conductors of main lighting feeders, including lighting panel with branch circuits open.

         e) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid state device.

         f) Equipment which may be damaged during this test shall be disconnected.

         g) The Engineer shall be consulted if minimum insulation values cannot be obtained.

2) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3) Perform continuity test to insure correct cable connection.

c. Test Values – Visual and Mechanical

1) Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels should be in accordance with NETA ATS-2021, Table 100.12 unless otherwise specified by the manufacturer.

d. Test Values – Electrical

1) Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS-2021 Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.

3) Cable shall exhibit continuity.

4) Deviations in resistance between parallel conductors shall be investigated.

5. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

6. A functional test and check of electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

a. Visual and physical check of cables, circuit breakers, transformers, and connections associated with each item of new and modified equipment.

b. Verification that electrical equipment has been labeled with Arc Flash protection boundary and PPE levels, as required by Section 26 05 73 – Protective Device Studies.

c. Setting of protective relays in conformance with results of the Short Circuit Study required by Section 26 05 73 - Protective Device Studies and testing of relays to assure that relays will trip at the current value and time required by the Study.

d. Circuit Breakers

1) Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted by a representative of the circuit breaker manufacturer.

2) Time and pickup setting shall correspond to the recommendations of the Short Circuit Study.

3) Setting shall be tabulated and proven for each circuit breaker in its installed position.

4) Test results shall be certified by the person performing the tests and shall be submitted to the ENGINEER.

7. Complete ground testing of grounding electrodes per requirements below prior to operating the equipment.

B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the ENGINEER and after process control devices have been adjusted as accurately as possible. Alarm conditions shall be simulated for each alarm point, and alarm indicators shall be checked for proper operation. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

C. Metering and indication lights for motors and other devices shall be tested for proper operation.

D. All control circuits such as motor, interlock and remote shall be tested for proper operation.

E. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

F. All lighting panels, circuits and fixtures; and power panels, circuits and receptacles shall be tested for proper operation.

G. Provide ground resistance tests on the system and submit results

1. Visual and Mechanical Inspection

a. Verify ground system is in compliance with drawings and specifications.

2. Electrical Tests

a. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.

b. The earth resistance of each ground electrode shall be measured and recorded before electrodes are connected to the grounding loop.

c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

3. Test Values

a. The resistance between the main grounding electrode and ground shall be no greater than five ohms for commercial or industrial systems.

b. Investigate point-to-point resistance values which exceed 0.5 ohm.

H. Subsystems shall be defined as individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.

2.3 TEST REPORTS

A. The test report shall include the following:

1. Summary of project.

2. Description of equipment tested.

3. Description of test.

4. Test data.

5. Analysis and recommendations.

B. Test data records shall include the following minimum requirements:

1. Identification of the testing organization.

2. Equipment identification.

3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.

4. Date of inspections, tests, maintenance, and/or calibrations.

5. Identification of the testing technician.

6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

7. Indication of expected results when calibrations are to be performed.

8. Indication of “as-found” and “as-left” results.

9. Sufficient spaces to allow all results and comments to be indicated.

C. The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

TABLE 100.18

THERMOGRAPHIC SURVEY
SUGGESTED ACTIONS BASED ON TEMPERATURE RISE

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1ºC - 3ºC	1ºC - 10ºC	Possible deficiency; warrants investigation
4ºC - 15ºC	11ºC - 20ºC	Indicates probable deficiency; repair as time permits
- - - - - -	21ºC - 40ºC	Monitor until corrective measures can be accomplished
>15ºC	>40ºC	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT. In the absence of consensus standards for ΔT, the values in this table will provide reasonable guidelines.

An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, *Electrical Power Systems Maintenance and Testing*, by Paul Gill, PE, 1998.

It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology.

PART 3 TEST RECORD SHEETS

The test record sheets listed below shall be used to record testing of electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

Sheet No.	Title
1	Insulation Resistance (Power, Control Wire, and Cable) Test Record
2	Insulation Resistance (Instrument Wire and Cable) Test Record
3	NOT USED
4	Ground Electrode Testing Test Record
5	NOT USED
6	Bonding Resistance Readings (Nonelectrical Equipment/Structures) Test Record
7	Bonding Resistance Readings (Electrical Equipment) Test Record
8	NOT USED
9	Insulation Resistance (Equipment) Test Record
10	Insulation Resistance (Rotating Equipment) Test Record
11	Equipment Absorption Ratio and Polarization Index Test Record
12	Record Feeder Breaker (480 V MCC) Test Record
13	Breaker/Contactor (480 V MCC) Test Record
14	460 V Motor Circuit (480 V MCC) Test Record
15	NOT USED
16	Electric Motor Run-In Test Record
17	NOT USED

INSULATION RESISTANCE
(POWER, CONTROL WIRE, AND CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
TEST EQUIPMENT: _____ TEST VOLTAGE: _____
AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____

NOTES:
1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.
2. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.
3. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."
4.

Panel No. Circuit No. Feeder No.	Wire Tagging	Cable Rated Voltage	Wire or Cable Quantity	Insulation Size	From	To	Resistance (megohms)*	Initials

*Minimum acceptable values:

Cable Rated Voltage	Test Duration	Resistance for Cable Only	Cable/Wire Size or Amperage	Resistance When Cable Connected to Equipment
			(megohms)	(ohms)

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE
(INSTRUMENT WIRE AND CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
TEST EQUIPMENT: _____ TEST VOLTAGE: _____
AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____

NOTES: 1. Record only the lowest value.
2. MP - Multi-pair cable. SP - Single pair cable.
3. Megger with instruments disconnected.
4. Use 250 volt (or lower voltage, when specified) range on DC test set.
5. Readings will vary with temperature and cable length.*

Cable Number or Instrument Number	Indicate MP or SP Type (2)	Conductor to Conduit (Single Pair Non-Shielded Cables) (megohms)	Conductor to Conductor (megohms) (1)	Shield to Conductor to Shield (megohms) (1)	Overall Shield to Shield (Multipair Cables Only) (megohms) (1)	Lead and Armor (Multipair Cables Only (megohms)	Shield to Conduit (Single Pair Cables Only) (megohms)	Initials

DISTRIBUTION:

CONTRACTOR/Date _____

GROUND ELECTRODE TESTING
TEST RECORD

TEST EQUIPMENT: _____ _____
(Note 1) (Note 2)

REFERENCE DRAWING: _____ _____

NOTES: 1. Record resistance-to-earth for each electrode with all other conductors disconnected. Resistance not to exceed 25 ohms for any single anode.
2. Check continuity from each electrode to any test bar or other electrode such that the complete ground loop is tested.

Rod Number	Resistance to Earth (ohms)	Ambient Temperature (ºC/ºF)	Weather	Taps (□)	Initials/Date

DISTRIBUTION:

CONTRACTOR/Date _____

BONDING RESISTANCE READINGS
(NONELECTRICAL EQUIPMENT/STRUCTURES)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Vessels, tanks, and structural steel bonded to the main grounding system, dedicated ground rod or foundation, as indicated on drawings listed below.
2. Measure resistance from ground wire tap (or anchor bolt) to tagged equipment frame or structural steel.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

BONDING RESISTANCE READINGS
(ELECTRICAL EQUIPMENT)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Electrical equipment bonded to the main grounding system or dedicated ground rod, as indicated on drawings listed below.
2. Measure resistance from ground wire tap to tagged equipment bus bars, tagged equipment enclosures, and any other points indicated on the drawings.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE (EQUIPMENT)
TEST RECORD

TEST EQUIPMENT: _____ SUBSTATION: _____
AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____
REFERENCE DRAWING: _____ REF. SEC.: _____

NOTES: 1. Use 1,000-V test set for equipment rated 600 volts and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. For equipment with solid state control circuits, consult manufacturer's literature for maximum test voltages.

Switchgear MCC (other)	INSULATION RESISTANCE (megohms) *						Test Voltage (kV)	Rated Voltage (kV)	Initials/ Date
	∅A to G	∅B to G	∅C to G	∅A to ∅B	∅B to ∅C	∅C to ∅A			

*Minimum acceptable values:

EQUIPMENT VOLTAGE CLASS (megohms)	RESISTANCE

TESTER'S INITIALS/DATE _____

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE (ROTATING EQUIPMENT)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____
EQUIP. TEMP., IF KNOWN: _____ ºC _____ ºF HOW KNOWN: _____

NOTES:
1. Use 1,000-V test set for equipment 600-volt and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. Test duration shall be 1 minute, note if otherwise: _____.
3. Isolate all motor leads from one another and from frame, test phase separately, wherever practical.
4. Document testing of low voltage and medium voltage equipment on separate sheets.
5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Equipment Tag No.	INSULATION RESISTANCE (megohms) *						Rated Voltage	Equipment Initial/Date
	∅A to G	∅B to G	∅C to G	∅A to ∅B	∅B to ∅C	∅C to ∅A		

*Minimum acceptable values:

VOLTAGE CLASS	RESISTANCE (megohms)

DISTRIBUTION:

CONTRACTOR/Date _____

EQUIPMENT ABSORPTION RATIO
AND POLARIZATION INDEX
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____
EQUIP. TEMP., IF KNOWN: _____ ºC _____ ºF REL. HUMIDITY: _____

NOTES: 1. Perform test as indicated on Test Records for each individual equipment type. Reference the following sheets:

Transformers	8
Equipment	9
Motors and Generators	10

2. Absorption Ratio = $\frac{\text{1-Minute Resistance Value}}{\text{30-Second Resistance Value}}$
3. Polarization Index = $\frac{\text{10-Minute Resistance Value}}{\text{1-Minute Resistance Value}}$

OHMS TO GROUND 30-SECOND READING ∅A TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅A TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅A TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅B TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅B TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅B TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅C TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅C TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅C TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX

TESTER'S INITIALS/DATE _____

DISTRIBUTION:

CONTRACTOR/Date _____

FEEDER BREAKER (480 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION			
LOAD (kW/kVA)		VOLTAGE	F.L.A.
CIRCUIT BREAKER MFG.		RATING	SETTING
CONDUCTOR SIZE	POWER		GROUND

1. Check nameplate data of breaker against approved vendor drawings. _____
2. Check breaker components for cleanliness. _____
3. Check mechanical function of breaker. _____
4. Check wiring for proper identification. _____
5. Check conduits/cables for tagging. _____
6. Check components for identification. _____
7. Check equipment for conformance of area classification. _____
8. Check installation for seals, breathers, and drains. _____
9. Verify power conductor continuity. _____
10. Check that power cable insulation resistance test (megger) is completed. _____

DISTRIBUTION:

CONTRACTOR/Date _____

BREAKER/CONTACTOR (480 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION			
LOAD (kW/kVA)		VOLTAGE	F.L.A.
CIRCUIT BREAKER MFG.		RATING	SETTING
CONTACTOR MFG.		SIZE	
CONDUCTOR SIZE	POWER	CONTROL	GROUND

1. Check nameplate data of breaker, contactor fuses and relays against approved vendor drawings. _____

2. Check main and auxiliary contacts. _____

3. Check contactor/breaker components for cleanliness. _____

4. Check control fuses, CPT rating, and coil voltage. _____

5. Check mechanical function of contactor and breaker. _____

6. Check wiring for proper identification. _____

7. Check conduits/cables for tagging. _____

8. Check components for identification. _____

9. Check equipment for conformance to area classification. _____

10. Check installation for seals, breathers, and drains. _____

11. Verify continuity of all power and control leads. _____

12. Check that power and control cable Insulation Resistance Test (megger) is completed. _____

13. Complete functional operation check of the control circuit using contract drawings and approved vendor drawings. Close and open the contactor using all control devices. _____

DISTRIBUTION:

CONTRACTOR/Date _____

460 V MOTOR CIRCUIT (480 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION			
MOTOR TAG NO.		VOLTAGE	F.L.A.
KW/HP		RPM	S.F.
CIRCUIT BREAKER MFG.		RATING	SETTING
STARTER MFG.		SIZE	O/L HTR. SIZE
C.T. RATIO		O/L RELAY SETTING	
CONDUCTOR SIZE	POWER	GROUND	

1. Check motor starter for cleanliness. _____

2. Check nameplate data and tagging of motor starter components for conformance to approved vendor drawings. _____

3. Check conduits and/or cables for correct tagging. _____

4. Check equipment and installation for conformance to area classification. _____

5. Check main and auxiliary contacts of breaker and contactors. _____

6. Manually check mechanical operation of breaker, contactor, O/L relay, and O/L reset device. _____

7. Check continuity of power and control cables. _____

8. Complete functional operation check of the motor control circuit using the contract drawings and approved vendor drawings. Close and open the starter using all control devices. _____

9. Verify proper operation of motor winding space heater unit. _____

DISTRIBUTION:

CONTRACTOR/Date _____

ELECTRIC MOTOR RUN-IN
TEST RECORD

TEST EQUIPMENT: _____ REFERENCE DRAWING: _____

NOTES: 1. Duration of tests to comply with specifications.

TEST	REMARKS	INITIALS/DATE
RESISTANCE: Bonding resistance measured from motor frame to main ground/earth system tap. _____ ohms		
VOLTAGE: Actual voltage measured at Motor Control Center. _____ volts		
ROTATION CHECK: Bump motor to verify rotation. Motor to be uncoupled.		
NO LOAD CURRENT: At beginning of test _____ amps At end of test _____ amps		
TEMPERATURE OF BEARING: Check bearing for high temperature: Before start: 15 minutes after start 30 minutes after start 1 hour after start 2 hours after start 3 hours after start		
VIBRATION: Make visual inspection during run-test. Record any unusual vibration in remarks column.		
NOISE: Record any unusual noise in remarks column.		

DISTRIBUTION:

CONTRACTOR/Date _____

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SECTION 26 05 10
ELECTRIC MOTORS

PART 1 GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide electric motors, accessories, and appurtenances complete and operable, in conformance to the Contract Documents.

B. The provisions of this Section apply to low voltage 3 phase, AC squirrel cage induction motors throughout the Contract Documents, except as indicated otherwise.

C. The CONTRACTOR shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittals.

B. Complete motor data shall be submitted with the driven machinery Shop Drawings. Motor data shall include:

1. Machine name and specification number of driven machine

2. Motor manufacturer

3. Motor type or model and dimension drawing. Include motor weight.

4. Nominal horsepower

5. NEMA design

6. Enclosure

7. Frame size

8. Winding insulation class and temperature rise class

9. Voltage, phase, and frequency ratings

10. Service factor

11. Full load current at rated horsepower for application voltage

12. Full load speed

13. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.

14. Type of thermal protection or overtemperature protection, where included

15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable

16. Bearing data. Include recommendation for lubricants of relubricatable type bearings.

17. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery. Provide shaft grounding details and information. Provide insulated bearing details and information.

18. Power factor at 1/2, 3/4 and full load.

19. Recommended size for power factor correction capacitors to improve power factor to 0.95 percent lagging when operated at full load.

C. If water cooling is required for motor thrust bearings, the Shop Drawing submittals shall indicate this requirement.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electric motors driving identical machines shall be identical.

B. Maximum motor loading shall be equal to nameplate horsepower rating or less, exclusive of service factor and be verifiable from the submittal data of the driven machinery.

C. Motor Capacity

1. The CONTRACTOR supplying the driven machinery shall size motors for the larger of the following criteria:

   a. Size motors to continuously carry the maximum load that develops across the full range of driven equipment operation.

   b. Size motors for minimum size indicated

2. In every case, motor size shall be derated from nameplate values as follows:

   a. Ambient Temperature

      1) For ambient temperatures up to but not exceeding 40 degrees C, no derating is required.

      2) For ambient temperatures exceeding 40 degrees but less than 50 degrees C, derate nameplate HP ratings to 85 percent.

   b. Site Altitude: No derating is required for altitudes less than 3300 feet (1000 meters). Higher altitudes require the following derating factors:

Altitude	Derating Factor
3,300 to 5,000 ft	97 percent
5,001 to 6,600 ft	94 percent
6,601 to 8,300 ft	91 percent

8,301 to 9,900 ft	88 percent
9,901 to 11,500 ft	85 percent

3. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the WORK.

D. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these requirements to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

A. General: Electric motors shall comply with NEMA MG-1 - Motor and Generator. Motors used with adjustable frequency drives shall comply with NEMA MG-1, Part 31, and shall be clearly identified as “Inverter Duty.”

B. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.

C. Motor Voltage Ratings: Low voltage motors shall have voltage ratings in accordance with the following, unless otherwise indicated:

1. Motors below 1/2 HP shall be rated 115 volts, single phase, 60 Hz. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable, provided leads are brought out to the conduit box.

2. Motors 1/2 HP and larger shall be rated 460 volts, 3 phase, 60 Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable, provided every lead is brought out to the conduit box.

D. Insulation: Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dT as defined in NEMA MG 1-31. The adjustable frequency drive manufacturer shall coordinate with the motor manufacturer to determine when additional dV/dT protection is required. Where required, it shall be furnished and installed as per the manufacturer’s written instructions.

E. Motors 50 HP or smaller located in non-hazardous areas shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15 for non-VFD applications and service factor of 1.15 (sine)/1.0 (inverter) for VFD applications.

F. Motors 50 HP and greater located in non-hazardous areas shall be TEFC, with a service factor of 1.15 for non-VFD applications and service factor of 1.15 (sine)/1.0 (inverter) for VFD applications.

G. Motors for use in hazardous locations shall have enclosures suitable for the classification indicated. Such motors shall be U.L. listed and be stamped as such.

H. Motors installed outdoors shall be provided with 120-volt AC space heaters, wired to a terminal strip in a low voltage motor junction box. If provided by the manufacturer when not specified, the

manufacturer shall not require that they be connected or the CONTRACTOR shall connect them at no extra cost to the OWNER, in order to keep the warranty in force.

I. NEMA Premium Efficiency Motors

1. Motors with a nameplate rating of 1 HP and larger shall be NEMA premium efficient units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112 - Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.

2. Efficiency: Nominal efficiency and minimum efficiency shall be defined in accordance with the following tables. Both efficiencies shall be included in the Shop Drawing submittal.

TOTALLY ENCLOSED - FAN COOLED (TEFC)

FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS
RATED 600 VOLTS OR LESS

	2 POLE		4 POLE		6 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2	85.5	82.5	86.5	84.0	88.5	86.5
3	86.5	84.0	89.5	87.5	89.5	87.5
5	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	--	--
450	95.8	95.0	96.2	95.4	--	--
500	95.8	95.0	96.2	95.4	--	--

Source: NEMA MG1 - 2011, Table 12-12

J. Two speed motors shall be of the 2 winding type.

2.3 ACCESSORY REQUIREMENTS

A. General: Horizontal motors 3 HP and larger and every vertical motor shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Where conduit sizes indicated do not match the motor terminal box, the CONTRACTOR shall provide means to accommodate the motor requirements. Motor boxes other than open drip-proof shall be gasketed.

B. Lifting Devices: Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

C. Special Requirements: The CONTRACTOR shall refer to individual equipment specifications for special requirements such as motor winding thermal protection or multi-speed windings.

D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

E. Nameplate: Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40. Inverter duty motors shall be clearly identified as such.

F. Where motors are indicated by elementary schematics or specifications to have zero speed switches, the switches shall be factory mounted integral to the motors. Switches shall close the contacts when the motor is at zero speed.

G. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be manufactured by Aegis, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.

H. The motor manufacturer shall furnish for installation by the CONTRACTOR power factor correction capacitors for each motor 10 HP and larger, and started with FVNR, FVR, FVNR-AT (auto-transformer) or FVTS (two-speed, high speed winding corrected) starters only. Motors started with VFDs shall not have capacitors. Reduced voltage, solid state starters shall be provided with capacitors, where specifically shown. The capacitors shall be fused, with internal resistors, suitably enclosed for mounting adjacent to the starter, MCC, or the motor, and sized to improve power factor to not less than 95% at full load. Size shall be as recommended by the motor manufacturer. The capacitors shall be wired to the motor starter output terminals. Dieletric fluid shall be non-PCB, biodegradable and non-flammable.

2.4 MOTOR THERMAL PROTECTION

A. Single Phase Motors: Single phase 120, 208, or 230-volt motors shall have integral thermal overload protection or shall be inherently current limited.

B. Thermostats: Where indicated or specified, winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer. All inverter duty motors shall be provided with winding thermostats, unless RTDs are specified. All explosion-proof motors shall be provided with winding thermostats.

2.5 MOTOR BEARINGS

A. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with lubricated-for-life ball bearings.

C. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

D. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve, and, (where subject to freezing), insulation with heat tracing.

F. Inverter Duty Motors: Provide an insulated bearing to prevent circulating bearing currents.

2.6 MANUFACTURERS, OR EQUAL

A. U.S. Motors/Nidec

B. Baldor

C. WEG

PART 3 EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment. Shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer’s recommendations.

B. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 26.

3.2 FACTORY TESTING

A. Motors rated 100 HP and larger shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the ENGINEER.

3.3 FIELD TESTING

A. The CONTRACTOR shall perform the following field tests (see also Section 26 01 26 – Electrical Testing):

1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Visually check that motor overload heaters are properly sized and that MCP breaker settings are correct for the motor installed.

6. Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1,000 VAC plus twice the rated voltage of the motor.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 19
WIRE AND CABLING

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide wire and cable, complete and operable, in accordance with the Contract Documents.

B. In the event that motors provided are larger horsepower than the motors indicated, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the increased motor horsepower in accordance with Section 26 05 10 – Electric Motors. Revisions are part of the WORK of this Section.

1.2 ACTION SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings in accordance with Sections 01 33 00 –Submittals and 26 00 00 – Electrical Work, General. Submit cable test results in accordance with this Section as well as Section 26 01 26 – Electrical Tests.

1.3 DELIVERY, STORAGE AND HANDLING

A. The CONTRACTOR shall protect all cables from damage at all times.

B. Cable ends shall be protected from water entry in accordance with the manufacturer's recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become submerged prior to splicing or termination, the cables shall be replaced in their entirety.

C. Cables shall be pulled into raceways in accordance with the manufacturer's requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer's written instructions.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Conductors, include grounding conductors, shall be stranded copper. Aluminum conductor and/or solid conductor wire and cable will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

B. Low Voltage Power and Lighting Wire

1. Wire rated for 600 volts in duct or conduit for power and lighting circuits shall be single conductor, Class B Type XHHW or XHHW-2 cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any power or control wiring in this project, except as specifically permitted within control panels per Section 40 95 13 – Control Panels.

2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

3. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Wiring for 600-volt class power and lighting shall be as manufactured by Okonite, General Cable, Southwire, or equal.

C. Low Voltage Control Wire

1. Low voltage control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2. Control wiring shall be No.14 AWG.

3. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by American, General Cable, or equal.

D. Instrumentation Cable

1. Instrumentation cable shall be rated at 300 volts, minimum.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-clear for 2 conductor cable and black-red-clear for 3 conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 or larger AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.047-inches.

4. Single pair, No. 16 AWG, twisted, shielded cable shall be Belden Part No. 8719, similar by General Cable, or equal.

5. Single triad, No. 16 AWG, twisted, shielded cable shall be Belden Part No. 8618, similar by General Cable, or equal.

E. Low Voltage Power and Control, Multi-Conductor/Tray Cable

1. Multi-conductor tray cable shall be rated 600 volts, listed by UL as Type TC cable per Article 336 of the NEC. The individual conductors shall be UL listed as Type XHHW or XHHW-2, with a sunlight-resistant PVC overall jacket.

2. Minimum conductor sizes shall be the same as for power and lighting wire and control wire as specified above.

3. Multiple conductor power cables include the following:

Phase Conductor Size (AWG)	Minimum Ground Wire Size (AWG)	No. of Conductors (not incl. Ground)
12	12	2 3
10	10	2 3
8	10	3
6	8	3
4	6	3
2	6	3
1/0	6	3
2/0	4	3
4/0	4	3

4. Multi-conductor control cables include the following:

Conductor Size (AWG)	No. of Conductors (Including 1#14 AWG Ground)
14	3
14	4
14	5
14	7
14	9
14	12
14	19
14	37

F. Cable Splices and Terminations

1. Where cable lugs are required for power cable terminations, utilize compression lugs – 3M Scotchlok 30000 and 31100 Series, Penn Union HBBLU and BLU, Burndy Hylug, or equal. Utilize compression tools as recommended by the manufacturer. Pressure type, twist-on connectors (wire nuts) will not be acceptable.

2. Pre-insulated fork tongue lugs shall be Thomas & Betts, Burndy, or equal.

3. General purpose insulating tape shall be Scotch No. 33, Plymouth Slip-knot, or equal. High temperature tape shall be polyvinyl as manufactured by Plymouth, 3M, or equal.

4. Labels for coding 600 volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by W.H. Brady, 3M, or equal.

5. Stress cone material for make-up of medium voltage shielded cable shall be as manufactured by Raychem, 3M, or equal.

6. Shielded power cable shall be spliced using kits specifically designed to splice medium voltage, shielded power cables. Splice kits shall be designed for continuous submergence. Heat shrink splice kits shall be Raychem “Type HVS”, or equal. “Cold” shrink splice kits shall

be 3M “5760 Series”, or equal. The CONTRACTOR’s personnel shall be trained by the splice kit manufacturer for proper installation of the splices, and shall submit certification of training as a shop drawing. A certified trainee shall perform the splice work.

PART 3 EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall provide, terminate and test all power, control, and instrumentation conductors.

B. The CONTRACTOR shall, as a minimum, provide the number of control wires listed in the conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.

C. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.

D. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

E. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be neatly fanned out to terminals.

F. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.

3.2 FIELD ASSEMBLY

A. General

1. Wire taps and splices shall be properly taped and insulated according to their respective classes.

2. In general, there shall be no cable splices in underground manholes or pullboxes. If splices are necessary, the cables shall be spliced using submersible cable splices, suitable for continuous submergence. Splices in underground manholes and pullboxes may be made only with the approval of the ENGINEER.

3. Stranded conductors shall be terminated directly on equipment box lugs making sure that conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4. Excess control and instrumentation wires shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin, and be neatly coiled.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

3. The CONTRACTOR shall provide as a minimum the number of control wires listed in the conduit schedule or as indicated in the Contract Documents. Excess wires shall be treated as spares.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4 - 20 mA system.

2. Two and 3 conductor shielded cables installed in conduit runs which exceed available standard cable lengths may be spliced in pullboxes with the prior approval of the ENGINEER. Such cable runs shall have only one splice per conductor.

D. Power Wire and Cable

1. 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR. Cables rated above 2,000 volts shall be spliced or terminated only at equipment terminals indicated.

2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape.

3. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable and terminal manufacturer. The CONTRACTOR shall submit the proposed termination procedure as a Shop Drawing.

4. VFD shielded power cables shall have the shield grounded at all locations where it is exposed.

E. Cable Identification

1. General: Wire and cable shall be identified for proper control of circuits and equipment and to reduce maintenance effort. Identification shall be installed at every termination point.

2. Identification Numbers: The CONTRACTOR shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3-inches of conductor terminals. "Control and Instrumentation Conductors" shall be defined as any conductor used for control, interlock, alarm, annunciator, or signal purposes.

   a. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.

   b. 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white.

   c. 120/240-volt system conductors shall be color coded as follows: Line 1 - Black, Line 2 - Red, and Neutral - White.

d. 480/277-volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray.

e. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs. Color coding tape shall be used where colored insulation is not available. Colored identification tape may be used on conductors between the local disconnect and the load, where permitted by the NEC. Any phase changes necessary for proper rotation shall be made at the driven equipment where colored insulation is used. Phase changes may be made on the load side of the local disconnect, where phase colors are identified using tape.

f. General purpose AC control cable shall be red. General purpose DC control cable shall be blue.

g. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

h. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

3.3 FIELD QUALITY CONTROL

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-95-658/NEMA WC70 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01 33 00 – Submittals, prior to shipment of cable. The following field tests (in addition to the tests specified in Section 26 01 26 – Electrical Tests shall be the minimum requirements:

1. Insulation resistance testing, using a DC megohmeter, shall be performed on cables operating at more than 2,000 volts to ground. Time-resistance readings shall be taken and recorded at intervals of 30 seconds and one minute. Time-resistance voltage levels shall be per the cable manufacturer's recommendations.

2. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.

3. Field testing shall be done after cable is installed in the raceways.

4. Field tests shall be performed by a NETA-certified test organization. Test results shall be submitted to the ENGINEER for review and acceptance.

5. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cable shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cable in service.

END OF SECTION

SECTION 26 05 26
GROUNDING

PART 1 GENERAL

1.1 THE SUMMARY

A. Provide the electrical grounding system, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 ACTION SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittals and Section 26 00 00 – Electrical Work, General.

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

B. Shop Drawings

1. Submit manufacturer's product information for connectors, clamps, and all grounding system components, showing compliance with the requirements of this Section.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

B. Grounding System

1. Grounding loop conductors shall be bare annealed tin-plated copper conductors.

2. Conductors shall be No. 4/0 unless indicated otherwise.

3. Ground Rods

   a. Unless indicated otherwise, provide ground rods minimum of 3/4 inch in diameter, 10 feet long, and with a uniform covering of electrolytic copper metallically bonded to a rigid steel core.

   b. Provide corrosion-resistant copper-to-steel bond.

   c. The rods shall conform to UL 467.

   d. The rods shall be of the sectional type, joined by threaded copper alloy couplings.

4. Make buried, concrete-encased, or otherwise inaccessible cable-to-cable and cable-to-ground rod connections using exothermic welds by Cadweld, Thermoweld, or equal.

5. Exposed Connectors

   a. Exposed grounding connectors shall be of the compression type (connector-to-cable), constructed of high-copper alloy, and manufactured specifically for the particular grounding application.

   b. The connectors shall be Burndy, O.Z. Gedney, or equal.

6. Use grounding clamps to bond each separately-derived system to the grounding electrode conductors.

7. Equipment Grounding Circuit Conductors

   a. The conductors shall be the same type and insulation as the load circuit conductors.

   b. The minimum size shall be as indicated. Where not indicated, sizes shall conform to Table 250.122 of the National Electrical Code.

   c. Metallic conduit systems shall have an equipment grounding wires as well as being equipment grounding conductors themselves.

8. Grounding Materials Manufacturer, or Equal

   a. Copperweld

   b. Thermoweld

   c. Burndy

   d. Thomas and Betts

   e. OZ Gedney

PART 3 EXECUTION

3.1 PREPARATION

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Provide a supplemental ground connection for motor shaft grounding rings, where applicable.

C. Do not use bolts for securing the motor box to the frame or the cover for grounding connectors.

D. Sizes shall be as indicated on the Conduit Schedule and in accordance with NEC Article 250.

E. Route the conductors inside the raceway.

F. Provide a grounding-type bushing for secondary feeder conduits that originate from the secondary section of each MCC section, switchboard, or panelboard.

G. Individually bond the raceway to the ground bus in the secondary section.

H. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw, and, for grounding type devices, to the equipment grounding conductor.

I. Provide a separate grounding conductor in each individual raceway for parallel feeders. Connect the parallel ground conductors together at each end of the parallel run, as required by the NEC.

J. Provide additional grounding system testing in accordance with Section 26 01 26 – Electrical Tests.

K. Embedded Ground Connections

1. Underground and grounding connections embedded in concrete shall be UL-listed ground grid connectors.

2. The connection shall be made in accordance with the manufacturer's instructions.

3. Do not conceal or cover ground connections until the ENGINEER or an authorized representative has established that every grounding connection conforms to the requirements of the Contract Documents and has given the CONTRACTOR written confirmation.

L. Ground Rods

1. Provide ground rods at the indicated locations.

2. A single electrode that does not have resistance-to-ground of 5 ohms or less shall be augmented by additional electrodes to obtain this value.

3. Take the resistance-to-ground measurement during dry weather, a minimum of 48 hours after a rainfall.

4. Rods forming an individual ground array shall be equal in length.

M. Instrumentation Shield Grounding

1. Shielded instrumentation cable shall have its shield grounded at one end only unless the approved Shop Drawings indicate that the shield will be grounded at both ends.

2. The grounding point shall be at the control panel or at the receiving end of the signal carried by the cable.

3. The termination of the shield drain wire shall be on its own terminal screw.

4. Jumper together the terminal screws, using manufactured terminal block jumpers or a No. 14 green insulated conductor.

5. Connect the ground bus via a green No. 12 conductor to the main ground bus for the panel.

END OF SECTION

SECTION 26 05 33
ELECTRICAL RACEWAY SYSTEMS

PART 1 GENERAL

1.1 THE SUMMARY

A. Provide electrical raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittals, and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

2. Submit dimensioned layout drawings of proposed embedded/encased raceway routings within concrete slabs.

3. As-Built Drawings

a. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

b. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Submittals.

PART 2 PRODUCTS

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.

2.2 CONDUIT

A. Rigid Aluminum (RAL) Conduits

1. Provide rigid aluminum conduit manufactured from 6063 alloy, temper T-1.

2. Provide rigid aluminum conduit manufactured in accordance with NEMA C80.5 – Electrical Rigid Aluminum Conduit, and UL-6A – Electrical Rigid Metal Conduit - Aluminum, Red Brass and Stainless Steel.

3. Manufacturer, or Equal

a. V.A.W. of America

b. Alcoa

B. Rigid Galvanized Steel (RGS) Conduit

a. Not used.

C. PVC Rigid Non-Metallic Conduit

1. Provide rigid non-metallic conduit manufactured from Schedule 40 or 80 PVC, as indicated, and sunlight-resistant.

2. Provide rigid non-metallic conduit manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.

3. Manufacturer, or Equal

a. Carlon

b. Cantex

D. Rigid PVC-Coated Aluminum (RPAL) Conduit

1. The conduit shall meet the requirements for RAL conduit as indicated above.

2. Bond a PVC coating to the outer surface of the conduit.

3. Ensure that the bond between the coating and the conduit surface is greater than the tensile strength of the coating.

4. Provide the inside surfaces and threads of the conduit with a 2-mil urethane coating.
5. Provide a PVC coating thickness not less than 40 mils.

6. The PVC-coated RAL shall be manufactured in accordance with the following standards:

a. UL-6A

b. ETL PVC-001

7. Manufacturer, or Equal

a. Robroy Industries

b. O'Kote

c. Thomas & Betts

E. Fiberglass Reinforced Plastic (FRP) Rigid Non-Metallic Conduit:

a. Not used

F. Liquid-Tight Flexible Conduit

1. Provide liquid-tight flexible conduit constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.

2. Provide liquid-tight flexible conduit manufactured in accordance with the requirements of UL-360 - Steel Conduits, Liquid-Tight Flexible.

3. Manufacturer, or Equal

    a. Anaconda, Sealtite

    b. Electriflex, Liquatite

G. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General

1. For use with metallic conduit, provide cast fittings of the threaded type with 5 full threads. Material to match conduit.

2. Fittings and Boxes

    a. Provide fittings and boxes with neoprene gaskets and non-magnetic stainless steel screws.

    b. Attach covers by means of holes tapped into the body of the fitting.

    c. Covers for fittings attached by means of clips or clamps will not be accepted.

3. Provide boxes larger than standard cast types manufactured of Type Type 316 stainless steel, NEMA 4X.

4. Terminations

    a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or equal.

    b. In other than outdoor areas, provide sealed locknuts and bushings.

5. Hazardous Locations

    a. In hazardous locations, provide conduit, fittings, and boxes suitable for the indicated Class and Division.

    b. Provide conduits terminated in NEMA 7 boxes with a male bushing, Adalet Type PEM, or equal, inside the box.

B. Cast Aluminum Fittings and Boxes

1. Provide cast aluminum boxes and fittings with less than 0.40 percent copper content, and use with aluminum conduit.

2. Manufacturer, or Equal

a. O.Z. Gedney

b. Appleton

c. Crouse-Hinds

C. PVC Fittings and Boxes

1. For use with rigid non-metallic conduit, provide fittings manufactured of solvent-welded PVC.
2. Provide boxes manufactured of PVC or fiberglass reinforced polyester (FRP).

3. Manufacturer, or Equal

a. Carlon

b. Crouse-Hinds

c. Hoffman

4. Provide welding solvent as required for the installation of non-metallic conduit and fittings.

D. PVC-Coated RAL Fittings

1. For use with PVC-coated RAL, provide PVC-coated coated that are the products of the same manufacturer as the conduit.

2. Provide male and female threads and internal surfaces with a 2-mil urethane coating.

E. Stainless Steel Boxes

1. Provide NEMA 4X stainless steel boxes, constructed of Type 316 stainless steel.

2. Provide stainless steel of a minimum of 14-gauge thickness, with a brushed finish.

3. Door Hinges

a. Provide doors with full-length stainless steel piano hinges.

b. Non-hinged boxes will not be accepted.

4. Manufacturer, or Equal

a. Hoffman

b. Rohn

c. Hammond

F. Sheet Steel Boxes

1. Sheet steel boxes shall be galvanized steel outlet and switch boxes.

2. Manufacturer, or Equal

a. Raco

b. Steel City

c. Appleton Electric

PART 3 EXECUTION

3.1 GENERAL

A. Run wiring in raceway unless indicated otherwise.

B. Install raceways between equipment as indicated.

C. Provide raceway systems that are electrically and mechanically complete before conductors are installed.

D. Bends and Offsets

1. Provide bends and offsets that are smooth and symmetrical, and accomplished with tools designed for this purpose.

2. Provide factory elbows wherever possible.

E. Combined Raceways

1. Raceways other than those containing power conductors may be combined in strict accordance with the NEC and with prior written permission from the ENGINEER.

2. In general, combine only raceways containing the same type (control, signal, and the like) and voltage of conductors/cables, or dedicated conduits from one source to one device/equipment, in accordance with the NEC.

3. Permission from the ENGINEER shall not relieve the CONTRACTOR of responsibility to meet national, state and local requirements.

4. Do not combine wiring for redundant systems into single raceways.

F. Routing

1. Where raceway routings are indicated, follow those routings to the extent possible.

2. Where raceways are indicated but routing is not indicated, such as home runs or on conduit developments and schedules, raceway routing shall be the CONTRACTOR's choice and provided in strict accordance with the NEC as well as customary installation practice.

3. Provide the raceway encased, exposed, concealed, or under-floor as indicated, except conceal conduit in finished areas unless specifically indicated otherwise.

4. Adjust routings in order to avoid obstructions.

G. Coordination

1. Coordinate between trades prior to installing the raceways.

2. The lack of such coordination shall not be justification for extra compensation, and any costs for removal and re-installation to resolve conflicts shall be part of the Contract Price.

H. Install exposed raceways parallel or perpendicular to structural beams.

I. Expansion Fittings

1. Install expansion fittings with external bonding jumpers wherever exposed raceways cross building expansion joints.

2. Install expansion/deflection fittings where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur.

3. Encased Expansion Fittings

a. Install encased expansion fittings wherever encased conduits cross building expansion joints.

b. Deflection type fittings shall not be required for encased conduits crossing an expansion joint within a single structure.

4. Provide expansion and expansion/deflection fittings constructed of the same material as the raceway to which they are installed.

J. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

K. Install exposed raceways at least 1/2 inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, install exposed raceways at least 1/4 inch from the face of walls or ceilings by the use of clamp backs or struts.

L. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, provide a means of suitable insulation in order to prevent such corrosion.

3.2 CONDUIT

A. Provide exposed conduit manufactured of rigid aluminum, except as follows and unless indicated otherwise:

1. In Class I, Div I or Div II hazardous locations, provide rigid aluminum conduit.

2. For conduit containing only grounding system bonding conductors, provide Schedule 80 PVC conduit.

3. Conduit encased in concrete shall be constructed of Schedule 40 PVC.

B. Concrete Encasement

1. Where PVC conduit is stubbed up from a concrete encasement, provide a PVC-coated RAL elbow.

2. The conduit shall emerge from the concrete in a direction perpendicular to the surface whenever possible.

3. Do not encase conduit in the bottom floor slab below grade.

C. Size

1. Provide exposed conduit of 3/4-inch minimum trade size.

2. Provide encased conduit of one-inch minimum trade size.

D. Install supports at distances required by the NEC.

E. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4 inch for concrete not exposed to weather or in contact with the ground.

F. Penetrations

1. Provide conduit passing through walls or floors with plastic sleeves.

2. Perform core drilling in accordance with the requirements of Section 26 00 00 – Electrical Work, General.

3. Conduits passing through a slab, wall, or beam shall not significantly impair the strength of the construction.

G. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall meet the following requirements:

1. Conduits with their fittings embedded within a column shall not displace greater than 4 percent of the gross area of cross section;

2. Conduits shall not be larger in outside dimension than 1/3 the overall thickness of the slab, wall, or beam in which it is embedded; and,

3. Conduits shall not be spaced closer than 3 outside diameters on centers.

H. Place the conduit such that cutting, bending, or displacing reinforcement from its proper location will not be required.

I. Coat threads with a conductive lubricant before assembly.

J. Joints

1. Provide joints that are tight, thoroughly grounded, secure, and free of obstructions in the pipe.

2. Adequately ream the conduit in order to prevent damage to the wires and cables inside.

3. Use strap-wrenches and vises to install the conduit, in order to prevent wrench marks on the conduit.

4. Replace conduit with wrench marks.

5. Where installed in chemical or fuel containment areas, the conduit shall not have joints or fittings located below the top of the containment area to prevent entry of chemicals or fuel into the conduit system.

K. Slope

1. Wherever possible, slope the conduit runs to drain at one or both ends of the run.

2. Wherever conduit enters a substructure below grade, slope the conduit in order to drain water away from the structure.

3. Take extreme care in order to avoid pockets or depressions in the conduit.

L. Where conduits from duct banks enter building walls below grade, transition to PVC-RAL at least 12” outside the wall. Installation of PVC-coated aluminum conduit though a core-drilled hole in an exterior wall below-grade shall utilize a sealing device as manufactured by Link Seal, or equal.

M. Connections

1. Make connections to lay-in-type grid lighting fixtures by using flexible metal conduit not exceeding 4 feet in length.

2. Make connections to motors and other equipment subject to vibration by using liquid-tight flexible conduit not exceeding 3 feet in length.

3. Provide equipment subject to vibration that is normally provided with wiring leads with a cast junction box for the make-up of connections.

N. Provide conduit seal fittings in hazardous classified locations, in strict accordance with the NEC.

O. Provide conduit, fittings, and boxes required in hazardous classified areas that are suitably rated for the area, and provide in strict accordance with NEC requirements.

P. Duct sealant shall be foam duct sealant such as Polywater FST or approved equal. Provide duct sealant at the following locations:

1. Where required by NEC Article 300.7.

2. In areas where chlorine gas or fumes from sodium hypochlorite exist to prevent passage of gas through the raceway system.

Q. Empty Conduits

1. Tag empty conduits at both ends to indicate the final destination.

2. Where it is not possible to tag the conduit, identify the destination by means of a durable marking on an adjacent surface.

3. Install a pull-cord in each empty conduit in floors, panels, manholes, equipment, and the like.

4. Install a removable plug on empty conduits that terminate below grade, in vaults, manholes, handholes, and junction or pullboxes.

R. Identification of Conduits

1. Identify conduits at ends and at pulling points.

2. Identification shall be the unique conduit number assigned in the Contract Documents.

3. Other than 120 VAC panelboard circuits, if a conduit has not been assigned a unique number in the Contract Documents, assign a unique number following the numbering scheme used in the Contract Documents.

4. Assign a unique number to 120 VAC panelboard circuits, similar to the cable numbering scheme used in the Contract Documents.

5. Provide conduit identification by a stamped or engraved non-corroding metal tag attached to the conduit bushing.

6. Provide an engraved phenolic nameplate in accordance with the requirements of Section 26 00 00 – Electrical Work, General, or a computer printed self-adhesive label attached to the equipment or enclosure inside which the conduit terminates.

7. Markings with a pen or paint will not be accepted.

S. Identification of Pullboxes and Junction Boxes

1. Identify pullboxes and junction boxes.

2. Identification shall be the unique conduit number assigned in the Contract Documents, or if not assigned a unique number the CONTRACTOR shall assign one following the numbering scheme used in the Contract Documents.

3. Provide box identification by a stamped or engraved non-corroding metal tag or an engraved phenolic nameplate, in accordance with the requirements of Section 26 00 00 – Electrical Work, General, and attached to the box or enclosure.

4. Markings with a pen or paint will not be accepted.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 05 43
UNDERGROUND RACEWAY SYSTEMS

PART 1 GENERAL

1.1 THE SUMMARY

A. Provide underground raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. Manholes, pullboxes, and fittings that are dedicated to the underground raceway system shall comply with the requirements of this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittals, and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1. Submit complete catalog cuts of all raceways, fittings, pullboxes, and manholes, marked where applicable in order to show proposed materials and finishes.

C. As-Built Drawings

1. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

2. Show routings, burial depths, manhole and handhole locations and sizes, and where applicable, connections to drainage systems.

3. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

PART 2 GENERAL

2.1 MANHOLES AND PULLBOXES

A. Frames and Covers

1. Provide traffic-type covers with an H-20 loading, except as otherwise indicated.

2. Identify manhole and pullbox covers as "ELECTRIC" by providing raised letters cast into the covers.

3. Provide frost-proof and water-tight grey iron frames and covers with solid lids and inner lids, and with 28-inch clear openings.

4. Bolt the covers and lids to cast-in-place steel frames using corrosion-resistant hardware.

5. Factory-prime the frames.

6. Provide covers constructed of cast-iron, and provide pick holes.

7. Provide frames with a 1/2-inch drilled and tapped hole and lug in order to accommodate a No. 4/0 AWG bare stranded copper conductor connected to a ground rod and the ground conductor of power cables passing through the manhole.

8. Manhole frames and covers shall be Neenah Foundry No. NF-1755GT18 or equal.

B. Equip manholes and pullboxes with pulling-in irons, opposite and below each ductway entrance.

C. Provide manholes and pullboxes with closed bottoms; open-bottom manholes and pullboxes will not be accepted.

D. Provide PVC ductbank conduits with end bells.

E. Brackets

1. Provide non-metallic, non-conductive brackets and stanchions in manholes as required for racking wiring through the manholes. Attach to manhole walls using stainless steel anchors and hardware.

2. Brackets and stanchions: Underground Devices, Inc., or equal.

F. Precast Manholes and Pullboxes Manufacturer, or Equal

1. Jensen Precast

2. Mack

3. Quikset

4. U.S. Precast

2.2 DUCTBANKS

A. Provide underground ducts constructed of Schedule 40 PVC.

B. Encase ducts in red-dyed concrete with steel reinforcing bars.

C. Provide concrete with a 3,000-psi compressive strength conforming to the requirements of Section 03 31 00 – Cast-in-Place Concrete.

D. Colorant

1. The concrete shall be dyed red throughout the ducts; surface treatment will not be accepted.

2. Provide colorant consisting of an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

3. The costs, if any, of cleaning coloring pigment from the concrete delivery equipment and other related cleanings shall be considered as part of the WORK.

E. Ductbanks

1. Ductbanks shall contain a No. 4/0 bare stranded copper ground wire.

2. The ground wire shall be continuous through the ductbank and terminate at power distribution equipment and the grounding grid.

F. Identification Tape

1. Provide continuous lengths of underground warning tapes located 12 inches above and parallel to the ductbanks.

2. Provide tape consisting of 6-inch wide polyethylene film, imprinted with "CAUTION - ELECTRIC UTILITIES BELOW."

3. Provide tape that contains a non-ferrous metal foil conductor sandwiched in the tape for detection purposes.

4. Tape Manufacturer, or Equal: Brady

PART 3 GENERAL

3.1 GENERAL

A. Install underground raceways between manholes and pullboxes as indicated.

B. Raceway systems shall be electrically and mechanically complete before conductors are installed.

C. Provide bends and offsets that are smooth and symmetrical, and fabricated with tools designed for this purpose.

D. Use factory elbows wherever possible.

E. To the extent possible, follow the raceway routings as indicated on the Drawings.

F. Adjust the indicated routings as necessary in order to avoid obstructions.

G. Coordination with Other Trades

1. Coordinate with other trades prior to installation of raceways.

2. The lack of coordination shall not be justification for extra compensation.

3. Perform removal and re-installation to resolve conflicts as part of the WORK.

3.2 DUCTBANKS

A. Install ductbanks in accordance with the following criteria:

1. Assemble the duct using high-impact, non-metallic spacers and saddles in order to provide conduits with vertical and horizontal separation.

2. Set the plastic spacers every 5 feet.

3. Anchor the duct array every 5 feet in order to prevent movement during the placement of concrete.

4. Lay the duct on a grade line of at least 3 inches per 100 feet, sloping towards pullboxes or manholes.

5. Install the duct and adjust the pullbox and manhole depths such that the top of the concrete envelope is a minimum of 18 inches below grade and a minimum of 24 inches below roadways.

6. Accomplish changes in direction of the duct envelope by more than 10 degrees horizontally or vertically by using bends with a minimum radius 24 times the duct diameter.

7. Stagger duct couplings a minimum of 6 inches.

8. Provide select backfill or sand for the bottom of the trench.

9. Cleaning

    a. Clean each bore of the completed ductbank by drawing through it a standard flexible mandrel, one foot long and 1/4 inch smaller than the nominal size of the duct.

    b. After passing the mandrel, draw through a wire brush and swab.

10. For spare raceways that are not indicated to contain conductors, provide a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.

B. Grout duct entrances smooth, and terminate ducts with flush end bells.

C. Assemble sections of pre-fabricated manholes and pullboxes using waterproof mastic, and set on a 12-inch bed of gravel as recommended by the manufacturer or as required by field conditions.

D. Provide watertight ductbank penetrations through walls of manholes, pullboxes, and building walls below grade.

E. Terminate concrete-encased ductbanks at building foundations.

F. Where ducts enter buildings, provide duct sealant in every duct at the building-end of the duct run to prevent water or condensation entry from the duct bank into the building. Duct sealant shall be Polywater FST, Polywater FST-Mini, or equal.

G. When duct enters the building on a concrete slab on grade, do not encase the duct but transition to rigid steel PVC-coated conduits on stub-ups.

H. Sealing

1. Where an underground conduit enters a structure through a concrete roof or a membrane-waterproofed wall or floor, provide a Link-Seal or equal sealing device.

2. Use the sealing device with rigid metallic conduit.

3. Transition from PVC to rigid metallic conduit prior to building entry.

END OF SECTION

SECTION 26 05 73
PROTECTIVE DEVICE STUDIES

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall perform the a short circuit and protective device studies for the new electrical improvements in accordance with the Contract Documents.

B. The WORK of this Section shall include protection studies for motors with solid state overload and overcurrent protection devices.

C. It is the responsibility of the CONTRACTOR to obtain the information required from the electric utility and appropriate vendors.

D. This study applies to all Power distribution equipment both New and Existing. This includes but is not limited to the following:

1. Service Disconnects
2. Disconnect Switches
3. Transfer Switches
4. Motor Control Centers (MCCs)
5. Panelboards
6. Control Panels (480V and 120V)

E. The CITY will furnish drawing information. The contractor shall field verify all existing, proposed, and as-built information used in the calculation.

1.2 QUALIFICATIONS

A. Short circuit studies, protective device evaluation studies, arc-flash hazard analysis studies, and protective device coordination studies shall be performed by an engineering firm who has been regularly engaged in short circuit and protective device coordination services for a period of at least 10 years.

B. The indicated studies shall be signed by the professional electrical engineer, registered in the State of Florida, responsible for the studies.

C. The studies shall utilize computer programs with proven reliability and accuracy for performing 3-phase fault-duty calculations.

1.3 CONTRACTOR SUBMITTALS

A. The indicated studies shall be submitted and approved by the ENGINEER prior to final approval of the distribution equipment Shop Drawings and release of equipment for manufacture.

B. An initial short circuit study shall be submitted and reviewed before the ENGINEER will approve the Shop Drawings for medium-voltage switchgear, transformers, or 480-volt distribution equipment.

C. The short circuit, arc-flash hazard analysis, and protective device coordination studies shall be updated prior to Project Substantial Completion; utilize characteristics of as-installed equipment and materials.

D. The adequacy of the equipment "withstand" and interruption ratings shall be approved by the ENGINEER.

1.4 MANUFACTURERS' SERVICES

A. Where applicable, the motor control center manufacturer shall furnish the services of a qualified field engineer to calibrate the MCPs as recommended in the power system study.

PART 2 PRODUCS

Not used.

PART 3 EXECUTION

3.1 GENERAL

A. The studies shall include development of single-line and impedance diagrams of the power system.

B. The diagrams shall identify components considered in the study and the ratings of power devices, including transformers, circuit breakers, relays, fuses, busses, and cables.

C. The resistances and reactance of cables shall be identified in the impedance diagram.

D. The studies shall contain written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.

E. The studies shall include every protective device and feeder included or modified within the WORK, as well as existing to remain.

F. The studies shall include all portions of the electrical distribution system for normal and standby power sources down to and including the 480-volt distribution system.

3.2 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program, and shall be in accordance with the following Standards:

ANSI/IEEE 141	Recommended Practice for Electrical Power Distribution for Industrial Plants
ANSI/IEEE 242	Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems
ANSI/IEEE C 37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C 37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures

3.3 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation study shall be performed in order to determine the adequacy of circuit breakers, molded case switches, and fuses.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the attention of the ENGINEER.

C. Do not utilize series-rated circuit breakers to meet short circuit requirements for this project.

D. Devices shall be fully rated to withstand available fault currents.

3.4 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device coordination study shall be performed in order to develop the necessary calculations to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the ENGINEER's attention.

3.5 TIME/CURRENT COORDINATION CURVES

A. As a minimum, the time/current coordination curves for the power distribution system shall include the following items plotted on 5-cycle log-log graph paper:

1. time/current curves for each protective relay, circuit breaker, or fuse demonstrating graphically that the settings will provide protection and selectivity within industry standards

2. Each curve shall be identified, and tap and time dial settings shall be specified.

3. Provide individual curves for each feeder unless identical to others.

4. Selectivity

    a. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing.

    b. Where selectivity cannot be achieved, the ENGINEER shall be notified as to the cause.

    c. Recommendations shall be included for alternate methods that would improve selectivity.

5. time/current curves and points for cable and equipment damage.

6. circuit interrupting device operating and interrupting times

7. Indicate maximum fault values on the graph.

8. sketch of bus and breaker arrangement

9. magnetizing inrush points of transformers

10. thermal limits of dry-type and liquid-insulated transformers (ANSI damage curve)

11. Every restriction of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.

3.6 ARC FLASH STUDY

A. An arc flash study shall be performed with the aid of a digital computer program in order to determine the “Arc Flash Protection Boundary” and “Personal Protective Equipment” (PPE) levels for applicable electrical distribution equipment, stand-alone disconnects, starters, and VFDs in the power distribution system.

B. The arc flash study shall be performed in conjunction with short circuit calculations and protective device coordination.

C. The arc flash study shall be in accordance with the latest version of the following Standards:

1. NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces

2. IEEE 1584 IEEE guide for performing Arc Flash Hazard Calculations

3. OSHA (29 CFR PART 1910) Occupational Safety and Health Standards for General Industry

4. ANSI Z535.4 Product Safety Signs and Labels

D. The recommended values for the “Arc Flash Protection Boundary” and PPE levels, based on the arc flash study results, shall be tabulated in the study.

E. Labeling

1. The digital computer program shall provide the “Arc Flash Protection Boundary” and PPE values in a format that can be directly printed on to labels. See example in Section 3.9 for required information.

2. The CONTRACTOR shall furnish and install these labels.

3.7 FINAL SUMMARY REPORT

A. Summarize the results of the indicated power system studies in a final report.

B. The report shall include the following items:

1. single-line diagram

2. impedance diagram

3. tabulation of all protective devices identified on the single line diagram

4. time/current coordination curves

5. specific recommendations, if any

6. test instrumentation, condition, and connections, as applicable, for each study

7. computerized fault current calculations

8. any suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety

9. recommendations to minimize the arc flash energy

C. The report shall include information concerning the computer program used for the study, as well as a general discussion of the procedure, items, and data considered in the preparation of the study.

D. Submit Electronic copies of the report to the ENGINEER.

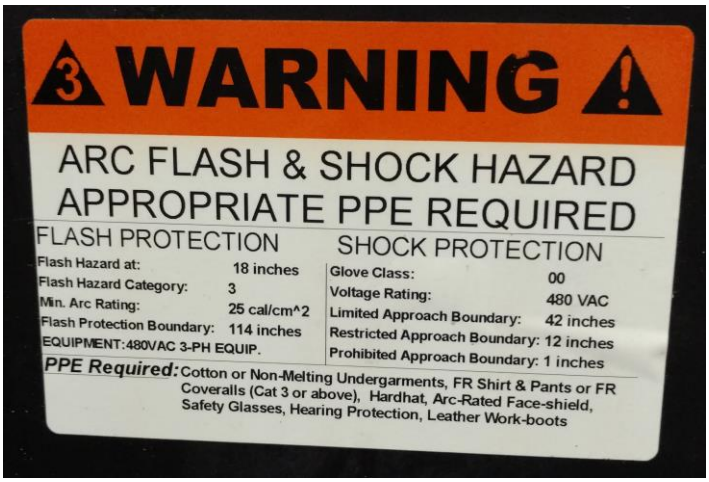
3.8 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. Test, calibrate, and adjust the protective relays and circuit breaker trip devices as required in accordance with the recommendations in the power system coordination study.

B. Calibrate the MCPs as required in accordance with the recommendations in the power system study.

C. Adjustments shall be made prior to energizing any electrical equipment.

3.9 Example Arc-Flash Label:



END OF SECTION

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SECTION 26 29 00
LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall modify existing motor control centers (MCCs), complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General, apply to the WORK of this Section.

C. In the event that provided motors are of greater horsepower than the indicated motors, revise the raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased motor horsepower in accordance with Section 26 05 10 – Electric Motors.

D. Single Manufacturer

1. The MCCs shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services.

2. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.

E. Coordination

1. The equipment provided under this Section shall operate the electric motor driver with the driven equipment as indicated under other equipment Sections.

2. The MCC manufacturer shall be provided with the following information, at a minimum:

a. Relevant Division 41 and Division 23 Sections for each piece of equipment driven by the MCC

b. Section 26 00 00 – Electrical Work, General

c. Section 26 05 10 – Electric Motors

d. Section 26 01 26 – Electrical Tests

e. the Electrical Contract Drawings

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 26 00 00 – Electrical Work, General.

B. Furnish the following equipment information in the Shop Drawings:

1. nameplate schedule

2. circuit breaker types, frames, size, ratings, SCCR, and settings

3. bucket size, accessories.

4. MCC Ladder Diagrams

    a. Furnish custom elementary schematic ladder diagrams for each bucket.

    b. The ladder diagrams shall include remote devices.

    c. Submittals not meeting these requirements will not be reviewed further and will be returned to the CONTRACTOR.

5. short circuit rating of the complete assembly

6. replacement parts lists and operation and maintenance procedures

7. time-current curves for protective devices

8. All hardware and accessories used to complete MCC modifications.

9. Factory test data certifying compliance with requirements of similar equipment from the same manufacturer

C. Spare Parts List

1. Furnish spare parts information for parts required by this Section as well any other spare parts recommended by the MCC manufacturer.

D. Startup and Testing Report

1. Within 15 days after completion of startup and testing, the CONTRACTOR shall submit a report for the MCC.

2. The report shall contain the following documentation:

    a. the device name, serial number, rating, and complete model number of each MCC

    b. a complete listing of all tests performed and the results of each test

    c. a complete listing of all circuit breaker and overload settings, fuse ratings, settings, setpoints and configuration information for devices with adjustable settings

PART 2 PRODUCTS

2.1 GENERAL

A. The manufacturer of the low-voltage motor control center shall also manufacture at least the following:

1. molded case circuit breakers, up to and including 225 ampere frame size

2. disconnect switches

3. magnetic motor starters

4. control and timing relays rated at 600 volts AC

5. pushbuttons, lights and selector switches, including remote mounted control stations

6. meters, including ammeter, voltmeter, and solid-state metering devices

B. Single Manufacturer

1. Devices of the same type shall be products of the same manufacturer.

2. This requirement applies to control devices, custom-fabricated equipment, and insofar as practical to equipment manufactured on a production basis.

2.2 DESIGN, CONSTRUCTION, AND MATERIAL REQUIREMENTS

A. The motor control centers shall be 600-volt class and suitable for operation on a 3-phase, 60-Hz system.

B. The system operating voltage and number of wires shall be as indicated.

C. Power

1. Power distribution from the MCC shall be 480-volt, 3-phase, 3-wire.

D. Enclosure

1. The enclosure shall be of NEMA Type 1.

2. Compartment doors shall be interlocked with compartment circuit breakers, fitted with a maintenance override.

E. Cabinets

1. Control units inside compartments shall be clearly identified with tags or stencil markings.

2. Identification

a. Each control unit, including spares, spaces and blanks, lights, and devices shall be identified by an engraved nameplate.

3. Protective Coating

a. The finish for motor control center shall be light grey, matching the existing MCC color.

2.3 MAIN AND FEEDER CIRCUIT BREAKERS (480 V)

A. Circuit breakers having a frame size of 150 amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.

B. Circuit breakers with a frame size of 225 amperes to 1,200 amperes shall be molded case with RMS sensing electronic trip elements.

C. The interrupting capacity of the main and feeder branch circuit breakers shall be a minimum of 65,000 RMS symmetrical amperes.

D. Circuit breaker disconnect operators shall be capable of accommodating 3 padlocks for locking in the OPEN position.

E. Circuit breaker auxiliary contacts shall be furnished where indicated.

2.4 FACTORY TESTS

A. Provide the manufacturer's standard electrical and mechanical production tests and inspections for motor control centers and their components.

B. The tests shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of components including controls, protective devices, metering, and alarm devices.

2.5 SPARE PARTS

A. Not Used.

2.6 MCC MANUFACTURER

A. The existing MCC to be modified is General Electric "8000 Line". New parts to be from same manufacturer.

PART 3 EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall install modify the existing motor control center in accordance with the manufacturer's published instructions.

B. Conduit installation shall be coordinated with the manufacturer's as-fabricated drawings such that conduit stub-ups are within the area allotted for conduit.

C. Conduit shall be stubbed up in the section that contains the devices to which conductors are terminated.

3.2 STORAGE AND HANDLING

A. If stored at the Site, motor control center components shall be stored in a clean, dry space.

B. Factory wrapping shall be maintained or an additional heavy plastic cover shall be provided to protect units from dirt, water, construction debris, and traffic.

C. The storage space shall be heated or the MCC space heaters shall be energized.

D. Motor control centers shall be handled carefully to avoid damage to motor control center components, enclosure, and finish.

E. Damage shall be repaired before installation.

3.3 MANUFACTURER'S SERVICES

A. Inspection, Startup, Field Adjustment

1. The Service Representative shall supervise the following items, and shall certify that the equipment and controls have been properly installed, aligned, and readied for operation:

    a. installation of the equipment

    b. inspection, checking, and adjusting of the equipment

    c. startup and field testing for proper operation

    d. performance of repairs to correct any discrepancies or problems revealed during startup and testing

    e. performance of field adjustments to ensure that the equipment installation and operation comply with the indicated requirements

    f. Preparation and submittal of a report covering startup and testing, including a listing of equipment settings and parameters at the end of startup and testing.

3.4 INSTALLATION

A. The CONTRACTOR shall:

1. torque bolts to manufacturer's recommendations.

2. touch up scratches after the equipment has been installed;

3. verify that nameplate, and other identification is accurate.

3.5 FIELD TESTS

A. Provide a visual and mechanical inspection after installation, as follows:

1. Inspect for physical damage, proper installation, and grounding.

2. Check tightness of bolted connections.

B. Electrical Tests

1. Refer to Section 26 01 26 – Electrical Tests.

2. Testing shall be in accordance with the manufacturer's recommendations.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 26 41 23
LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR, through a qualified Subcontractor, shall design and provide modifications to the exiting lightning protection system, complete and operable, as indicated in accordance with the Contract Documents.

B. The lightning protection Subcontractor shall be certified by the Lightning Protection Institute (LPI), for both the design and the installation of the lightning protection system.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes

NFPA 780	Standard for the Installation of Lightning Protection Systems
NFPA 70	National Electric Code
UL 96A	Lightning Protection Components
LPI-175	Lightning Protection Institute Installation Code

1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings in accordance with the requirements of Sections 01 33 00 – Contractor Submittals and 26 00 00 – Electrical Work, General.

1. Products: Furnish manufacturer’s catalog data for all materials.

2. Drawings

a. Furnish a scaled drawing of the facility showing the lightning protection system.

b. The drawing shall show, at a minimum:

1) the location of air terminals

2) the routing of conductors

3) connections to the electrical grounding system and ground rods

4) details of air terminal mounting and bonding to vents, chimneys, antennas, and other metallic structures

3. Cross-reference the materials provided with the manufacturer’s catalog numbers and cuts.

PART 2 GENERAL

2.1 GENERAL

A. Products shall be UL-listed for use in lightning protection systems.

B. Products shall be Class I for structures not greater than 75 feet high and Class II for structures higher than 75 feet.

C. Air terminals for aluminum roofs or structures shall be of aluminum construction.

D. Air Terminals

1. Air terminals shall project a minimum of 10 inches above the objects protected, and shall be located at intervals not exceeding 20 feet along ridges and around the perimeter of flat roof or gently sloping roofs.

2. Flat or gently sloping roofs exceeding 50 feet in width shall be provided with additional air terminals at intervals not exceeding 50 feet on the flat or gently sloping area.

3. Locate air terminals within 24 inches of the roof edge and outside corners of the protected area.

4. Provide air terminals for metal stacks, flues, and mechanical equipment having a metal thickness of less than 3/16 inch and not within a zone of protection of an air terminal.

5. Equipment with a metal thickness 3/16 inch or greater shall be bonded in accordance with code requirements.

6. Air terminals shall be No. A71, 1/2-inch by 12-inch (or longer, as required), constructed of solid aluminum, and shall use air terminal bases of cast aluminum construction.

E. Conductors

1. Structures Less than 75 Feet High

a. Main size conductors on the roof shall be No. A28, Class I aluminum lightning conductor, consisting of 28 strands of 14 AWG aluminum wire weighing 115 lbs. per 1000 feet.

b. Secondary bonding conductors shall be No. A10, secondary bonding conductor, consisting of 10 strands of 14 AWG aluminum wire.

c. Down Conductors

1) Conceal down conductors in exterior wall construction.

2) Use bimetallic connections for the transition from aluminum conductors to copper grounding electrode conductors.

F. Miscellaneous Hardware

1. Provide miscellaneous hardware as may be required for the installation of the lightning protection system.

2. The hardware shall be compatible with the indicated air terminal and conductor materials.

3. Nuts, bolts, and other fasteners shall be constructed of stainless steel.

G. Corrosion Protection

1. Provide corrosion protection at the junctions of dissimilar metals and at locations where the components of the lighting protection system may be subjected to corrosion.

2. Use bimetallic connectors and fittings for splicing and bonding dissimilar metals.

3. Bimetallic connectors shall be located not less than 18 inches above grade.

H. Grounding Materials

1. Ground rods and ground conductors shall conform to the requirements of Section 26 05 26 – Grounding.

2. Down conductors shall be connected to the ground rods using exothermic weld connections.

I. Structural Steel System

1. Structural steel may be substituted for down conductors.

2. The main steel columns shall be grounded an average maximum distance of 60 feet using Class II material.

3. Roof penetrations from steel to perimeter cables shall be at intervals not exceeding 100 feet in accordance with the requirements of UL 96A, LPI 175, and NFPA 780.
4. Use exothermic welds for steel connections.

PART 3 EXECUTION

3.1 GENERAL

A. The lightning protection system shall be installed in accordance with applicable code requirements by a Subcontractor certified in the following organizations:

1. NFPA

2. LPI

3. UL

B. Bends in conductors shall be gradual, utilizing a radius of 8-inches or greater and forming an angle of at least 90 degrees.

3.2 ROOF PENETRATIONS

A. Roof penetrations shall be made using a conduit sleeve passing through a pitch pocket.

B. The CONTRACTOR shall construct the pitch pockets in such a way as to maintain the roofing warranty in full force, where applicable.

3.3 INTERCONNECTIONS OF METALS

A. Metal bodies within 6 feet of the conductor shall be bonded to the system with approved fittings and conductor.

B. Bonding of metallic objects and systems at roof levels and elsewhere on the structure shall be complete.

C. Exterior architectural metal fascia, curtain walls, or mullions, which extend the full height of the structure, shall be bonded, if not inherently bonded through the building frame.

D. Metal Bodies of Conductance

1. Metal bodies of inductance located within 6 feet of a conductor or object with secondary bonds shall be bonded with secondary cable and fittings.

2. Typical of these are:

a. roof flashings

b. parapet coping

c. gravel guards

d. isolated metal building panels or siding

e. roof drains and down spouts

f. roof insulation vents

g. other sizeable miscellaneous metal fabrications

3.4 INSPECTION AND ACCEPTANCE

A. The lightning protection system shall be inspected, tested, and certified.

B. The CONTRACTOR shall retain the services of an independent inspector.

C. An LPI/UL Certificate of Inspection shall be furnished to the ENGINEER.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 40 05 06
PIPE COUPLINGS

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide pipe couplings indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings.

C. The couplings, adapters and joints shall be provided with restraining devices to restrict pipe axial movement. Where the restraining devices and/or details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to provide the devices/details necessary to restraint the piping system.

D. The Items specified in this section include the following:

1. Groove Couplings
2. Sleeve Couplings
3. Flanged Coupling Adapters
4. Dismantling Joints
5. Expansion Joints
6. Flexible Connectors
7. Transition Couplings
8. Quick Disconnect Couplings
9. Tapping Sleeves
10. Miscellaneous Adapters

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 –Submittals.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Product submittals, and shall be specifically identified with the applicable style or series designation, pressure rating and restraint system if applicable.
2. Couplings schedule or layout indicating where the couplings will be installed.

3. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and guides, including information on materials, temperature, and pressure ratings

4. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

1.3 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping couplings, adapters and joints accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 PRODUCTS

2.1 GENERAL

A. Extent of Work

1. Piping couplings, adapters, joints and accessories shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. The CONTRACTOR shall not be allowed to substitute any other type of coupling in lieu of the couplings as specified herein unless approved by the ENGINEER.

3. The CONTRACTOR shall assign the responsibility to the coupling manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER for review.

B. Pressure Rating

1. Couplings, adapters and joints shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

C. Seals

1. Seal elastomer materials shall be selected to be compatible with the fluid service, pressure and temperature. They shall be composed of elastomeric-compound material that will not deteriorate from age under normal storage or use conditions.

2. Where couplings are used in water containing dissolved ozone residual or chloramines, seal material shall be Viton-A.

D. Coating

1. Couplings shall be lined and coated at the factory, unless otherwise indicated.

2. Coating shall be in accordance with the Section 09 96 00 – High Performance Coatings, unless otherwise indicated.

E. General

1. Provide cast grooved type couplings where indicated, conforming to the requirements of AWWA C606 - Grooved and Shouldered Joints.

2. Grooved or banded piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.

   a. If grooved connections are used, the remaining thickness of pipe material after grooving shall be adequate to carry the load imparted to the joint. Joints for thin wall pipes shall be banded or welded with a collared end to fit coupling.

   b. Rolled pipe ends are not acceptable as a means of connection for metallic piping.

3. Equipment connections with mechanical-type couplings shall be provided with rigid grooved couplings or flexible type coupling with harness in sizes where rigid type couplings are not available, unless thrust restraint is provided by other means.

4. Couplings shall be electrically bonded.

5. For uniformity and compatibility of the piping components; grooving tools, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling.

F. Grooved Type Couplings Manufacturer, or Equal

1. Grooved couplings for ductile iron piping shall be provided with flush seal gaskets.

   a. Victaulic Company, Style 31 (flexible or rigid)

   b. Gustin-Bacon (banded or grooved)

2. Grooved couplings for steel piping

   a. Victaulic Company, Style 177 / 77 / W77 (grooved, flexible, or rigid)

   b. Victaulic Company, Style 107H / 07 / W07 or HP-70 (grooved, rigid)

   c. Gustin-Bacon (banded or grooved)

3. Grooved couplings for stainless steel piping

   a. Victaulic Company, Style 489 (rigid)

   b. Victaulic Company, Style 77S (flexible)

   c. Gustin-Bacon (banded or grooved)

2.2 SLEEVE COUPLINGS

A. General

1. Provide sleeve couplings specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.

2. Couplings shall be constructed without pipe stop.

3. The middle ring shall be at least the same wall thickness as the pipe to which the coupling is connected and not less than 1/4-inch thick.

4. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. For standard sleeve couplings, the coupling shall be either 5 or 7 inches long for pipe diameters up to and including 30-inch and 10 inches long for pipe diameters greater than 30-inch. For long sleeve couplings, the coupling shall be 16 inches long for all pipe diameters.

6. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling.

C. Insulating Sleeve Couplings

1. Where insulating couplings are required, both ends of the coupling shall be provided with a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of coupling metal parts from the pipe.

D. Sleeve-Type Couplings Manufacturer, or Equal

1. World Wide Metric, Inc. (Dresser), Style 38

2. Ford Meter Box Company, Inc., Style FC1 or FC3

3. Smith-Blair, Inc., Style 411

2.3 FLANGED COUPLING ADAPTERS

A. Provide flanged coupling adapters specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.

C. Flanged Couplings Adapter Manufacturer, or Equal

1. Smith-Blair, Model 913

2. Dresser, Model 128-W

3. JCM, Model 303

2.4 DISMANTLING JOINTS

A. Provide dismantling joints products specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.

C. Dismantling Joints Manufacturer, or Equal

1. Smith-Blair, Model 975

2. Dresser, Model 131

3. JCM, Model 309

2.5 EXPANSION JOINTS

A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures, accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints.

B. Expansion joints shall be provided with flanged ends and constructed of stainless steel, Monel, rubber, or other materials best suited for each individual service. Where expansion joints are used in water containing dissolved ozone residual or chloramines, provide Type 316 stainless steel expansion joints.

C. Where bellows-type expansion joints are mounted near the suction nozzle of the pump, a stainless steel internal liner shall be provided to minimize turbulence as the flow passes through the arches of the bellows.

D. Expansion joints for Plastic Tanks

1. Expansion joints for piping connections to polyethylene tanks nozzles shall be provided by the tank manufacturer, selected for the fluid service, and sized for up to 4% tank expansion or movement as required by the tank manufacturer. Fastener hardware shall be of Type 316 stainless steel construction.

2. Expansion joints for other plastic tanks shall be constructed of molded PTFE with at least two convolutions and flanged joints. Flanges shall be ductile iron with Type 316 stainless steel bolts and nuts. Flexible connectors shall be Proco Series 442 molded expansion joint, or equal.

2.6 FLEXIBLE CONNECTORS

A. Low-Temperature

1. Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated.

2. Flexible connectors for service temperatures up to 180 degrees F shall be flanged-reinforced neoprene or butyl spools, rated for a working pressure of 40 to 150 psig, or reinforced flanged duck and rubber, as best suited for the application.

3. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for a minimum 150-psig working pressure, unless otherwise recommended by the equipment manufacturer.

4. The connectors shall be a minimum of 9 inches long and provided with face-to-face flanges, unless otherwise indicated.

5. The final material selection shall be approved by the manufacturer.

B. High-Temperature (temperature exceeding 250°F (120°C))

1. Install flexible connectors in engine exhaust piping and where indicated.

2. Connectors shall be sufficient to compensate for thermal expansion and contraction and to isolate vibration between the engine and the exhaust piping system.

3. Connectors shall be stainless steel bellows-type, flanged, and rated for minimum 150 psig, 2000 degrees F.

2.7 TRANSITION COUPLINGS

A. Provide transition-coupling products specifically designed suitable for the fluid service and manufactured for the piping applications.

B. The transition couplings shall have function and design similar to the flexible couplings, joint and flanged coupling adapters for connecting piping having different outside diameters.

2.8 QUICK DISCONNECT COUPLINGS

A. Quick disconnect couplings shall be of the cam lock type (cam and groove type) consisting of a male adapter conforming to Specification MIL A-A-59326A. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leak proof up to full system pressures.

B. Each adapter shall be furnished with a dust cap complete with an 18-in long security chain of corrosion resistant material.

C. Unless otherwise indicated, the quick disconnect couplings shall be flanged connection to piping and materials shall be Type 316 stainless steel.

D. Quick connect couplings shall be as manufactured by LMC-Couplings; Dover Corporation; Ever-tite; or equal.

2.9 TAPPING SLEEVES

A. Provide tapping sleeve products specifically designed suitable for the fluid service and manufactured for the piping applications

B. Unless otherwise indicated, the tapping sleeves shall be of full circumference band with flanged outlet connection sized to ANSI class 150. Material of construction for the body and fastener shall be stainless steel.

C. Gasket material: Nitrile (Buna-N) or EPDM.

D. Tapping sleeves shall be as manufactured by Smith-Blair; Romac Industries; Dresser or equal.

2.10 MISCELLANOUS ADAPTERS

A. A special pipe adapter may be required to provide proper connection between different type of pipes and/or fittings. The adapter may be indicated on the Drawing with the pipe type or equipment. However, it is the CONTRACTOR'S responsibility to ensure proper connection between various type of pipes and pipe appurtenances. Provide adapters as required whether specifically indicated or not.

B. Provide piping adapter products specifically designed suitable for the fluid service and manufactured for the piping applications.

PART 3 EXECUTION

3.1 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

B. The CONTRACTOR shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation.

C. The CONTRACTOR shall assign the responsibility to the couplings manufacturer to review the piping connection to the couplings and submit any modifications to the ENGINEER for review.

3.2 INSTALLATION

A. Where couplings are shown to connect piping to mechanical equipment such as pumps, compressors, and blowers, the piping shall be aligned with the equipment point of connection and shall be perpendicular to the axis of the flange or fitting for which the piping is to be connected.

B. The couplings or the piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment.

C. Restrained Joints on couplings, adapters and joints

1. Couplings, adapters and joints on pressure lines shall be harnessed unless thrust restraint is provided by other means.

2. Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11, or as indicated.

3. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.

4. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation in order to prevent misalignment of the pump imparted by the thrust within the piping system.

5. Other means of restraining the coupling such as set screws on piping will not be accepted.

END OF SECTION

SECTION 40 05 07
PIPE SUPPORTS

PART 1 GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing the pipe supports.

C. The provisions of this Section shall apply to piping in Divisions 33 and 40.

D. The CONTRACTOR shall provide supporting devices for supporting and restraining piping as indicated on the Drawings. Where pipe support devices and/or restraining details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to support and restraint the piping for a complete and functional pipe support system.

E. Seismic and Wind Forces

1. Pipe support details indicated in the Contract Drawings are sized for gravity loads only, and not designed to resist seismic and wind forces. However, pipe support details indicating ”SEISMIC COMPLIANCE” on drawings are designed to resist seismic and wind forces.

2. The CONTRACTOR shall arrange for the services of a registered professional engineer experienced in pipe support design to design such pipe supports to resist seismic and wind forces.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittals.

B. Shop Drawings

1. Submit Shop Drawings which shall include the following information:

a. Drawings of pipe supports, hangers, anchors, and guides.

b. Pipe support schedule or layout indicating where the supports will be installed.

c. Calculations for special supports and anchors, stamped and signed by a registered professional engineer in the state where the project is located.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Code Compliance

1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, and probable forces applied during construction as well as stresses on piping, equipment, and structures.

2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping – Chapter II, Part 5 -Expansion, Flexibility, and Pipe Supporting Element and design the pipe supporting elements in accordance with the rules of MSS SP-58 -Pipe Hangers and Supports – Materials, Design and Manufacture, except as supplemented or modified in this Section.

3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.

2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR.

3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction, and shall be as acceptable to the ENGINEER.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment.

2. Hangers shall have a means of vertical adjustment after erection.

3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.

4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.

5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Lateral or Axial Movement.

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.

2. Where lateral or axial 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-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.

E. Spring-Type Hangers

1. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping.

2. Spring-type hangers shall be sized per the manufacturer's printed recommendations and for the loading conditions encountered.

3. 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 the compression of the spring.

4. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. Thermal Expansion

1. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely away from the anchored points.

2. Components shall be structurally suitable to withstand the imposed loads.

G. Heat Transmission

1. Supports, hangers, anchors, and guides shall be designed and insulated such that excessive heat will not be transmitted to the structure or to other equipment.

H. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to support frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

J. Materials of Construction

1. Pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged supports, as well as piping, conduits, and equipment in hydraulic structures located two feet above water level, shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel, unless otherwise indicated.

3. Piping in chemical and corrosive service areas shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

K. Point Loads

1. Meters, valves, heavy equipment, and other point loads on PVC, FRP, or other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, FRP, or other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields for general service and Type 316 stainless steel shields for chemical or corrosive areas.

L. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the ENGINEER for any anchor applications not appearing on the table.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.
Existing Concrete	Use non-shrink grouted anchors, expansion anchors, or epoxy anchors. Epoxy anchors are not permitted for vertical hanging applications or where sustained tension is exerted on the anchor. Exceptions: Expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degree F or higher than the limiting temperature recommended by the manufacturer.
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors.

M. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, 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.

2.2 SUPPORT SPACING

A. 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.

B. Where pipe spacing are indicated on the Drawings and are referenced to a Standard Detail, that requirement shall take preference over the general requirements of this section.

C. Pipe support spacing shall not exceed the maximum indicated spans. Piping with grooved joint couplings, flexible joints, and bend fittings shall be balanced supported by a minimum of two pipe supports per pipe length, one at near each joint/fitting.

D. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.

E. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

F. Steel Pipe

1. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below.

2. Support Spacing for standard wall or heavier welded steel, stainless steel or alloy steel pipe.

Nominal Pipe Diameter, Inches	Maximum Span, ft (Water Service)	Maximum Span, ft (Gas or Vacuum Service)
1/2	6	7
3/4 and 1	8	9
1-1/4 to 2	10	12
3	12	14
4	14	15
6	16	18
8 and 10	18	20
12 and 14	20	24
16 and 18	22	26
20 and greater	24	30

G. Ductile Iron Pipe

1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, inches	Support Configuration
All diameters	two supports per pipe length, with one of the two supports located at a joint

H. Copper Tube

1. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below:

Nominal Tube Size, inches	Support Spacing, feet	
	Water Service	Vapor Service

¾ and smaller	5	5
1	6	8
1-1/2 to 2-1/2	8	10
3	10	14
4	12	16
5	13	18
6	14	20
8	16	23

I. Schedule 80 PVC and CPVC Pipe

Nominal Pipe Size, inches	Temperature		
	100 °F and below	101 to 120 °F	121 to 140 °F
1	5	3.5	3
1-1/2	5.5	3.5	3.5
2	6	4	3.5
3	7	4.5	4
4	7.5	5	4.5
6	9	6	5
8	9.5	6.5	5.5
10 and larger	10	7	6

J. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.3 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.
2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. Basic PSA, Inc.

2. Bergen-Paterson Pipe Supports Group

3. Grinnell

4. Power Piping Company

5. TOLCO (Eaton B-Line)

2.4 COATING

A. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and shall receive protective coatings in accordance with the requirements of Section 099600 – Protective Coating.

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's printed instructions and per ANSI/MSS SP-58 Pipe Hangers and Supports- Materials, Design, Manufacture, Selection, Application and Installation.

2. Embedded concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.

3. Hangers shall be adjusted to line up groups of pipes at the proper slope for drainage and venting, as close to ceilings or roofs as possible, and without interference with other WORK.

3.2 FIELD FABRICATION

A. Quality Control

1. Field fabricated pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.

2. Hangers and supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

NO TEXT FOR THIS PAGE

SECTION 40 91 00
INSTRUMENTATION AND CONTROLS, GENERAL

PART 1 GENERAL

1.1 GENERAL

A. Furnish and install all field equipment, modifications to PLC-8, PLC programming and SCADA HMI screens for a complete operational installation of the new carbon scrubber odor control units. Work includes but is not limited all raceways, conduit, conductors, junction boxes, terminal strips, surge protection and wire terminations.

B. Where applicable, programming and configuration of PLCs located within new Vendor furnished equipment shall be the responsibility of the equipment supplier.

C. This Specification has been developed to establish minimum requirements for modifications to the existing plant control system. This installation shall be designed, constructed, tested and documented in strict accordance with the guidelines of this document.

D. 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.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all WORK specified herein shall conform to or exceed the applicable requirements of the referenced documents to the extent that the requirements therein are not in conflict with the provisions of this Section; provided, that where such documents have been adopted as a code or ordinance by the public agency having jurisdiction, such code or ordinance shall take precedence.

B. The instrumentation and controls WORK shall conform to or exceed the applicable regulations, standards, specifications, and codes which are referenced in Section 01 42 19 Reference Standards, and current as of the date of the final inspection for this Contract, including, but not limited to, those which are established by the following sources:

1. The International Society of Automation (ISA)

2. National Electrical Code (NEC)

3. National Fire Protection Association (NFPA)

4. Institute of Electrical and Electronic Engineers (IEEE)

5. Occupational Safety and Health Administration (OSHA)

6. American National Standards Institute (ANSI)

7. National Electrical Manufacturers Association (NEA)

8. Insulated Cable Engineers Association (ICEA)

9. Local Power and Telephone Companies

10. Local Authorities having jurisdiction over the work

11. Federal Communication Commission (FCC)

12. Underwriter Laboratory (UL)

C. Where the requirements set forth in these Specifications or on the Drawings are greater or more rigid than the mandatory requirements referenced above, the applicable Specifications or Drawings shall govern.

D. In the case of conflict between any mandatory requirements and Specifications or Drawings, the mandatory requirement shall be followed in each case, but only after submitting such proposed changes to the ENGINEER for approval.

E. Nothing contained in these Specifications or shown on the Drawings will be so construed to conflict with any national, state, municipal, or local laws or regulations governing the installation of work specified herein, and all such acts, ordinances, and regulations, including the National Electrical Code, are hereby incorporated and made a part of these Specifications. All such requirements will be satisfied by the CONTRACTOR at no additional expense to the OWNER.

F. The Drawings and Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If a conflict between Drawings and Specifications is discovered, this shall be referred to the ENGINEER as soon as possible for resolution. Should a conflict exist between the Drawings, Specifications, and/or mandatory requirements (i.e., codes, ordinances, etc.), it will be assumed that the more expensive method has been estimated, unless such alternate has been agreed to prior to submission of bids.

1.3 CONTRACTOR QUALIFICATIONS AND ADITIONAL RESPONSIBILITY

A. The contractor providing this system shall be an instrumentation and control systems contractor who is experienced in and regularly engaged in engineering, installation, and service of systems of similar size and complexity within the water treatment industry.

B. 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 mounting and wiring of relays, transformers, disconnecting means, and other control devices as required forming a complete system.

C. The installing contractor shall maintain an office with full time sales and service staff within a one-hundred-and-fifty-mile radius of the site. Emergency warranty service response shall be guaranteed to be a maximum of four-hours between the time of emergency notification and arrival of service personnel on site. An emergency service condition shall be considered to exist when any failed system hardware or software prevents or threatens to prevent the pumping station from fulfilling its intended purpose as determined by the owner or engineer.

D. Non-emergency service requests shall be responded to within 2 business days. Telephone support for operating procedures and non-hardware problems shall be provided on an unlimited basis during the warranty period.

E. An unconditional warranty shall be provided for all equipment supplied for Two years from date of final acceptance of system by the owner. THIS WARRANTY SHALL INCLUDE ANY DAMAGES CAUSED BY LIGHTNING INDUCED ELECTRICAL SURGES; ONLY DAMAGES CAUSED BY DIRECT LIGHTNING STRIKES TO THE BUILDING STRUCTURE (AS DETERMINED BY THE ENGINEER) SHALL BE EXCLUDED FROM THE WARRANTY. Theft, fire, vandalism and floods shall be excluded from the warranty except for fire damage which originates at equipment which is provided as part of this work.

F. Provide the services of a qualified systems integrator that has demonstrated competence in providing controls system integration on this type of facility. Submit 5 example projects of installed history of the type and complexity of this project. Submit project data, and reference contacts. Provide the services of one of the following PLC/HMI system integrators for this project:

1. Revere Control Systems (863) 646-5781
2. BCI Technologies (239) 433-9600
3. TAW Custom Equip (813) 223-5800
4. Rocha Controls (813) 628-5584

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall provide submittals in accordance with Section 01 33 00- Submittals and the additional submittal requirements specified in this Section, and in Division 40.

B. Submit Shop drawings illustrating modifications to PLC-8. Include a Bill of Material, Cut sheets for all materials, proposed layout/locations for new equipment withing the panel, and revised schematic drawings for the existing control panel.

C. Shop drawings with SCADA HMI screens, and operations and maintence manuals. Provide with the SCADA HMI screens screenshots of each screen/control and descriptions.

1.5 WARRANTY

A. All parts, material labor, travel, subsistence, or other expenses incurred in providing services and service visits during the warranty period shall be borne by the CONTRACTOR under the guarantee specified in Division 1. Equipment, software, and materials that do not achieve their intended purpose shall be replaced by the CONTRACTOR to attain compliance, at no additional cost to the OWNER.

PART 2 GENERAL

PROGRAMMING

A. The contractor shall through the use of a systems integrator, furnish all programming of the applicable plant PLCs and SCADA to support the addition of the new odor control units. Refer to Part 1 of this section for the systems integrator qualifications.

B. All scaling, alarm monitoring and setpoints shall be stored/performed by the PLC. SCADA will only act as a medium to input and extract the information from the PLC. All parameters shall be accessible from the SCADA HMI.

C. At a minimum, the system shall monitor/control following. Refer to the P&ID for additional requrirements:

1. Alarms

a. High Differential Pressure for each DPIT

b. High H2S for each gas detector/logger

c. Fault for each odor control unit

2. Monitoring

    a. Run status for each odor control unit

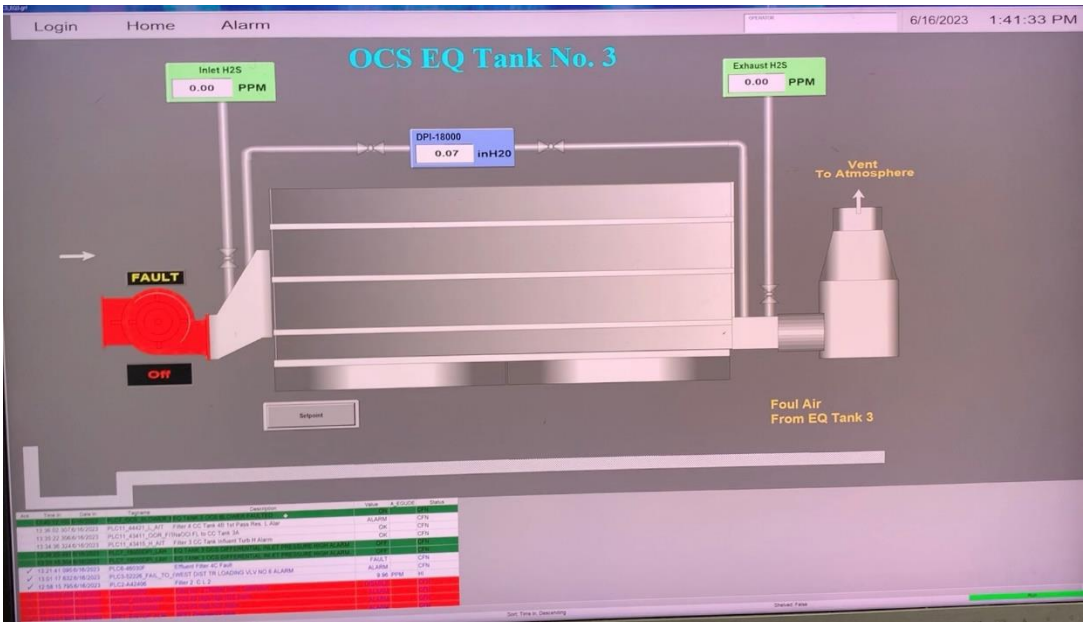
    b. In Remote status for each odor control unit

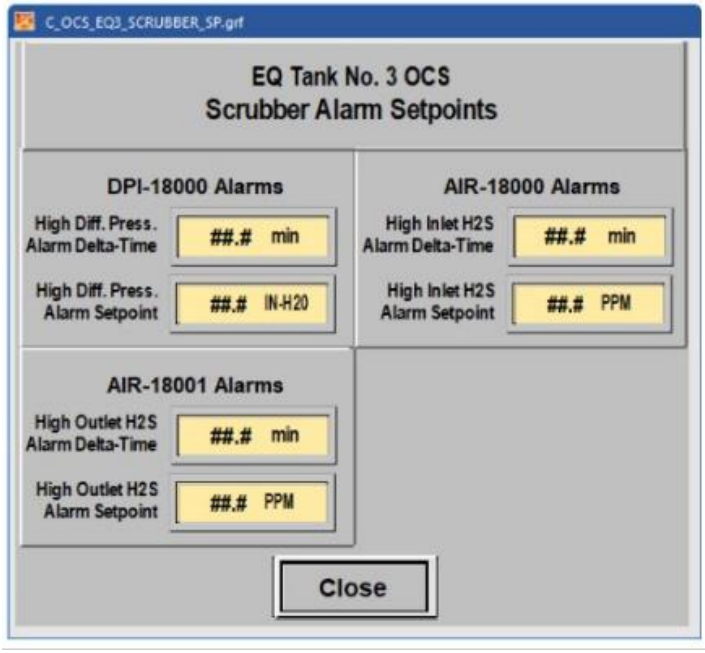
    c. H2S readings from each gas detector/logger

3. Control

    a. Remote Start/Stop control for each odor control unit

4. The SCADA HMI shall follow Collier County's SCADA graphics standards. Refer to the sample graphics below as an example. These graphics shall be customized to suit the application of the new carbon scrubber units and functions.





PART 3 EXECUTION

3.1 STORAGE

A. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

B. Storage: It is the CONTRACTOR's responsibility to assure proper handling and on-site storage of instrumentation and control equipment in accordance with the System Supplier's recommendations. All equipment and materials delivered to the jobsite shall be stored in a location which will not interfere with the operations of other contractors or the OWNER. Equipment shall not be stored outdoors. Storage and handling will be performed in manners which will afford maximum protection to the equipment and materials.

C. Equipment shall be stored in dry shelters, including in-line equipment, and shall be adequately protected against mechanical damage. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through tests as directed by the ENGINEER. If such tests reveal defects, the equipment shall be replaced.

3.2 INSTALLATION

A. General

1. All systems and instrumentation, including instrumentation furnished under other Divisions, shall be installed, connected calibrated, tested, started, and placed into operation in accordance with CONTRACT documents under Division 40 and the manufacturers' instructions. The installation shall be coordinated with the ENGINEER and the OWNER. This shall include final integration in concert with equipment specified and provided by others.

2. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all equipment.

3. Equipment Locations: The configurations indicated in the contract documents are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.

4. The CONTRACTOR shall review the existing site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

5. The Contract Documents identify conduits and instruments required to make a complete system. The CONTRACTOR shall be responsible for providing any reasonable additional or different type connections as required by parts of the specific installation requirements, or as practical.

B. Conduit, Cables, and Field Wiring

1. Conduits, process equipment field control wiring, 4 to 20 mA signal circuits, signal wiring to field instruments and to insturmnet junction boxes, control panels, PLC input and output wiring, and other field wiring and cables shall be provided under Division 26 and without delay to the WORK of Division 40.

2. Terminations, modifications, and wire identification inside equipment and panels furnished under this or any other Division shall be provided under Division 40.

3. The CONTRACTOR shall supervise and coordinate installation and termination and identification of field signals, power, and utilities associated with the installation.

4. The CONTRACTOR shall resolve signal, power, or functional incompatibilities between the new and existing interfacing devices.

C. Installation and Connections:

1. Instruments, control panels, and equipment shall be anchored by methods that comply with requirements applicable to the Site. Appropriate mounting stands and bracket materials and workmanship shall be provided and shall comply with requirements of the Contract Documents.

2. Existing Instruments that are to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this WORK prior to reinstallation of each instrument.

3. The Contract Documents show necessary conduit and instruments required to make a complete instrumentation. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method

of installation, shall be submitted to the ENGINEER for approval prior to commencing that WORK. Such changes shall not be a basis of claims for extra WORK or delay.

4. Conduits and/or raceways in building interior locations shall be surface mounted on walls or ceilings wherever possible and run perpendicular and parallel to building lines. Conduits shall not be routed on floors in areas subject to foot traffic. In exterior locations conduit shall be routed below grade.

5. Wires and cables shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the ENGINEER. Wiring shall be protected from sharp edges and corners.

6. Signal and low voltage wiring shall be run in a separate conduit from power and 120-volt control wiring.

7. Field wiring shall terminate at terminal blocks in the control panel. Field wiring shall not be wired directly to equipment in the control panel except communication and specialty cables that must be wired directly to their respective equipment.

8. Power and signal wires shall be terminated with crimped type lugs.

9. Wires shall be marked clearly with an identification wire number labels that are of a permanent nature.

10. Connectors shall be, as a minimum, water tight.

11. Sensing Lines and Tubing:

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

    b. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at panels requiring pipe or tubing entries.

12. Differential pressure elements shall have 3 valve manifolds.

13. The CONTRACTOR shall verify the correctness of each installation, including polarity of electric power and signal connections. The CONTRACTOR shall certify in writing all discrepancies have been corrected for each loop or system checked out. In addition, the CONTRACTOR shall make sure process connections are free of leaks.

D. Removal of Abandoned Equipment: Unless otherwise specified, all existing equipment in each facility that is no longer required after the new system has been put in service shall be removed and delivered by the CONTRACTOR to the OWNER.

3.3 FIELD QUALITY CONTROL

A. General:

1. Devices provided under Division 40 shall be initially calibrated by the manufacturer at the manufacturer's facility prior to shipment. Following installation, the devices shall be field

calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

2. Each instrument shall be field tested, inspected, and adjusted to the indicated performance requirement in accordance its manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirement, or, in the absence of a contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER.

B. Calibration Points: During bench and field calibration each instrument shall be calibrated at least at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and outputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. Bench Calibration: Instruments that have been bench-calibrated by the manufacturer shall be verified in the field after installation to determine whether any of the calibrations are in need of adjustment.

D. Field Calibration: Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1. Project name

2. Loop number and site or process name and number

3. Tag number

4. Manufacturer

5. Model number

6. Serial number

7. Calibration range

8. Calibration data: Input, output, and error at 0 percent, 50 percent, and 100 percent of span

9. Switch setting, contact action, and dead-band for discrete elements

10. Space for comments

11. Space for sign-off by System Supplier and when applicable by the manufacturer and date

12. Test equipment used and associated serial numbers

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall have the System Supplier sign the calibration sheet when calibration is complete. The ENGINEER will sign the calibration sheet when the calibration and testing has been accepted.

H. Loop Testing: The Contractor shall test newly installed and modified existing loops for continuity and functionality. The up-to-date wiring diagrams shall be used as reference. The ENGINEER and/or the OWNER shall be notified in advance of loop testing to allow allow for the testing to be witnessed.

I. The CONTRACTOR shall notify the ENGINEER of scheduled tests minimum of 7 calendar days prior to the estimated completion date of installation and wiring.

J. Interlocks: Hardware and software interlocks between the instrumentation and the motor control circuits, and packaged equipment controls shall be checked to the maximum extent possible.

K. Loop Validation:

1. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the HMI displays associated with the PLC. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.

2. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by contract requirements or by published manufacturer accuracy specifications, whenever contract accuracy requirements are not indicated. Each analog loop shall be tested by applying simulated analog or discrete inputs to the first element of an analog loop. For loops which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75, and 100 percent of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. Analog loop test data, including calculated RMS summation system accuracy tolerance, shall be documented by the CONTRACTOR on the loop validation sheets. The validation sheets shall be included in the O&M Manuals.

L. Loop Validation and Certification Sheets:

1. Loop Validation: The CONTRACTOR shall prepare loop validation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop validation sheets shall form the basis for operational tests and documentation. Each loop validation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the System Supplier:

a. Project name

b. Loop number

c. Tag number, description, manufacturer, and model number for each element

d. Installation bulletin number

e. Specification sheet number

f. Loop description number

g. Adjustment check

h. Space for comments

i. Space for loop sign-off by the System Supplier and date

j. Space for ENGINEER witness signature and date

2. Loop Certification: A certified copy of each loop test validation sheet signed by the System Supplier, the ENGINEER or the ENGINEER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that the loops have been tested and the instrumentation in the loop has been successfully calibrated, inspected, and tested.

M. Manufacturer’s Services

1. The CONTRACTOR shall provide jobsite visits and services of a manufacturer’s technical field representative for supervision of the following:

a. Oversee installation: Supervise installation and connection of all instruments, elements, and components of every system, including connection of instrument signals to primary measurement elements and to final control elements.

b. Verify that installed instrument and software (where applicable) meet manufacturer’s recommendations

c. Certify installation and reconfirm manufacturer's accuracy statement

d. Oversee loop testing, prepare loop validation sheets, and certify loop testing

e. Certify when testing is completed.

f. Training the OWNER's personnel

2. Manufacturer's services shall be furnished for the following equipment:

a. Carbon Scrubber Control/Starter Panel

b. Diffrential Pressure Transmitters

c. H2S Gas Detectors

3.4 COMMISSIONING

A. Commissioning is the verification that the complete WORK functions on an extended basis are in full conformance with the Contract requirements.

B. As part of the commissioning, the entire system shall operate continuously without failure for 30 consecutive days without failure (see test details below), thus extending its operation test longer than the commissioning period specified in other sections.

3.5 STARTUP OPERATION

A. General: Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities must be completed before startup activities begin.

B. When all equipment and systems have been assessed by the CONTRACTOR to have been successfully carried through complete operational and functional tests with not less than a minimum of simulation, and the ENGINEER concurs in this assessment, system startup by the OWNER'S operating personnel can follow.

C. Each facility, process, or site startup shall be performed in accordance with the approved test procedures.

D. Scheduling of startup shall be coordinated by the CONTRACTOTR among all parties involved so that the tests may proceed without delays or disruption by uncompleted work. System startup and training and instruction of the OWNER's personnel must be completed a minimum of seven (7) days prior to the final acceptance test.

1. Troubleshooting and Corrections

    a. The Contractor shall participate in all start-up activities. If problems occur, the CONTRACTOR and the System Supplier shall jointly participate in the diagnosis wiring, control interface, hardware and software problems and correct deficiencies. The Contractor shall be responsible and bear all expenses to diagnose and correct all the deficiencies for work and equipment furnished under this CONTRACT.

    b. Existing Instruments, Wiring and Interface: As specified above, prior to start of the WORK the CONTRACTOR shall request the OWNER to demonstrate that all existing equipment and software that is to be reused or interfaced with in this project works properly for the intended function. Consequently, if during the calibration, testing or start up the Contractor and/or the System Supplier encounters problems with existing instruments, hardware, wiring, or software that have been demonstrated to work, the CONTRACTOR shall notify the Engineer and the OWNER. In this case, the CONTRACTOR, the System Supplier and the Owner's representative shall jointly participate in the diagnosis of the problem. The course of action how to correct the deficiency shall be determined jointly by the OWNER, the Engineer and the CONTRACTOR/System Supplier. The CONTRACTOR shall be compensated for correcting the deficiencies or replacing the equipment.

    c. If a problem is found to be a result of the CONTRACTOR's workmanship or equipment and work furnished under this CONTRACT, the CONTRACTOR shall be responsible and bear the expenses for correcting the deficiencies.

3.6 CLOSEOUT ACTIVITIES

A. Training:

1. Training Subjects, Duration, and Agenda: The training shall include operation and maintenance procedures, troubleshooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment. During the course, hands-on experience with the system equipment shall be provided. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the system.

a. Duration – an average of two (2) hours per each type of instrument/equipment

b. Subjects - installation, setup, configuration, maintenance, calibration, and troubleshooting:

1) Carbon Scrubber Control/Starter Panel

2) Diffrential Pressure Transmitters

3) H2S Gas Detectors

3.7 CRITERIA FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section and all Division 40, the following conditions shall be fulfilled before the WORK is considered substantially complete:

1. Submittals have been completed and approved.

2. The instrumentation has been calibrated; loop tested, pre-commissioned, commissioned, and the startup completed.

3. The OWNER's training has been performed.

4. Spare parts and expendable supplies and test equipment have been delivered to the OWNER.

5. The Final Acceptance Test has been successfully completed.

6. Major punch-list items have been corrected.

7. As built drawings have been submitted.

8. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

9. Debris associated with installation of instrumentation has been removed.

10. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

END OF SECTION

SECTION 40 91 04
H_2S GAS MEASURING

PART 1 GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall furnish H2S measuring and logging systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Instrumentation and Controls, General

B. Applicable Sections in Division 40 – Process Interconnections.

C. Division 26 – Electrical.

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Instrumentation and Controls, General.

PART 2 PRODUCTS

2.1 H2S Loggers

A. Manufacturer: Acrulog, no equal.

B. Description: Furnish and install H_2S gas detection and logging panels in accordance with the design drawings. Logging Panels shall be Acrulog Continuous Emission Monitors (CEM) utilizing Acrulog DLU H_2S Parts Per Million (PPM) loggers, no equal.

C. Materials / Components:

1. Enclosure

a. Enclosure shall be temperature controlled NEMA 4X rated stainless steel enclosure and include 120V power supply, gas detecors/loggers, sample pumps, dessicant, and all other apptunances for operation.

b. System shall contain a thermostatically controlled fan heater for maintaining temperature within enclosure between 40 F and external ventilation fan to operate at 90 F.

c. System shall be of wall-mount type, in a weatherproof enclosure, with a clear window to allow access to LCD indicator and controls.

2. Monitors.

a. The loggers shall be Acrulog DLU H_2S Parts Per Million (PPM) no equal. The loggers shall be Long Deployment (LD) type capable of transmitting real time data. Models shall be as follows depending on application:

MODEL	Range	Accuracy
DLU-H2S-1000-PPM	0-1,000 ppm	± 2 ppm[1]

Note: 1) When operating at 20 ppm gas (normal operating temperature and pressure).

3. Accessories

Include the following accessories with each logger:

a. Integral 4-20mA output. Refer to electrical plan drawings for device locations.

b. Integral sample pump.

c. Integral mositure filter with desiccant beads to reduce sample humidity.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. H2S Gas Measuring monitoring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 - Instrumentation and Controls, General. Manufacturer's service, supervision, and training shall also be in accordance with Section 40 91 00 - Instrumentation and Controls, General.

END OF SECTION

SECTION 40 91 08
PRESSURE MEASURING

PART 1 GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Instrumentation and Controls, General

B. Applicable Sections in Division 40 – Process Interconnections.

C. Division 26 – Electrical.

1.3 ACTION SUBMITTALS / INFORMATIVE SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Instrumentation and Controls, General.

PART 2 PRODUCTS

2.1 DIFFERENTIAL PRESSURE TRANSMITTERS

A. Manufacturers: Pressure Transmitter Manufacturer, shall be Rosemount model 3051CD, or equal.

B. Description: Differential pressure transmitters shall be a differential pressure-sensing unit type. It shall convert the differential pressure measurement to a linear signal of 4-to-20 mA DC output at 24 VDC, 2-wire type, with an allowable loop load of not less than 600 ohms. The sensor shall have sealed fill fluid and isolation/sensing diaphragm. A temperature compensation unit shall also be part of the sensing module.

C. Performance / Design Criteria:

1. Continuously (external) adjustable span, zero and dampening (internal) adjustment.

2. Accuracy shall be at least plus minus 0.10 percent of span.

3. Ambient operating range of minus 40 degree F to plus 250 degrees F.

4. Provide vent, drain, block and bleed valve plugs.

5. Transmitter output shall be compatible with HART protocol.

6. Sensor or transmitter failure alarm - High or low failure mode - shall be provided and shall be user selectable.

D. Materials / Components:

1. Sensor fill fluid shall be silicon.

2. Process wetted parts and diaphragm shall be as recommended by the manufacturer for the service intended and as indicated in the data sheet.

3. As a minimum, housing material shall be 316 stainless steel or as recommended by the manufacturer for the service and installation application intended and as indicated in the data sheet. As a minimum, housing shall be Explosion proof.

4. Non-wetted parts shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

5. Each differential pressure transmitter shall be furnished with a three-valve manifold. As a minimum, the three-valve manifold housing material shall be 316 stainless steel or the same as the transmitter and as recommended by the manufacturer and as indicated in the data sheet. The wetted parts shall be as recommended by the manufacturer and as indicated in the data sheet.

6. Transmitter shall have an integral digital LCD indicator scaled in linear engineering units.

7. Process connection style shall be ½-inch NPT or flange. Connection style and flange size rating and material shall be as recommended by the manufacturer and as indicated in the data sheet for the intended service and installation application.

8. Provide mounting hardware suitable for the intended service and installation application (e.g. surface mounting, 2-inch pipe, etc.). Mounting hardware shall be suitable for the installation environment.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested.

END OF SECTION

SECTION 40 95 13
CONTROL PANELS

PART 1 GENERAL

1.1 THE SUMMARY

A. General: This section provides additional requirements for new control panels, vendor furnished control panels, instrumentation junction boxes, and modifications to existing control panels.

B. The VENDOR shall provide control panels, complete and operable, in accordance with the Contract Documents. This section shall be referenced for furnishment of new control panels and for modifications to existing panels.

C. This section also applies to existing control and PLC panels that are required to be modified. All Modifications to existing panels are the responsibility of the CONTRACTOR through the use of a Systems Integrator. Refer to Section 40 91 00 Instrumentation and Controls General for additional requirements.

D. Contractor's System Integrator shall integrate all VENDOR provided equipment and control panels with PLC-8, Plant SCADA System, develop HMI Screens and programming, as well as complete PLC hardware modifications as necessary for a complete functional system, as intended.

E. The VENDOR shall be responsible for selecting, sizing, and providing the correct and necessary type and quantity of the panels for each process control application. The install CONTRACTOR shall be responsible for all necessary hardware and responsibilities that shall include, but are not limited to:

1. Mounting the panel

2. Locating and mounting interior and exterior instruments, hardware and equipment in the panel

3. Field interface terminal blocks

4. Terminating panel internal wiring and signals

5. Terminating communication and network cabling and wiring

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 – Instrumentation and Controls, General

B. Applicable Sections in Division 40

C. Division 26 – Electrical

D. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

E. All panels shall conform to the specifications; codes and standards requirements specified Section 40 91 00 - Instrumentation and Controls, General.

F. Each control panel, including panels for service entrance equipment, shall meet all UL listing and labeling requirements including UL Standard 508 and UL Standard 508A and shall be UL labeled accordingly. Contractor shall arrange components and wiring to meet UL requirements stated above.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. The Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Instrumentation and Controls, General.

1.4 QUALITY ASSURANCE

A. Factory and field tests shall be performed in accordance with Section 40 91 00 – Instrumentation and Controls, General.

1.5 WARRANTY

A. Guarantee and Special corrections of defects and software upgrade requirements and warrantee shall be in accordance with Section 40 91 00 - Instrumentation and Controls, General.

PART 2 PRODUCTS

2.1 GENERAL

A. All panel assemblies, such as new control panels, remote I/Os, terminal junction boxes, analyzer systems, etc. shall be mounted inside a new outdoor or indoor NEMA-rated type enclosure, suitable and designed for the application for which it was intended, as specified or as shown on the drawings. If required, PCIS panel assemblies shall be mounted in existing enclosures. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted.

B. The enclosure and back panel shall be sized to contain the equipment required to make the installation complete and suitable for its intended purpose. Field conditions and the guidelines provided in the specifications and/or the drawings shall be followed. Accessibility for ease of maintenance, future expansion and good installation and industry practices shall be considered when sizing an enclosure. Spare space shall be kept clear of wiring, etc., to give contiguous clear space for future additions.

C. In cases where existing panel is used, the CONTRACTOR shall review the available space in the field or in the existing panel to determine the proper size of back panel suitable to accommodate the required equipment for the facility. It should be noted that panel layouts shown on the Drawings are diagrammatic. The shop drawings shall reflect the accurate layout of the equipment in the panel.

D. Environmental Suitability and NEMA Rating

1. Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain instrumentation devices 20-percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide power wiring for these devices. Enclosures shall be suitable for the environment that they are installed. Panel instruments and equipment in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

2. Control panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.

3. NEMA Rating

   a. All panels shall have a NEMA-rated type enclosure suitable for the environment that it is located. Different NEMA rated enclosures and suitable materials of construction (e.g. stainless steel, fiberglass, etc.) shall be used for specific applications, project requirements and for corrosive and/or hazardous environments.

   b. All outdoor panels in unclassified areas shall be rated NEMA 4X, with 316 (min 12GA) stainless steel construction unless otherwise indicated or specified.

   c. Indoor mounted enclosures in conditioned areas shall be NEMA 1, painted steel construction, unless otherwise indicated.

   d. Indoor mounted enclosures in non-conditioned areas shall be NEMA 1 gasketed or NEMA 12, unless otherwise indicated.

   e. Instrumentation and enclosures in hazardous areas shall be suitable and/or protected for use in the particular hazardous or classified location in which it is to be installed.

2.2 CONSTRUCTION

A. Material and Fabrication

1. NEMA 4X type enclosures shall be constructed of a minimum of 12-gauge 316 stainless steel. The enclosure shall be painted white and include stainless steel sun shields painted white on the top, sides, and door secured with 1-inch stand-offs. The enclosure shall also feature a sloped top similar to Hoffman WaterShed design or equal.

2. All panel indicators shall be located on a dead front behind the outer door.

3. The panel shall include a defeatable remote operating breaker handle which prevents the dead front door from being opened while the main breaker is in the on position.

4. Seams shall be continuously welded and ground smooth. Corners shall be welded and ground smooth.

5. Each enclosure shall have a heavy gauge, continuous piano hinge pin which shall support each door.

6. Door and body stiffeners shall be provided where required. The stiffeners shall be welded to the inside of enclosures to prevent deformation due to the weight of face-mounted instruments.

7. Doors shall be sealed with a closed cell neoprene gasket.

8. Doors shall include door handle with 3-point latch and lock kits with common key shall be provided for all doors.

9. The interior rear and sides of each enclosure shall have steel mounting channels for supporting mounting panels.

10. All new control panel enclosures shall be furnished with an LED light with manual on/off switch mounted to the top of the interior of the panel, and powered from the panel.

B. Back and Side Panels: Each enclosure shall be provided with a removable back panel. Depending on the size of the enclosure more than one back panel may be required. Removable side panels shall not be used unless approved by the engineer.

C. Finish: Non-stainless steel enclosures shall have an ANSI 61 gray polyester urethane powder coating electrostatically applied to inside and outside surfaces. Enclosure interior, and back and side panels shall be white.

D. Accessories: The CONTRACTOR shall provide additional panel accessories where indicated in the drawings or specifications.

E. Instruments Mounting

1. Equipment mounted at the rear of enclosure shall be installed to allow for commissioning adjustments, operation and servicing requirements. The CONTRACTOR shall arrange components and wiring to meet UL requirements.

2. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

3. For front mounted hardware, cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth. Mounting the instruments shall not degrade the NEMA rating of the enclosure.

4. DIN rail mounted equipment shall be used as much as possible.

5. Each enclosure shall be provided with interior nameplates to identify equipment tags and functions.

F. Enclosures shall be Hoffman, Saginaw Controls Engineering, or equal.

2.3 ELECTRICAL REQUIREMENTS (WHERE REQUIRED)

A. The main power supply to the control panel controls shall be 120 VAC, 60 Hz. The CONTRACTOR shall provide the main power supply from an external source. The CONTRACTOR shall provide a step down transformer as required to power the panel.

B. The CONTRACTOR shall provide wireways, wire, and electrical fittings and components for 120V and 24VDC circuits to instruments and other electrical devices in the panel for a complete and operable installation. Wiring methods and materials for all panels shall be in accordance with the NEC requirements.

C. The circuits for 24VDC shall run in separate wireways from the 120 VAC circuits.

D. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external foreign voltage. A “CAUTION- Foreign Voltage” nameplate shall be attached to the outside of the enclosure door warning of foreign voltages inside the enclosure.

E. If required by the contract documents, the control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel.

2.4 COMPONENTS

A. Terminal Blocks

1. The control panel shall be provided with sufficient terminal blocks for the connection of external field conductors, signals, and power and for use inside the panel for power distribution and for future expansion. In order to facilitate easy and safe loop maintenance, each analog input loop shall have a disconnect with test plugs built into its field terminal block.

2. Spare Terminal Blocks for Signals: The CONTRACTOR shall provide 20-percent spare terminals in the panel for each type of actual I/O. The number of terminals shall take in account the types of I/O for which spares are provided (Three (3) terminal for each AI or AO shall be provided).

3. Spare Terminal Blocks for Power and Other Applications: In addition to the spare terminals for signals, The CONTRACTOR shall provide spare terminals for 3 additional power distribution and grounding applications circuits.

4. Terminal blocks for all wiring shall be modular terminals, DIN rail mounted type rated at 15 amperes at 600 VAC and have a minimum width of 8-mm suitable for No. 12 A.W.G. stranded wire. Terminals shall be the solderless box lug type with pressure plates in actual contact with the wire to minimize wire breakage. Each terminal shall have a light colored strip for marking the terminal number or circuit designation. Double high terminal blocks are not acceptable.

5. External connections to and from enclosures shall terminate on terminal blocks, except approved communication and data cables. Circuit isolating switches and fuse terminals shall include non-conducting pullers which can be removed with finger alone, without tools. Additionally, the panel shall be provided with identified terminal strips for the connection of external/field conductors.

6. Terminals shall be as manufactured by Square D Class 9080 Type M, Allen-Bradley Bulletin 1492 Type H or J, by Entrelec, or equal.

B. Signal, Control and Power Wiring

1. General: The signal, control and power wiring specified herein shall apply only to the wiring inside the panel. Field wiring shall be in accordance with requirements specified in Division 26.

2. Wire type and sizes: Conductor shall be flexible, stranded, copper UL approved type wires, and shall be rated 600 volts. The following wire sizes and insulation types and color shall be used inside the control panel for the listed applications:

    a. 120 VAC power wires: Main 120 VAC power wiring for distribution in the control panel (line, neutral and ground) shall be a minimum of 12 AWG, or heavier as required by the panel load, with THHN/THWN insulation.

    b. Power conductors in branch circuits such as for lighting, receptacle, heater and thermostat, etc. shall be a minimum of 14 AWG also with THHN/THWN insulation.

    c. Wiring for 600 volt class power and lighting shall be as manufactured by Okonite, General Cable, Southwire, or equal.

    d. The following insulation color code designation shall be used:

1) Line Power – Black

2) Neutral (grounded circuits) – White

3) Power Ground – Green

4) Ungrounded 120 VAC control circuit conductors (switched power) – Red

5) Wires energized by 120 VAC source external to the control panel (usually used for DO) shall have yellow insulation

e. 120 VAC Control Wires: For AC control wiring shall be No. 14 AWG machine tool grade type MTW, rated for 90 degrees C at dry locations and be as manufactured by American, General Cable, or equal.

f. 24 VDC power, status, alarm, and control wires shall be a minimum of 16 AWG or heavier as required, with TFFN/MTW insulation.

g. The following insulation color code designation shall be used:

1) Positive (+) – Blue

2) Common (-) – Blue/White

3) DC Ground – Green/Yellow

h. Signals and Instrumentation Wires and Cables

1) Analog and instrumentation signal wiring inside the panel shall be No. 18 AWG minimum twisted shielded pair of stranded tinned copper conductors rated at 600 volts. Insulation shall be color coded PVC/Nylon - black-white for 2 conductor cable and black-red-white for 3 conductor cable.

2) Multi-conductor cables where indicated shall consist of No. 18 AWG copper stranded tinned copper signal wires twisted in pairs, with 90-C, 600V fault insulation. Multi-conductor cables shall be sized to allow for 10 percent spare signal wire.

3) All analog and Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 22 or larger AWG stranded tinned copper drain wire, and a PVC outer jacket with a minimum thickness of 0.047-inches.

4) Insulation color code designation for 2- conductor cable shall be as follows:

a) Positive (+) – Black

b) Negative (-) – White

5) Insulation color code designation for Triad cable shall be Black-Red-White.

6) Single pair, No. 18 AWG, twisted, shielded cable shall be Belden Part No. 3088AE, similar by General Cable, or equal.

7) Single triad, No. 18 AWG, twisted, shielded cable shall be Belden Part No. 3089A, similar by General Cable, or equal.

C. Wire Markings: Each conductor in the control panel connected to a given electrical point shall be designated by a single unique wire number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal connection using numbered wire marking sleeves or heat shrink plastics by Brady, or equal.

D. Surge Protection Devices: Surge protection devices (SPD) shall be provided to process control loops, instruments, and networks (e.g. Modbus, Profibus, Device Net, etc.) for protection against induced current surge and transient surge sources (e.g. lightning, power switching, static discharge, etc.). The SPD shall divert the resulting surges safely to earth and limit voltages to acceptable levels.

1. Each end of a loop shall be protected by a SPD - at the control panel side and at the instrument, device, or equipment in the field side.

2. For application and installation in hazardous area classification, the SPD shall be certified to meet all hazardous area classifications required for the environment to which it is to be installed.

3. Technical Data and Design:

a. The SPD shall be of the fast acting type, capable of limiting the surge destructive high voltage transients, and shall feature accurate voltage control. It shall be maintenance-free and fully automatic self-resetting, once the over voltage has ceased.

b. The SPD shall be of a multi stage hybrid circuit design, incorporating gas-filled discharge tubes (for high surge current diversion) with zener diodes for fast operation. It shall have the following features:

1) Withstand a minimum of 10kAmp at 8/20µs total surge current impulse per wire for all 24VDC discrete and analog control panels interfaces.

2) Withstand at least 1.4 Kamp lightning impulse current at 10/350µs total surge current impulse per wire for all 24VDC discrete and analog control panels interfaces.

3) Housing shall be modular, 7mm maximum width, and of the DIN rail mount type for all 24 VDC analog and discrete control panel interfaces. Field SPD shall have ½ NPT threaded connection and shall be housed in a NEMA 4 rated housing and NEMA 4X rated for corrosive environment.

4) Operating Ambient Temperature Range -40ºC to +80ºC

5) 120VAC discrete circuits shall be protected by 7mm maximum width DIN rail mount, metal oxide varistor (MOV) SPDs for control panel interfaces

6) Field instrument SPDs shall be of the threaded conduit entry type with 20kA maximum surge current per wire. 7mm maximum width DIN rail mount units may also be used for 120VAC field instruments as specified.

7) Range of voltage ratings to suit all process I/O applications

4. Applications (non-hazardous locations): Use surge protection at the control panel and field instrument as described below. Approved equals will be considered in lieu of specified SPD models. Contractor shall make adjustments as required to suit specific field conditions or preferred mounting options.

    a. Each 4-20 MADC, 2-Wire, 24 VDC analog loop (including HART) and each 24 VDC digital (discrete) loop shall be protected by installing one (1) MTL series SDM model SD32M at the control panel side, and one (1) MTL model TP-48 or equal, on the instrument side in the field.
    b. Each 4-20 MADC, 4-wire analog loop shall be protected by installing two (2) SPD on each end of the loop. The SPDs shall be the same as those used for a 2-wire analog loop.

    c. Each 24 VDC digital (discrete) shall be protected by installing one (1) MTL series SD model SD32 or SD32X at the control panel side, and the instrument side in the field, depending on the mounting conditions.

    d. Each 120 VAC digital (discrete) shall be protected by installing one (1) MTL series SD model SD150X at the control panel side, and one (1) MTL model TP-AC 420-N or SD150X or equal, on the instrument side in the field, depending on the mounting conditions.

    e. Each CAT-5 or CAT-6 Ethernet network cable from the PLC in the control panel to the network node connection shall be protected by installing one (1) MTL model ZB24596 or equal on each side of the cable.

2.5 ELECTRICAL COMPONENTS

A. General Purpose Relays

1. General purpose relays in the control panel(s) shall be compact plug-in type with contacts rated 10 amperes at 120-volts ac; or 24 VDC. Quantity and form of contacts shall be as required by the application. However, the relay shall have a minimum of two (2)-form C contacts (double pole-double throw), except when used as interpose relay for the PLC's DO modules they shall have a minimum of one (1)-form C (single pole single throw) contacts. Each relay shall be provided with a neon light to indicate energized state.

2. The relay socket and mounting shall be a standard DIN rail mount with pullover wire spring ("horseshoe clip").

3. Relays shall be IDEC compact relays type RHXB-UL with SHXB-05 sockets where X indicates the number of form C contact, or equal.

B. Slave and Interpose Relays: Additional slave relays shall be provided when the number or type of contacts required exceed the contact capacity and/or rating of the specified relays and timers. Additional relays shall be provided when higher contact rating is required in order to interface with starter circuits or other equipment. The slave and interpose relays shall be as the general purpose relays specified above.

C. Time Delay Relays - Electronic Type: Time delay relays shall be plug-in electronic type with on-delay or off-delay actuation as required. Output contacts shall be DPDT rated 10-amperes at 120-volts ac minimum. Each unit shall include an adjustable time delay with a time range scale. Operating temperature range of the units shall be -20 to +120 degrees-F minimum and each device shall be rated for 10,000,000 mechanical operations and 500,000 electrical operations.

Time delay relays shall be Idec RTE series, Schneider Electric, Agastat Series SCC, Omron, or equal.

D. Indicating Pilot Lights

1. Indicating lights shall be ultra-bright multiple LED cluster lamps, push-to-test full voltage type and shall be heavy-duty, oil-tight construction. Operators shall be nickel or chrome plated. Each light shall have a screwed-on prismatic lens approximately 1-inch in diameter. Miniature style devices are not acceptable.

2. Lens colors shall be red for "run," "open," or "on"; green for "stopped," "closed," or "off"; and amber for alarm.

3. Indicating lights shall be Square D Company, Class 9001 Type K, General Electric Company Type CR104P, or equal. Each light shall have a factory-engraved legend plate, as shown on the Contract Documents.

E. Selector and Pushbutton Switches: Selector and pushbutton switches shall be rated 10-amperes at 600 volts; shall be heavy-duty, oil-tight construction; and shall have the number of positions and poles required. Miniature style devices are not acceptable. Operators shall be nickel or chrome plated. Switches shall be Square D Company, Class 9001 Type K, General Electric Company Type CR104P, or equal. Each switch shall have a factory-engraved legend plate as shown on the Contract Documents.

F. Signal Isolators, Conditioners and Converters

1. Signal isolators conditioners and converters shall be provided as required to resolve any signal level incompatibilities, to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component.

2. Signal isolators, integrators and converters shall be 24 VDC or 120 VAC powered as applicable, and shall DIN rail mounted. Isolators shall be by Phoenix Contact, Acromag, or equal.

G. Nameplates: Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front or the inside of the control panel. A nameplate shall be provided for each instrument and device. The nameplates shall be descriptive to define the function and system of such device in accordance with the CONTRACT DOCUMENTS or the approved shop drawings. Nameplates shall be fabricated from white-face, black-center, laminated engraving plastic.

2.6 SPARE PARTS AND SPECIAL TOOLS

A. Control panel spare parts selected by the ENGINEER or the OWNER and special tools shall be furnished where indicated in accordance with Section 40 91 00 - Process Control and Instrumentation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Preparation for Shipment and Shipping

1. Control panels shall be crated for shipment using a heavy framework and skids as required and cushioned to protect the finish and the instruments during shipment. Shipments shall be by air-ride vehicle. Suitable cushioning material shall be used to protect interior hardware that could be damaged due to mechanical shock.

2. Depending on panel size, each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

3. Control panels shall be installed in accordance with Section 40 91 00 - Process Control and Instrumentation System.

3.2 INSTALLATION

A. CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

1. Wiring Installation

   a. Wiring methods and materials for panels shall be in accordance with the NEC requirements and industry practices.

   b. Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, and (3) wiring from components on a swing out panel to components on a part of the fixed structure.

   c. Aptly grouped using nylon tie straps, and shall be fanned out to terminals. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the hinge loop so that conductors are not strained at the terminals.

   d. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

   e. Splicing of shall be kept to a minimum and only if the wire cannot be replaced. Splicing shall be either soldered or pressure crimped type. Data and communication wires/cables shall not be spliced.

2. Wiring Termination

   a. All field wiring shall terminate at a terminal block in the enclosure. Field wiring shall be terminated first at the field interface terminal block and then wired to the devices/instrument or PLC inside the panel. Except for antenna cable, Cat 5e cables and other specialty cables, such as thermocouples and data cables, field wiring shall not be wired directly to the panel mounted device.

   b. Terminals and fuses for each conductor and shield drain wire of a twisted shielded pair or triad cable shall be mounted consecutively next to each other.

   c. Terminal blocks shall be grouped based on their function and voltage. Each group of terminal blocks shall be located in the panel to provide easy access, safety, practicality, and minimization of internal wiring.

   d. Terminal blocks for 24 VDC signals shall be grouped separate from the power and other 120 VAC terminals.

e. Terminal blocks for 24 VDC signals shall be grouped separate from the 24VDC power as well. Likewise, terminal blocks for 120 VAC power and distribution shall be grouped separate from the 120 VAC terminals for control signals.

f. Each terminal and wire connection shall be tagged in accordance with the approved shop drawings or OWNER's standard tagging/numbering, if available.

3.3 FIELD QUALITY CONTROL

A. General: Calibration, testing, and instruction shall be performed in accordance with Section 40 91 00 - Process Control and Instrumentation.

3.4 ADJUSTING

A. As specified elsewhere in these specifications and as shown on the drawings, the CONTRACTOR is required to remove or disconnect some existing equipment as a result of their complete or partial replacement of their functionality, and in some cases to provide space for the new equipment. In all cases the CONTRACTOR shall disconnect the replaced equipment and functions and ensure that the remaining equipment and their remaining (not replaced) functionality shall continue to function/operate as originally intended. The CONTRACTOR shall also restore the condition of the modified operational control or monitoring circuits. Nothing shall be disconnected or removed without prior coordination with the OWNER.

B. Analog Loops: Whenever an existing analog loop is modified, the CONTRACTOR shall ensure that the integrity and isolation of the loop is maintained and the shield is grounded correctly. In modifying an analog loop the CONTRACTOR shall also ensure/modify the 24 VDC to that loop so that the power supply source of that loop is part of the control panel and backed up by the UPS in it.

C. Field Connection Panels and Interface Terminal Blocks: In cases where field I/O wiring has to be extended to the control panel from enclosures that are removed or modified, the CONTRACTOR shall provide separate enclosures/field connection panel (FCP), as required, to which field I/Os are wired, and from which the signals shall be wired to the control panel.

END OF SECTION

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SECTION 44 31 16

CARBON ADSORBER ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Furnish all materials, equipment and incidentals required to install carbon adsorber odor control systems for the control of atmospheric H_2S and other noxious odors as shown on drawings and specified herein. The odor control system shall be an activated carbon adsorber system consisting of two parallel systems each with an adsorber vessel, centrifugal fan, activated carbon, interconnecting ductwork and other appurtenances for a complete operating system. Manufacturer shall have sole source responsibility for supplying all odor control equipment from the inlet dampener on top of the fan inlet box to the Odor Control Vessel, as shown on Plan Sheet M-101, Section A – Proposed Odor Control Section View.

B. The malodorous air shall enter the carbon adsorber and shall flow through two densely packed beds of activated carbon in each adsorber vessel. The activated carbon shall remove hydrogen sulfide and other odor causing constituents. The air shall continue through the vessel and be exhausted through the discharge stacks.

C. The entire system shall consist of the following major components for each carbon adsorber vessel:
   1. Inlet Isolation Damper
   2. Fan Inlet Box
   3. Fan
   4. Fan Outlet Flexible Connector
   5. Fan Outlet/Adsorber Inlet Transition
   6. Carbon Adsorber Vessel
   7. Exhaust Stacks
   8. Activated Carbon Media
   9. Electrical Control Panel

1.2 REFERENCE SPECIFICATIONS

A. Section 01 45 00 Quality Control

B. Section 23 31 16 FRP Ductwork

C. Section 26 05 10 Electric Motors

D. Section 40 91 04 H_2S Gas Measurement

E. Section 40 91 08 Pressure Measurement

F. Section 40 95 13 Control Panels

1.3 QUALITY ASSURANCE

A. All systems shall be supplied by a single manufacturer fully experienced, reputable and qualified in the manufacture of the equipment to be furnished.

B. In order to ensure unity of responsibility, fan, damper, ducting, vessel, control panel, carbon and other miscellaneous system appurtenances shall be furnished by a single manufacturer.

C. The mechanical, structural, and electrical design has been based on the RJC-1013DR – Dual Bed Rectangular Carbon Adsorber system manufactured by Evoqua Water Technologies. The cost of any changes and modifications to the engineering design necessary to adapt alternate equipment to the layout and design shall be borne by the VENDOR. Clearances shown on the Drawings shall be maintained. Any such proposed changes or modifications are subject to review and acceptance of the OWNER. Any costs associated with the engineering review shall be borne by the VENDOR.

D. System shall be a carbon adsorption system manufactured by Evoqua Water Technologies, San Diego, CA.

E. Specified Manufacturer: Evoqua Water Technologies.

1.4 ENGINEER'S PRE-APPROVAL OF DEDUCTIVE ALTERNATIVE EQUIPMENT

A. Section not used.

1.5 SUBMITTALS

A. The VENDOR shall submit shop drawings to the Engineer, and as a minimum, the following items:

1. Certified shop and erection drawings showing the important details of construction, dimensions, and anchor bolt locations.
2. Process instrumentation diagrams, wiring diagrams, electrical requirements and control panel layouts and fabrication details.
3. Descriptive literature, bulletins and catalogs of the equipment.
4. The total weight of the equipment, as well as the weight of the single largest items, for coordination with contractor to unload, handle, and set equipment.
5. Wind load bracing and anchoring requirements for local conditions.
6. Details for leveling and setting equipment.
7. Calculations showing theoretical anticipated life of carbon media, based on anticipated average hydrogen sulfide (H_2S) concentrations.
8. Carbon media MSDS and specification sheet.
9. If requested, the manufacturer shall submit detailed description of the laminate and the type of reinforcing to be used and a letter from the resin manufacturer stating that the laminate and reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application and that the resin will meet the performance requirements stated and is suitable for the service conditions specified herein and the fabrication technique proposed.

1.6 OPERATING INSTRUCTIONS

A. The VENDOR shall provide 5 copies of operation and maintenance manuals for all equipment furnished.

1.7 Reference Standards: The materials employed in items fabricated of fiberglass reinforced plastic shall be capable of withstanding maximum calculated stresses that may occur during fabrication, installation, and continuous operation, with allowance for an adequate safety factor. To confirm

materials properties, test reports shall be conducted by an independent, qualified testing laboratory on representative material samples in accordance with the latest revision of ASTM standards:

1. ASTM C581, Determining Chemical Resistance of Thermosetting Resins used in Glass Fiber Reinforced Structures Intended for Liquid Service.
2. ASTM C582, Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion Resistant Equipment.
3. ASTM D638, Test for Tensile Properties of Plastics.
4. ASTM D695, Test for Compressive Properties of Rigid Plastics.
5. ASTM D746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
6. ASTM D790, Test for Flexural Properties of Plastic.
7. ASTM D883, Standard Nomenclature Relating to Plastics.
8. ASTM D1505, Test Method for Density of Plastics by the Density Gradient Technique.
9. ASTM 1693, Test Method for Environmental Stress Cracking of Ethylene Plastics.
10. ASTM D2310, Machine Made Reinforced Thermosetting Resin Pipe.
11. ASTM D2563, Recommended Practice for Classifying Visual Defects in Glass Reinforced Laminated Parts.
12. ASTM D2583, Test for Indentation Hardness of Plastics by Means of a Barcol Impresser.
13. ASTM D2996, Filament Wound, Reinforced Thermosetting Polyester Chemical Resistant Tanks.
14. ASTM D3299, Filament-Wound Glass Fiber Reinforced Polyester Chemical Resistant Tanks
15. ASTM D4097, Contact Molded Fiber Reinforced Thermoset Chemical Resistant Tanks.
16. NBS Voluntary Product Standard PS15-69 Custom Contact Molded Reinforced-Polyester Chemical-Resistant Process Equipment.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Design Criteria: The odor control system shall be designed for the following operating conditions and shall meet the following performance criteria when put in service with fresh carbon media:

Number of Carbon Adsorber Systems	2
Air Flow Rate per each Adsorber System, cfm	15,000
Number of Media Beds per Adsorber	2
Air Flow Rate per Bed, cfm	7,500
Average Inlet H_2S Concentration, ppm	20
Peak Inlet H_2S Concentration, ppm	50

B. System Performance Criteria: The odor control system shall demonstrate following performance when operating under design flow conditions listed above.

INLET	OUTLET
≤10 ppm H_2S	0.1 ppm H_2S
>10 ppm H_2S	1.0% of inlet (99.0% removal)

2.2 CARBON ADSORBER VESSEL

A. MATERIAL OF CONSTRUCTION:

1. The vessel shall be cylindrically shaped and fabricated from premium grade vinyl ester resin.
2. Resin used in fabrication shall be vinyl ester resin such as Vipel F010 by AOC, Hetron 922 by Ashland Chemical, Derakane 411 by Dow Chemical, or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.
3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
4. Fabrication:
   a. General: Fabrication shall be either helically filament wound or contact molded in accordance with NBS PS 15-69, ASTM C582, ASTM D3299 and ASTM D4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.
   b. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per ft^2 CSM. The total corrosion liner thickness shall be 100 mils minimum.
   c. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.
5. Fittings: Each vessel shall be fitted with the following fittings:

Description	Size	Type	Qty.
Gas Inlet	Custom	Flanged	1
Gas Outlet(s)	36”	Flanged	1
Manway(s)	24”	Flanged	2
Drain(s)	2”	NPT	1
Pressure Taps	1”	NPT	2 per bed
Sample Ports	1”	NPT	3 per bed

2. DESIGN CRITERIA: Carbon adsorber vessel should be designed based on following:

Location	Outdoor
Vessel Internal Diameter, ft	13’-0”
Vessel Straight Wall Height, ft	15’-0”
Vessel Wall Thickness	Per Design Calculations
Wind Speed, mph(1)	179
Seismic Factors(2)	Sds=0.046 and Sd1=0.035
Internal Positive Pressure, inches W.C.	10

Maximum Operating Temperature, °F	120
Minimum Carbon Quantity, lbs.	
Number of Carbon Beds per Vessel	2
Carbon Bed Depth, ft.	3.0

(1) Based on ASCE 7-16, Risk Category III
(2) Based on ASCE 7-16, Site Classification D

2.3 CARBON ADSORBER VESSEL ACCESSORIES

A. Differential Pressure **–** Provide differential pressure transmitters in accordance with Section 40 91 08 Pressure Detection. Differential pressure shall be measured across each carbon media bed. The differential pressure transmitters shall be isolated with isolation valves and shall be mounted on the vessel. Carbon Sample Probes – Vessel shall have three (3) 1" diameter sample probes per bed which shall extend into the bed a minimum of twelve inches. The sample probes shall be blocked off with a ball valve constructed of PVC.

B. Grounding Rod **–** A stainless steel rod shall be provided to adequately ground each carbon bed. Rods shall be grounded via a 10-gauge wire.

C. Carbon Support Grating and Screen **–** Each adsorber vessel shall be furnished to accommodate a V-Bank bed of activated carbon having an average depth of three feet. The carbon bed shall be supported on a polypropylene screen through an FRP support grating system. The screen and the support system shall be removable through access manways. The support system shall consist of removable grating. Pall rings or other dumped packing media as a means of carbon support will not be acceptable. The support system shall be designed to withstand a load of at least 150 lbs/ft^2 with a minimum deflection of 1/4" under all conditions.

D. Access Manway **–** Each vessel shall have access manways as shown on the drawing and specified in 2.2.A.5 of this section.

E. Exhaust Stack **–** Each vessel shall have exhaust stacks as shown on the drawings and specified in 2.2.A.5 of this section.

F. Anchor Bolts **–** Each vessel shall be provided with properly sized epoxy HILTI anchor system.

G. Equipment Tags **–** The vessel shall be provided with an I.D. Tag with the following minimum information: Carbon Type, Vessel Dimension, Date of Manufacture, Design Conditions.

H. Neoprene Pad – A 1/4" thick, 60 durometer neoprene rubber sheet must be placed underneath each scrubber vessel to be supplied by the manufacturer.

I. H_2S Monitoring – H_2S monitoring equipment shall be provided in accordance with Section 40 91 04 – H2S Gas Measuring to sample one common inlet and one common outlet, for each carbon adsorber. Outlet sample shall be collected from the discharge stack for each carbon adsorber.

J. Pressure Gauges – Pressure gauges shall be provided to display system operating pressure upstream and downstream of each fan. Gauges to be installed gauge connection on FRP transition piece. Gauges shall have minimum range of 0 – 10 inches in H_2O, with 316 stainless steel body, glycerin filled, 63 mm dial, safety glass with 1/4-inch NPT 316 stainless steel connector. Gauge shall be series 8009S as manufactured by Ashcroft or approved equal.

K. FRP Mounting Plate – Each vessel shall include an integral FRP mounting plate located and sized for mounting of H_2S monitoring equipment and differential pressure equipment directly on vessels. The intent is that any device that has a display to be mounted directly on the vessels, including but

not limited to the H_2S monitoring equipment and differential pressure switches or gauge. Locations shall be as shown on drawings and coordinated during shop drawing review, but generally on the foul air inlet side of each vessel. All sample and pressure piping or tubing shall be mounted on the vessel and flexible tubing shall be installed inside rigid PVC piping or conduit. Mounting points for piping supports shall be provided integral to the vessels. Vendor shall coordinate H2S monitoring equipment mounting and sample points locations with EOR and Owner during the submittal process.

2.4 ACTIVATED CARBON MEDIA

A. TYPE: The activated carbon shall be high H_2S capacity, Midas® C30 by Evoqua Water Technologies, virgin, pelletized, derived from premium coconut shell, vapor phase type, suitable for the control of sewage odors. The carbon shall have the following specifications. No alternate media shall be acceptable.

B. SPECIFICATIONS:

Item	**Description/Value**
Carbon Source Material	Coconut Shell
Type	Pelletized
Pellet Diameter, mm (min)	3.8 to 4.2
Surface Area (B.E.T. – m^2/g)	1050
Iodine Number, mgI_2/g (min)	1250
Hardness Number, wt % (min.)	95
Butane Activity, wt % (min.)	31.4
Moisture Content, wt. % (max.)	3
Apparent density, g/cc	0.40
H_2S breakthrough capacity per ASTM D6646-01, gm-H_2S/cc-carbon (min)	0.30

2.5 EXHAUST FAN

A. Exhaust Fan: Fans shall have fiberglass reinforced plastic centrifugal backward inclined impeller. The wheel shall be dynamically balanced. Resin shall be suitable for exposure to the specific service conditions. The shaft shall be stainless steel. The shaft seal shall be Teflon or Viton. All FRP components shall be graphite impregnated. Exterior color shall match scrubber vessel color.

B. Fan bearings shall be heavy duty, self aligning grease lubricated ball type with minimum of 100,000 hours B-10 life. Fan shall be belt driven. Fan shall have adjustable drives. OSHA approved belt guard and shaft guard shall be provided. Motor shall be high-efficiency, TEFC, 1800 RPM with a 1.15 service factor and suitable for 3/60/230-460V.

C. Fan housing shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity. Bearing support brackets shall be positioned to directly oppose belt tension forces. Fan housing shall be a curved scroll design with a 1-inch drain connection at the bottom of the fan scroll. The fan inlet and the fan outlet shall be flanged.

D. A fan inlet box shall be provided on each fan. Fan inlet boxes shall be supplied by fan manufacturer. Fan inlet box shall be capable of supporting 200 pounds dead weight for connected foul air duct. Fan inlet boxes shall be of fiberglass construction with exterior color to match fans. FRP transitions shall be provided to transition from circular FRP duct to the rectangular inlet flange of the fan inlet boxes.

E. The fans shall each be designed for the following specifications:

Location	Outdoor
Air Flow Rate, cfm	15,000
Fan upstream duct losses, inches W.C.	2
Fan Total S.P., inches W.C.	7
Motor HP	30

F. Flexible Connector:
   1. Provide flanged expansion joint for outlet of fan to FRP vessel inlet transition piece. The flange drilling shall be coordinated with fan and transition.
   2. Type: W-design configuration with integral flanges suitable for service with FRP duct.
   3. The properties of the flexible connectors shall be as follows: Material shall be EPDM. Material shall be resistant to ultraviolet light degradation and shall be suitable for contact with odorous air as specified herein. The backing rings shall be 1/4-inch thick, 2" wide, type 304 stainless steel. The length from flange-to-flange shall be 6" unless shown otherwise. The extension shall be ½" inch, compression shall be 1-inch, lateral offset shall be 1 inch and the thickness shall be ¼-inch minimum.
   4. Manufacturer shall be Holz Rubber or approved equal.

G. The fan shall be anchored to a concrete pad without vibration isolators.

H. The motors shall be high-efficiency, TEFC with a 1.15 service factor and shall conform to the requirements of Section 26 05 10 Electric Motors. Motors shall be manufactured by WEG, Baldor, Reliance or approved equal. Motors shall include space heaters to prevent condensation in motor windings when motor is in standby. The motors shall be suitable for installation in Class 1, Division 2 rated hazardous area.

I. Fans shall be New York Blower, Hartzell or equal and shall have an AMCA seal.

J. Extended grease fitting tubes and mounting hardware shall be provided to allow lubrication from finished slab elevation without use of ladders, platforms or scaffolding. Grease tube fitting assembly shall not allow grease to leak from tubing onto the ground or other surfaces.

2.6 CONTROL PANEL

A. The system fan shall be field wired to a 316 stainless steel Electrical Control Panel that houses the starter and all controls for the unit.

B. The control panel shall have a NEMA 4X stainless steel enclosure, painted white and include sunshields with 1-inch standoffs on all doors in accordance with Section 40 95 13. Control panel enclosure shall include overhead interior led lighting with manual on/off switch.

A. The control panel shall feature a deadfront inner door for mounting pilot lights, and operators, as well as a main breaker handle and defeatable interlock that prevents opening the door while breaker is on.

2.7 DUCTWORK

A. Provide flanged FRP transition fittings as specified in and shown on the Contract Documents.

B. Provide pressure gauge connection upstream and downstream of the odor control fan.

C. Provide 3/8" holes upstream of each fan for airflow measurement and H_2S and other odor sampling. Holes shall be plugged with removable stoppers. Location to be confirmed during submittal review.

2.8 HARDWARE AND GASKETS

A. All hardware shall be 316 stainless steel. Gaskets shall be a minimum of 1/8" thick, full face, EPDM or neoprene suitable for the intended service.

PART 3 - EXECUTION

3.1 INSTALLATION

Odor control system shall be furnished and installed in accordance with manufacturer's recommendations. The VENDOR shall provide all utility connections, inlet ductwork from odor source, concrete pads, fencing and other items shown on the drawings not specified in this section. The VENDOR shall be responsible for providing a complete and operable system.

3.2 SERVICE OF MANUFACTURER'S REPRESENTATIVE

A. The VENDOR shall provide services of a qualified manufacturer's project manager, subject to OWNER's acceptance, who's primary office location is within 50 miles of the project site for all project coordination through project completion.

B. The VENDOR shall provide services of a qualified manufacturer's technical representative who shall inspect and certify proper installation of equipment, supervise loading of carbon media, assist in equipment start-up, and provide training of plant operators. As a minimum, the services shall be provided for one (1) trip for five (5) days.

3.3 EQUIPMENT WARRANTY

The manufacturer shall warrant that the equipment sold here under shall be free from defects in material and workmanship for a period of 24 months from Final Completion. The warranty does not include the carbon media itself.

3.4 PERFORMANCE TESTING

A. General: The VENDOR shall be responsible for all costs associated with odor control system testing. A one-time test will be performed to verify system performance. These testing requirements are in addition to those identified in Section 014500 – Quality Control, Paragraph 1.7.

B. Functional Testing: Using odorous process air, the entire odor control system shall be operated for not less than 24 continuous hours in order to demonstrate the mechanical and electrical integrity of the system. Any mechanical or electrical breakdowns, unusual vibrations, or control sequencing problems shall be considered sufficient cause to reject the test. Inability to successfully complete the functional testing in five tries shall be considered cause for the construction manager to reject the odor control system. VENDOR shall balance all air flows prior to system performance testing.

C. Performance Testing: The performance tests shall be conducted at such time as all anticipated odorous air streams are available. The time of the tests and detailed test procedure shall be submitted for approval prior to the testing period.

1. During testing air flow rates shall be held constant. All fine-tuning of operating conditions shall be performed prior to testing.

2. The test duration shall be a minimum of 4 hours. During this time, all pertinent operating parameters shall be monitored and recorded, sufficient sampling and analysis shall be conducted to demonstrate that flow rates are at design conditions.
3. Hydrogen sulfide concentration shall be measured at the inlet and outlet. Inlet and outlet levels shall be measured once every 30 minutes using a portable H_2S analyzer such as Interscan, Jerome or equal.
4. Results: A description of the performance tests shall be submitted. The hydrogen sulfide compound removal efficiency shall be as specified in the design and performance requirements. Should system performance not meet any of the above requirements, that system shall have failed the performance tests. The VENDOR shall make any additions or modifications to that scrubber system as may be necessary, at no additional cost to the Owner, and the performance tests for that system shall be repeated in its entirety.

END OF SECTION

NO TEXT FOR THIS PAGE

Collier County Growth Management and Community Development Department

Site Development Plan Insubstantial Change No. PL20230013848

Collier County North County Water Reclamation Facility #: 88322

Issued: 09/18/2023

Collier County
Growth Management Department
Development Review Division

September 18, 2023

Lisa Colburn - Stantec
5801 Pelican Bay Blvd. #300
Naples, FL 34108

RE: Insubstantial Change No. PL20230013848
Collier County North County Water Reclamation Facility (88322) (SDPI)

Dear Applicant:

This is in response to your submittal of plans showing modification to PL20120001111 to mitigate odors that may be present because of the treatment operations at the NCWRF. This proposed project is Phase 2 of the Odor Control replacement project for the equalization (EQ) tanks. The odor control currently provided for the EQ tanks is described below:

The existing odor control for the three EQ tanks consists of two, 3-stage wet chemical scrubbers, each sized to treat an airflow rate of 17,500 cubic feet per minute (cfm). The third odor control system is an Evoqua V-Bank Carbon Scrubber (SDPI - PL20200001432), located near EQ tank 3. This system was recently commissioned.
The existing duct work at the EQ tanks consist of a dedicated header for EQ 1 and a shared header for EQ 2 and EQ 3. This configuration has resulted in generally lower airflow rates from EQ 2. There are no dampers on the four air intakes located on the perimeter of each EQ tank nor on the single exhaust connection at the center of each EQ tank. As a result, effective airflow balancing is difficult to achieve. The typical H2S concentration at the inlets to the scrubbers is in the order of 30 parts per million (ppm).

To improve the distribution of air withdrawn for treatment, to mitigate odor impacts to properties in proximity to the facility, and to decrease labor and maintenance requirements associated with the existing odor control systems installed at the NCWRF the County is proposing to replace the existing odor control equipment with superior and more current technology. The proposed project (Phase 2) will include the installation of two (2) new carbon scrubbers that treat 15,000 cfm of airflow each and include 30 hp fans. To install the new scrubbers, two 28” fiber reinforced pipe (FRP) ducts will be installed (approximately 40 LF each), and a new concrete pad will be constructed for the new scrubbers and exhaust fans. The proposed concrete pad for equipment is in an area that is currently asphalt, which will not impact the impervious area. The proposed location for the odor control equipment will require some existing utility relocations. Furthermore, some minor electrical system improvements will be done related to the power distribution, instrumentation and control wiring, and PLC hardware modifications for the new odor control equipment.

This office has reviewed the plans and has no objection to the changes shown unless noted under stipulations.

STIPULATIONS:

- Issuance of a development permit by a county does not in any way create any rights on the part of the applicant to obtain a permit from a state or federal agency and does not create any liability on the part of the county for issuance of the permit if the applicant fails to obtain requisite approvals or fulfill the obligations imposed by a state or federal agency or undertakes actions that result in a violation of state or federal law. This permit is conditioned on all other applicable state or federal permits being obtained before commencement of the development.

- Per Ordinance 2021-48, onsite processing of construction demolition debris and crushing of inert waste materials from an off-site location is prohibited unless allowed in a previously approved conditional use or Board of County Commissioners approved development order.

SIGNAGE RESTRICTIONS:

- Please be advised that any permanent sign (wall, ground, monument, directory, etc.) requires a separate building permit and must meet the provisions of the Collier County Land Development Code, Section 5.06.00, and/or the

applicable provisions of the governing Planned Unit Development (PUD) document, regardless of any sign placement, dimensions, or color depicted on the site and/or architectural plans approved by this letter.

Please contact Annis Moxam at (239) 252-5519 to coordinate possible addressing changes.

"Be advised that this project has been reviewed by staff in accordance with the applicant's description of work as identified in the cover letter. The applicant bears full responsibility for identifying all proposed work and building permits for any work shown changed on the plans but not identified in the cover letter may be rejected pending further staff review."

Sincerely,

Development Review Division

Growth Management Department
2800 N. Horseshoe Dr.
Naples, Florida 34104
239-252-2400

cc: Engineering Inspector Supervisor
Customer Service, Addressing
Fire Code Official
Public Utilities

Florida Department of Environmental Protection

Revision to North County Water Reclamation Facility Permit #: FL0141339-034-DW1P

Revision Date: 10/26/2023

FLORIDA DEPARTMENT OF Environmental Protection

South District
PO Box 2549
Fort Myers FL 33902-2549
SouthDistrict@FloridaDEP.gov

Ron DeSantis
Governor

Jeanette Nuñez
Lt. Governor

Shawn Hamilton
Secretary

In the Matter of a
Permit Revision for:

Collier County Water Sewer District
Robert VonHolle, Director of Wastewater
3339 Tamiami Trail East, Suite 303
Naples, FL 34112
robert.vonholle@colliercountyfl.gov

Collier County - Domestic Wastewater
North County Water Reclamation Facility
Permit Number: FL0141399-034-DW1P
Revision Date: October 6, 2023

NOTICE OF PERMIT REVISION

This letter is in response to your request for a minor revision to the existing odor control system at the Collier County North Water Reclamation Facility. This is a revision to Permit FL0141399-034-DW1P, issued on June 5, 2018. The Department of Environmental Protection ("Department") approves the request, under Section 403, Florida Statues, as indicated below:

The Wastewater Treatment Description is revised to the following:

Operate an existing 24.1 MGD maximum monthly average daily flow (MMADF) permitted capacity wastewater treatment plant. The plant consists of four mechanical screens, one manual bar screen, four aerated grit removal units, two 1.5 MG equalization tanks, one dual purpose 1.3 MG aerated sludge holding /1.5 MG equalization tank, two 552,800-gallon aerated sludge holding tanks, two 152,000-gallon aerated sludge feed tanks, and two treatment trains (North and South). The North Train consists of: two 1 MG aeration basins (looped reactor), one 2 MG aeration basin (looped reactor), five clarifiers (one 58-foot diameter, two 65-foot diameter, two 80-foot diameter), eight 450-square feet automatic backwash filters, and two chlorine contact basins (79,700 gallon and 83,600 gallon). The South Train (Modified Ludzack-Ettinger Process) consists of: twelve anoxic/aerobic basins with a total volume of 8.64 MG, four 110-ft diameter clarifiers, twelve 450-square feet automatic backwash filters, and six chlorine contact basins (total of 312,000 gallon).

The permittee is authorized to retrofit the facility's odor control system. The revision includes the installation of two Evoqua carbon scrubbers that each treat 15,000 cfm with a 30 hp duty fan, two 28" fiber reinforced pipe (FRP) ducts (approximately 40 LF each), a concrete pad for the scrubbers and exhaust fans, minor electrical system improvements for power distribution, instrumentation and control wiring, and PLC hardware modifications associated with the new odor control equipment.

All other conditions shall remain unchanged. This letter shall be attached to the permit and become a permanent part thereof.

This permit revision is issued under Section 403.087 of the Florida Statutes and Rule 62-620.325, F.A.C.

This action is final and effective on the date filed with the Clerk of the Department unless a petition for an administrative hearing is timely filed under Sections 120.569 and 120.57, F.S., before the deadline for filing a

petition. On the filing of a timely and sufficient petition, this action will not be final and effective until further order of the Department. Because the administrative hearing process is designed to formulate final agency action, the hearing process may result in a modification of the agency action or even denial of the application.

Petition for Administrative Hearing

A person whose substantial interests are affected by the Department's action may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, F.S. Pursuant to Rules 28-106.201 and 28-106.301, F.A.C., a petition for an administrative hearing must contain the following information:

(a) The name and address of each agency affected and each agency's file or identification number, if known;
(b) The name, address, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests are or will be affected by the agency determination;
(c) A statement of when and how the petitioner received notice of the agency decision;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;
(f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the Clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, or via electronic correspondence at Agency_Clerk@FloridaDEP.gov. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing by the applicant and persons entitled to written notice under Section 120.60(3), F.S., must be filed within 14 days of receipt of this written notice. Petitions filed by any persons other than the applicant, and other than those entitled to written notice under Section 120.60(3), F.S., must be filed within 14 days of publication of the notice or within 14 days of receipt of the written notice, whichever occurs first. You cannot justifiably rely on the finality of this decision unless notice of this decision and the right of substantially affected persons to challenge this decision has been duly published or otherwise provided to all persons substantially affected by the decision. While you are not required to publish notice of this action, you may elect to do so pursuant Rule 62-110.106(10)(a).

The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C. If you do not publish notice of this action, this waiver will not apply to persons who have not received written notice of this action.

Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the Department's action may also request an extension of time to file a petition for an administrative hearing. The Department may, for good cause shown, grant the request for an extension of time. Requests for extension

of time must be filed with the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, or via electronic correspondence at Agency_Clerk@dep.state.fl.us, before the deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.

Mediation

Mediation is not available in this proceeding.

Judicial Review

Once this decision becomes final, any party to this action has the right to seek judicial review pursuant to Section 120.68, F.S., by filing a Notice of Appeal pursuant to Florida Rules of Appellate Procedure 9.110 and 9.190 with the Clerk of the Department in the Office of General Counsel (Station #35, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399-3000) and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice must be filed within 30 days from the date this action is filed with the Clerk of the Department.

EXECUTION AND CLERKING

Executed in Orlando, Florida.
STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Jennifer L. Carpenter
Director of District Management
South District

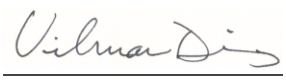
CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this document and all attachments were sent on the filing date below to the following listed persons:

Harold Schmidt, P.E., Stantec Consulting Services, harold.schmidt@stantec.com

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, F. S., with the designated Department Clerk, receipt of which is hereby acknowledged.



October 6, 2023

Clerk **Date**

Florida Department of Environmental Protection

Permit #: 189294-010 EM

Minor Modification of Permits 189294-009-EM and 189294-008-EI

FLORIDA DEPARTMENT OF
Environmental Protection

South District
PO Box 2549
Fort Myers FL 33902-2549
SouthDistrict@FloridaDEP.gov

Ron DeSantis
Governor

Jeanette Nuñez
Lt. Governor

Noah Valenstein
Secretary

November 9, 2023

Collier County BOCC
c/o Marc Lean, P.E.
Stantec Consulting Services, Inc.
3510 Kraft Road, Suite 200
Naples, Florida 34105
marc.lean@stantec.com

File No.: 189294-010 EM, Collier County
Modification of Permit No(s): 189294-009-EM, 189294-008-EI

Dear Mr. Lean:

Your request to modify the Permit No. 189294-008-EM has been received and reviewed by Department staff.

The proposed permit modification is to:
Construct a concrete slab for the proposed odor control equipment. The activity will remove 749 square feet of existing impervious asphalt, remove 145 square feet of existing pervious grassed area, and add an additional 894 square feet of new impervious concrete area.

After review by staff, the proposed modification is not expected to adversely affect water quality and will not be contrary to the public interest.

Modifications to the permit are shown as follows:

The above permit modification description for the impervious area in the flow equalization tank premises. 9 project drawings have been added to show the additional impervious area.

Since the proposed modification(s) along with the above amended permit conditions and monitoring requirements are not expected to result in any adverse environmental impact and water quality degradation, the permit is hereby modified as requested. By copy of this letter and the attached drawings, we are notifying all necessary parties of the modification.

This letter does not alter the permit other than as described above. This letter and referenced enclosures must be attached to the original permit.
The following links provide access to the original permit and the subsequent modifications:

Permit:
https://depedms.dep.state.fl.us:443/Oculus/servlet/shell?command=getEntity&[guid=23.1019599.1]&[profile=Permitting_Authorization]
Modification:
https://depedms.dep.state.fl.us:443/Oculus/servlet/shell?command=getEntity&[guid=23.1278360.1]&[profile=Permitting_Authorization]

NOTICE OF RIGHTS

This action is final and effective on the date filed with the Clerk of the Department unless a petition for an administrative hearing is timely filed under Sections 120.569 and 120.57, F.S., before the deadline for filing a petition. On the filing of a timely and sufficient petition, this action will not be final and effective until further order of the Department. Because the administrative hearing process is designed to formulate final agency action, the hearing process may result in a modification of the agency action or even denial of the application.

Petition for Administrative Hearing
A person whose substantial interests are affected by the Department's action may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, F.S. Pursuant to Rule 28-106.201, F.A.C., a petition for an administrative hearing must contain the following information:

(a) The name and address of each agency affected and each agency's file or identification number, if known;
(b) The name, address, any email address, any facsimile number, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests are or will be affected by the agency determination;
(c) A statement of when and how the petitioner received notice of the agency decision;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;
(f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the Clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing by the applicant must be filed within 21 days of receipt of this written notice. Petitions filed by any persons other than the applicant, and other than those entitled to written notice under Section 120.60(3), F.S., must be filed within 21 days of publication of the notice or within 21 days of receipt of the written notice, whichever occurs first. Under Section 120.60(3), F.S., however, any person who has asked the Department for notice of agency action may file a petition within 21 days of receipt of such notice, regardless of the date of publication. The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the Department's action may also request an extension of time to file a petition for an administrative hearing. The Department may, for good cause shown, grant the request for an extension of time. Requests for extension of time must be filed with the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, before the applicable deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.

Mediation

Mediation is not available in this proceeding.

FLAWAC Review

The applicant, or any party within the meaning of Section 373.114(1)(a) or 373.4275, F.S., may also seek appellate review of this order before the Land and Water Adjudicatory Commission under Section 373.114(1) or 373.4275, F.S. Requests for review before the Land and Water Adjudicatory Commission must be filed with the Secretary of the Commission and served on the Department within 20 days from the date when this order is filed with the Clerk of the Department.

Judicial Review
Once this decision becomes final, any party to this action has the right to seek judicial review pursuant to Section 120.68, F.S., by filing a Notice of Appeal pursuant to Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, M.S. 35, Tallahassee, Florida 32399-3000; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this action is filed with the Clerk of the Department.

Thank you for applying to the Submerged Lands and Environmental Resource Permit Program. If you have any questions regarding this matter, please contact Richard Boensch at 239-344-5607 or Richard.Boensch@FloridaDEP.gov. When referring to this project, please reference the file number listed above.

Executed in Orlando, Florida

STATE OF FLORIDA DEPARTMENTOF ENVIRONMENTAL PROTECTION

Jennifer L. Carpenter
Director of District Management
South District

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this document, including all copies, were sent to the addressee and to the following listed persons:
Collier County Property Appraiser, dstaruch@collierappraiser.com
Matt McLean, Collier County, Matthew.McLean@colliercountyfl.gov
Steve Messner, Collier County, Steve.Messner@colliercountyfl.gov
Robert VonHolle, Collier County, Robert.VonHolle@colliercountyfl.gov

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52(7), F.S., with the designated Department clerk, receipt of which is hereby acknowledged.

Clerk

November 9, 2023
Date

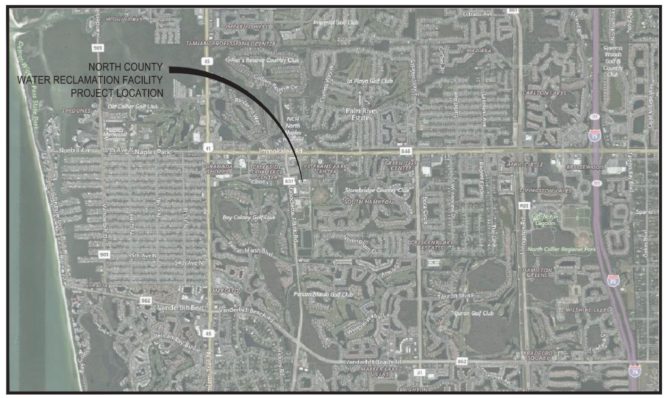
Enclosures:
9 New Project drawings

COLLIER COUNTY, FLORIDA
NORTH COUNTY WATER RECLAMATION FACILITY
EQ ODOR CONTROL - PHASE II

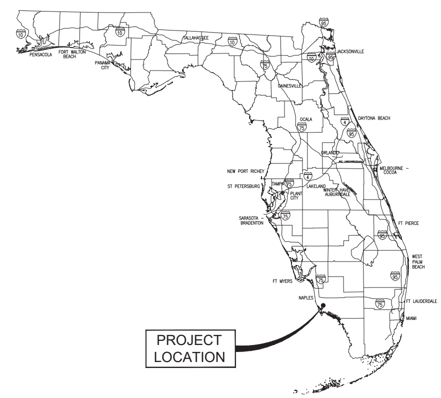
SECTION 35, TOWNSHIP 48 SOUTH, RANGE 27 EAST
PARCEL ID NO. 167840006 - ZONING DESIGNATION INDUSTRIAL, ORD 92-52
COLLIER COUNTY EPMD PROJECT #70148.12.4.2
INSUBSTANTIAL CHANGE TO PL20120001111

SHEET INDEX

SHEET NUMBER	TITLE	DESCRIPTION	ENGINEER OF RECORD
1	G-001	COVER AND INDEX SHEET	MARC LEAN, P.E.
2	G-002	SIGNATURE SHEET	
3	G-003	GENERAL NOTES AND ABBREVIATIONS	
4	C-101	EXISTING CONDITIONS PLAN	
5	C-102	DEMOLITION PLAN	
6	C-103	PROPOSED SITE PLAN AND ASPHALT RESTORATION	
7	C-104	STORMWATER POLLUTION PREVENTION PLAN	
8	C-500	BEST MANAGEMENT PRACTICES	
9	C-501	CIVIL DETAILS	
10	S-101	ODOR CONTROL EQUIPMENT PAD AND DUCT SUPPORT	PAUL R. DUQUETTE, P.E.
11	S-102	SECTIONS AND DETAILS	
12	S-103	ELEVATIONS AND DETAILS	
13	M-101	MECHANICAL PLAN AND SECTION VIEW	HAROLD E. SCHMIDT, P.E.
14	E-001	ELECTRICAL GENERAL NOTES, LEGENDS, AND ABBREVIATIONS	BRADLEY C. BUCHANAN, P.E.
15	E-002	ELECTRICAL GENERAL NOTES, LEGENDS, AND ABBREVIATIONS	
16	E-003	ELECTRICAL GENERAL NOTES, LEGENDS, AND ABBREVIATIONS	
17	E-101	ELECTRICAL DEMOLITION	
18	E-102	ELECTRICAL SITE PLAN	
19	E-103	ELECTRICAL GROUNDING AND LIGHTING PROTECTION	
20	E-401	ELECTRICAL COORDINATION NOTES	
21	E-501	ELECTRICAL TYPICAL DETAILS	
22	E-502	ELECTRICAL TYPICAL DETAILS	
23	E-601	ELECTRICAL ONE LINE DIAGRAMS MCC-12A/12B	
24	E-602	ELECTRICAL ELEVATION AND LOAD CALC MCC-12A/12B	
25	E-603	TYPICAL EXHAUST FAN STARTER SCHEMATIC	
26	I-001	INSTRUMENTATION AND CONTROLS GENERAL NOTES, LEGENDS, AND ABBREVIATIONS	
27	I-601	INSTRUMENTATION AND CONTROLS CARBON SCRUBBER P&ID	
28	I-602	INSTRUMENTATION AND CONTROLS CHEMICAL SCRUBBER P&ID	



LOCATION MAP



FLORIDA

PLANS PREPARED FOR:

Collier County

Collier County Government
33399 Tamiami Trail East Suite 303, Naples, FL 34112
Tel. (239) 252-8836 www.colliergov.net

PLANS PREPARED BY:

Stantec

Stantec Consulting Services Inc.
3510 Kraft Road, Suite 200
Naples, FL U.S.A.
34105-5029
Tel. 239.649.4040
www.stantec.com
Florida Certification No. 27013

COUNTY COMMISSIONERS:

RICK LoCASTRO ....DISTRICT 1
CHRIS HALL ....DISTRICT 2
BURT L. SAUNDERS .... DISTRICT 3
DAN KOWAL ....DISTRICT 4
WILLIAM L. McDANIEL, JR .... DISTRICT 5

Florida Department of Environmental Protection
Permit Number
189294-010-EM
South District
Fort Myers

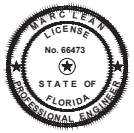
811.
Know what's below.
Call before you dig.

CALL 48 HOURS BEFORE YOU DIG
IT'S THE LAW! DIAL 811
SUNSHINE STATE ONE CALL OF FLORIDA, INC.

STANTEC PROJECT NO. 177311697
JULY, 2023

100% PLANS

NOT FOR CONSTRUCTION



Digitally signed by Marc Lean
Reason: I have reviewed this document
Date: 2023.10.10 13:37:46-04'00'

MECHANICAL:
MARC LEAN, P.E.
FLORIDA P.E. LICENSE NO. 66473

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY MARC LEAN, P.E. ON THE DATE ADJACENT TO THE SEAL.

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.

SHEET NUMBER	SHEET TITLE
G-001	COVER AND INDEX SHEET
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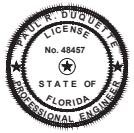

STUCTURAL:
PAUL R. DUQUETTE, P.E.
FLORIDA P.E. LICENSE NO. 48457

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SHEET NUMBER	SHEET TITLE
S-101	ODOR CONTROL EQUIPMENT PAD AND DUCT SUPPORT
S-102	SECTIONS AND DETAILS
S-103	ELEVATIONS AND DETAILS

MECHANICAL:
HAROLD E. SCHMIDT JR, P.E.
FLORIDA P.E. LICENSE NO. 38819

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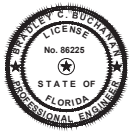
SHEET NUMBER	SHEET TITLE
M-101	MECHANICAL PLAN AND SECTION VIEW



ELECTRICAL:
BRADLEY C. BUCHANAN, P.E.
FLORIDA P.E. LICENSE NO. 86225

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY BRADLEY C. BUCHANAN, P.E. ON THE DATE ADJACENT TO THE SEAL.

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Stantec

Stantec Consulting Services Inc.
3510 Kraft Road, Suite 200
Naples FL, 34105-5029
Tel: (239) 649-4040
www.stantec.com

Client/Project Logo

Collier County

NOTES:

Revision	By	Appd	Date
100% PLANS	YG		JULY 2023
Issued	By	Appd	Date
File Name: 11697-C-002	MPL Dwn.	ML Dsgn.	SM Chkd.	JULY 2023 Date

Permit/Seal

NOT FOR CONSTRUCTION

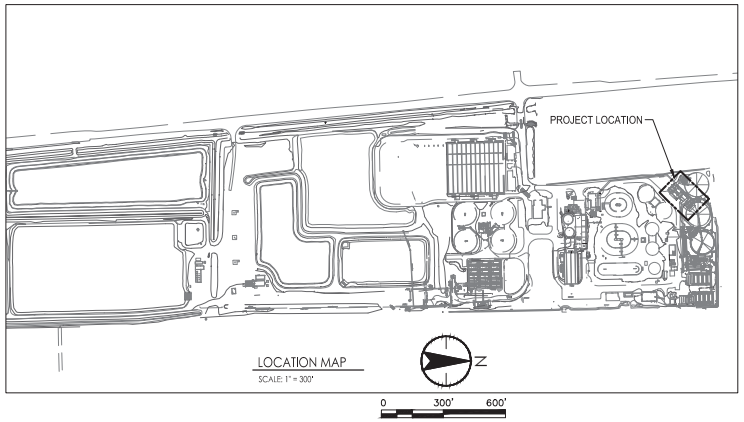
MARC LEAN, PE 66473

Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
SIGNATURE SHEET

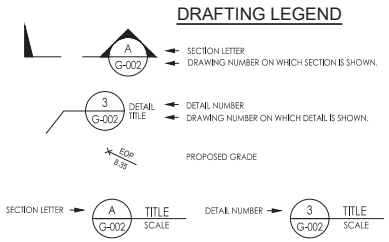
Project No. 177311697
Scale
Phase 100% PLANS
Drawing No. 2 of 28 G-002



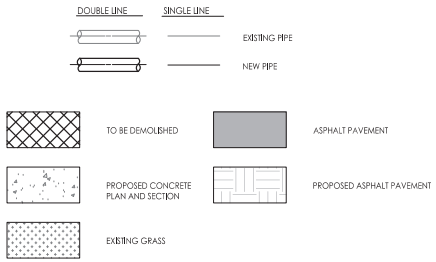
GENERAL NOTES

1. ALL MATERIALS AND CONSTRUCTION METHODS USED FOR THE PROPOSED IMPROVEMENTS SHALL CONFORM WITH THE COLLIER COUNTY LAND DEVELOPMENT CODE, THE COLLIER COUNTY WATER - SEWER DISTRICT UTILITIES STANDARDS MANUAL, THE APPROVED SUPPLEMENTAL TECHNICAL STANDARDS AND SPECIFICATIONS, AND ALL FEDERAL, STATE, AND LOCAL REGULATIONS. IN THE CASE OF A CONFLICT, THE MORE STRINGENT REQUIREMENT THAT RESULTS IN A HIGHER QUALITY FINISHED PRODUCT SHALL GOVERN.
2. ALL MATERIALS SUPPLIED SHALL CONFORM TO THE PLANS AND SPECIFICATIONS, AS WELL AS SHOP DRAWINGS AS APPROVED BY ENGINEER PRIOR TO CONSTRUCTION. SUBSTITUTE MATERIALS SHALL NOT BE APPROVED AFTER DELIVERY TO THE JOB SITE. ALL REQUESTS FOR MATERIAL SUBSTITUTION SHALL BE APPROVED PRIOR TO DELIVERY OF THESE MATERIALS TO THE JOB SITE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE AT ALL TIMES THROUGH THE DURATION OF CONSTRUCTION FOR THE PROTECTION OF EXISTING AND NEWLY INSTALLED UTILITIES FROM DAMAGE OR DISRUPTION OF SERVICE, THE CONTRACTOR SHALL BE RESPONSIBLE FOR TAKING SUCH MEASURES AS NECESSARY TO PROTECT THE HEALTH, SAFETY, AND WELFARE OF THOSE PERSONS HAVING ACCESS TO THE WORK SITE.
4. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988. NAVD 88, (+1.23') to = NGVD 29.
5. THE HORIZONTAL DATUM IS THE FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM 1983 (2011).
6. LOCATIONS, ELEVATIONS AND DIMENSIONS OF EXISTING UTILITIES, STRUCTURES AND OTHER FEATURES ARE SHOWN ACCORDING TO THE BEST INFORMATION AVAILABLE AT THE TIME OF THE PREPARATION ON THESE PLANS BUT DOES NOT PURPORT TO BE ABSOLUTELY CORRECT, THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS AND DIMENSIONS OF ALL EXISTING UTILITIES AND OTHER FEATURES AFFECTING THIS WORK PRIOR TO COMMENCING ANY CONSTRUCTION ACTIVITY.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL APPLICABLE PERMITS BEFORE COMMENCING WORK.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING OR REPLACING AND REMOVING AND DISPOSING ANY DAMAGED ITEMS INCLUDING, BUT NOT LIMITED TO DRIVEWAYS, SIDEWALKS, BOLLARDS, SIGNS, STORM CULVERTS, FENCES AND LANDSCAPING AS REQUIRED BY OWNER, ENGINEER OF RECORD, AND/OR OTHER GOVERNING ENTITIES.
9. ALL DISTURBED AREAS SHALL BE RESTORED, INCLUDING REGRADING, TO THEIR ORIGINAL CONDITION OR BETTER UNLESS OTHERWISE NOTED.
10. CONTRACTOR SHALL BE RESPONSIBLE FOR REGRADING AND REPLANTING VEGETATION IN ALL AREAS DISTURBED BY THE CONSTRUCTION.
11. CONTRACTOR SHALL PROVIDE ALL LABOR, EQUIPMENT, TOOLS, MATERIALS AND SERVICES NEEDED TO ENSURE ADEQUATE EROSION AND SEDIMENT CONTROL MEASURES. THESE MEASURES SHALL CONFORM TO THE PLANS AND SPECIFICATIONS AND ALL STATE AND LOCAL REQUIREMENTS.
12. ANY DISCREPANCIES IN THE DRAWINGS AND/OR SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE COUNTY IN WRITING BEFORE BIDDING OR COMMENCING WORK.
13. NO FIELD CHANGES OR DEVIATION FROM DESIGN SHALL BE MADE WITHOUT PRIOR APPROVAL OF THE COUNTY IN WRITING.
14. NO CONNECTION TO, OR ANY OTHER CONSTRUCTION SHALL BE PERFORMED ON AN EXISTING UTILITY MAIN OR STRUCTURE WITHOUT THE PRESENCE OF A COLLIER COUNTY UTILITY INSPECTOR.
15. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING TRAFFIC AND USAGE OF THE EXISTING STREETS ADJACENT TO THE PROJECT. ALL TRAFFIC MAINTENANCE CONTROLS SHALL BE IN ACCORDANCE WITH FLORIDA MANUAL OF TRAFFIC CONTROL AND SAFE PRACTICES FOR STREET CONSTRUCTION, MAINTENANCE, AND UTILITY OPERATIONS.
16. CONTRACTOR SHALL CONFIRM LIMITS OF STAGING AREA WITH PLANT MANAGER.
17. ALL TRENCHES SHALL MEET OSHA REQUIREMENTS AND CONTRACTOR SHALL CONFORM TO THE GUIDELINES SET FORTH IN THE FLORIDA TRENCH SAFETY ACT THROUGHOUT THE DURATION OF THE PROJECT, CONTRACTOR SHALL PROVIDE WRITTEN ASSURANCE THAT THE TRENCH EXCAVATION WILL COMPLY WITH OSHA TRENCH SAFETY STANDARDS.
18. COLLIER COUNTY PUBLIC UTILITIES DEPARTMENT WILL BE RESPONSIBLE FOR MAINTENANCE OF INFRASTRUCTURE PROPOSED ON THIS PROJECT, WITHIN THE SITE, INCLUDED OPEN SPACE, PAVED AREAS, ETC.
19. COLLIER COUNTY PUBLIC UTILITIES DEPARTMENT IS RESPONSIBLE FOR MAINTENANCE OF EXISTING WATER MANAGEMENT FACILITIES WITHIN THE FACILITY.
20. THE APPROVAL OF THESE CONSTRUCTION PLANS DOES NOT AUTHORIZE CONSTRUCTION OF REQUIRED IMPROVEMENTS WHICH ARE INCONSISTENT WITH EASEMENT OF RECORD.

DRAFTING LEGEND



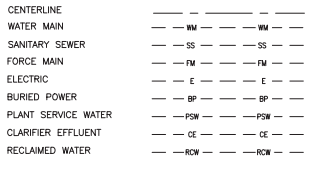
SYMBOLS LEGEND



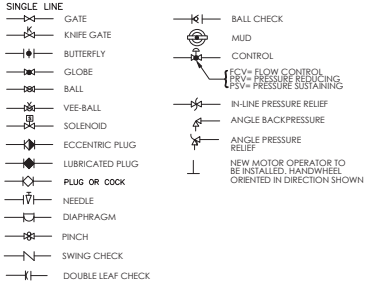
ABBREVIATIONS

ABN	ABANDONED OR ABANDON
AL. ALUM.	ALUMINUM
APPROX.	APPROXIMATE
BE	BURIED ELECTRICA
B.F., BF	BLIND FLANGE
BLDG.	BUILDING
CI	CAST IRON
C/L	CENTERLINE
CONC	CONCRETE
DBC	DUCT BANK
DET	DETAIL
DIA.	DIAMETER
DIP OR DI	DUCTILE IRON PIPE
DR	DRAIN
DWG.	DRAWING
EFF.	EFFLUENT
ELECT.	ELECTRIC
EL, ELEV.	ELEVATION
EOP	EDGE OF PAVEMENT
EQUIP.	EQUIPMENT
EXIST.	EXISTING
FD	FLOOR DRAIN
FRP	FIBERGLASS REINFORCED PLASTIC
ID	INSIDE DIAMETER
INFL	INFLUENT
INV	INVERT
MANUF	MANUFACTURER
MAX	MAXIMUM
MECH	MECHANICAL
MIN	MINIMUM
NO	NUMBER
NTS	NOT TO SCALE
PVC	POLYVINYL CHLORIDE PIPE
RD	ROOF DRAIN
REQ'D	REQUIRED
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SPEC	SPECIFICATION
SS	SANITARY SEWER, STAINLESS STEEL
STL	STEEL
TBA	TO BE ABANDONED
TBR	TO BE REMOVED
TYP	TYPICAL
UNK	UNKNOWN
WM	WATER MAIN

EXISTING LINETYPE



EXISTING VALVE SYMBOLS



SURVEY NOTES

1. TOPOGRAPHIC SURVEY PROVIDED BY AIM ENGINEERING & SURVEYING, INC, AIM PROJECT NUMBER 21-1416 PHASE 300, DATED SEPTEMBER 14, 2022,
2. SUBSURFACE UTILITY ENGINEERING TEST HOLE DATA PROVIDED BY AIM ENGINEERING & SURVEYING, INC, DATED DECEMBER 27, 2021 TO JUNE 16, 2022, HORIZONTAL DATUM: FLORIDA STATE PLANE, EAST ZONE, NAD 83, VERTICAL DATUM: NAVD 88 (NATIONAL GEODETIC VERTICAL DATUM) 1988.
3. NCWRF FLOW EQUALIZATION SYSTEM, PHASE 2 RECORD DRAWINGS, DATED JANUARY 2006, PREPARED BY HAZEN AND SAWYER AND HOLE MONTES.

Stantec
Stantec Consulting Services Inc.
3510 Kraft Road, Suite 200
Naples FL, 34105-5029
Tel: (239) 649-4040
www.stantec.com

Client/Project Logo

Collier County

NOTES:

Revision	By	Appd	Date

Issued	By	Appd	Date
BID SET			OCTOBER, 2023

File Name: 11697-Z-002	MPL Dwn.	ML Dsgn.	SM Chkd.	OCTOBER, 2023 Date

Permit/Seal

NOT FOR CONSTRUCTION

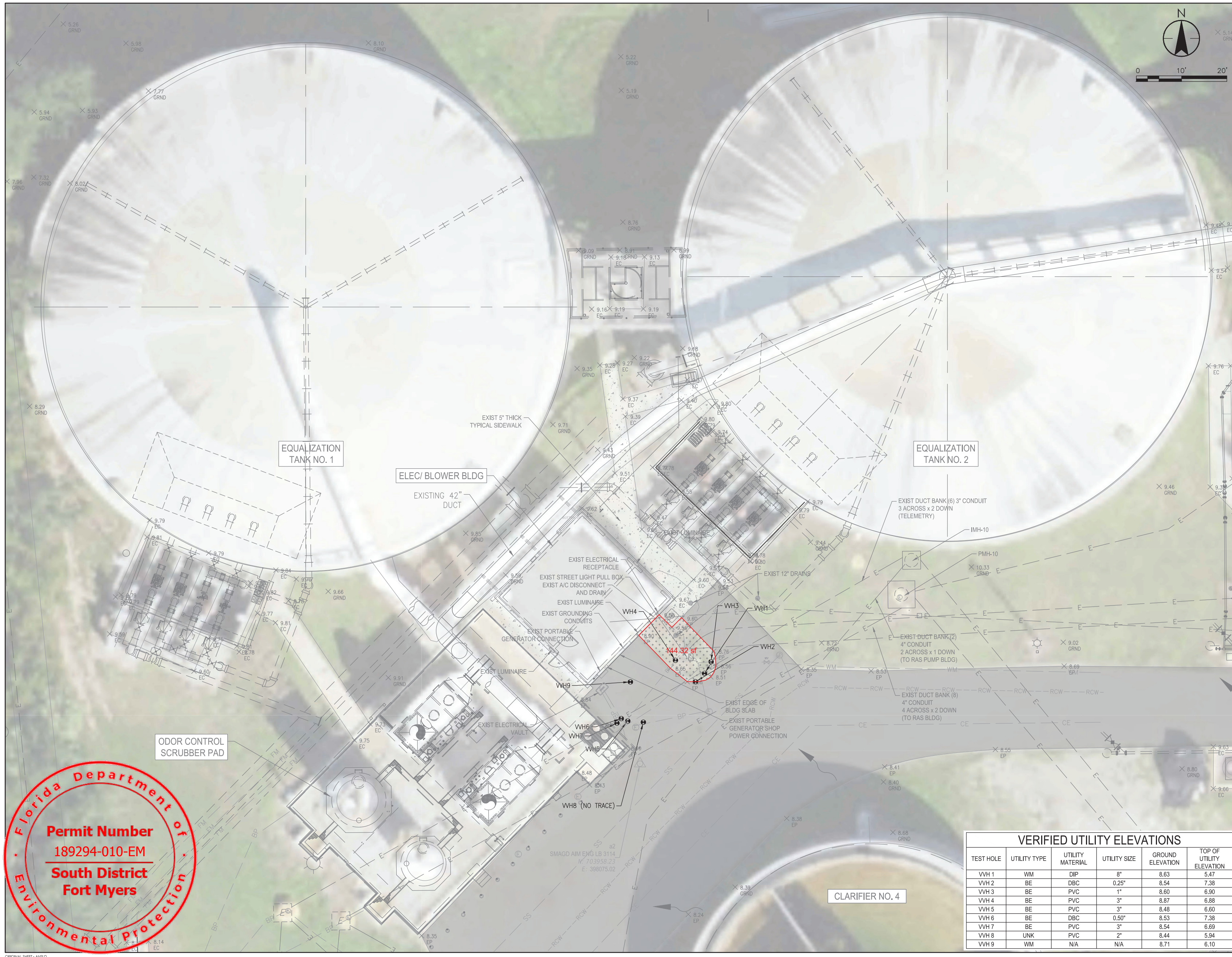
MARC LEAN, PE 66473

Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
GENERAL NOTES AND ABBREVIATIONS

Project No.	Scale
177311697	AS SHOWN
Phase	Drawing No.
100% PLANS	3 of 28 G-003



VERIFIED UTILITY ELEVATIONS					
TEST HOLE	UTILITY TYPE	UTILITY MATERIAL	UTILITY SIZE	GROUND ELEVATION	TOP OF UTILITY ELEVATION
VVH 1	WM	DIP	8"	8.63	5.47
VVH 2	BE	DBC	0.25"	8.54	7.38
VVH 3	BE	PVC	1"	8.60	6.90
VVH 4	BE	PVC	3"	8.87	6.88
VVH 5	BE	PVC	3"	8.48	6.60
VVH 6	BE	DBC	0.50"	8.53	7.38
VVH 7	BE	PVC	3"	8.54	6.69
VVH 8	UNK	PVC	2"	8.44	5.94
VVH 9	WM	N/A	N/A	8.71	6.10

Florida Department of Environmental Protection
Permit Number
189294-010-EM
South District
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ORIGINAL SHEET - ANSI D

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Collier County

NOTES:

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100% PLANS			JULY 2023
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File Name: 11697-C-101	MPL	ML	SM	JULY 2023
	Dwn.	Dsgn.	Chkd.	Date

Permit/Seal

NOT FOR CONSTRUCTION

MARC LEAN, PE 66473

Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

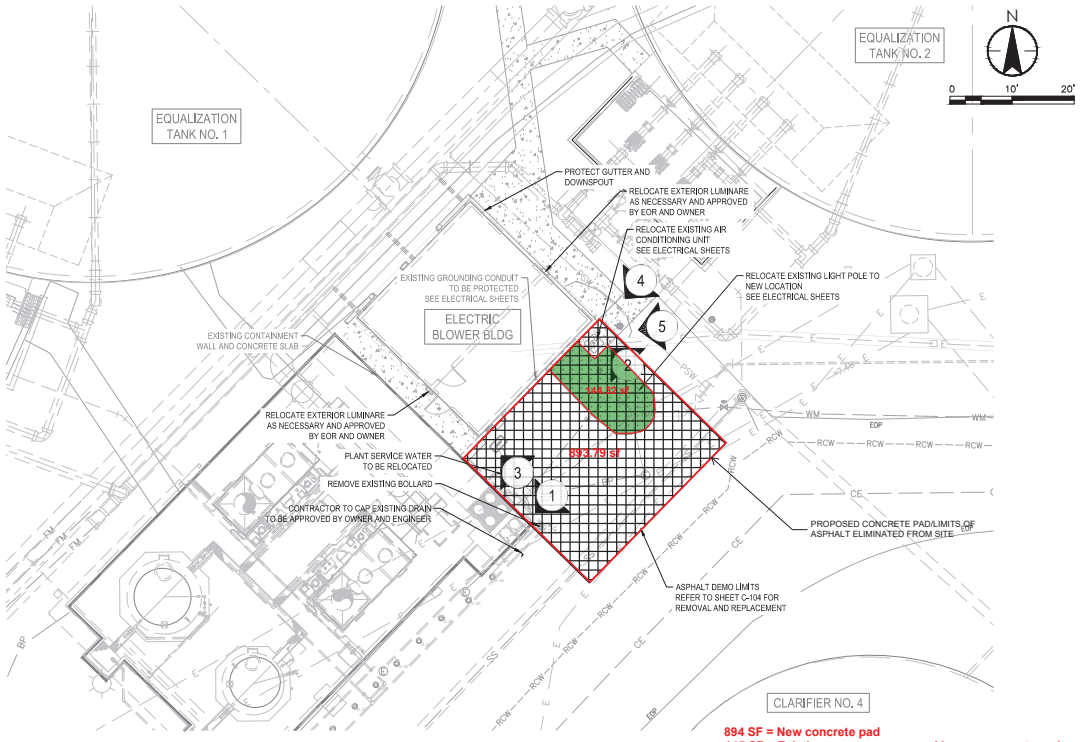
Title
EXISTING CONDITIONS PLAN

Project No. 177311697
Scale 1" = 10'

Phase
100% PLANS

Drawing No.

C-101

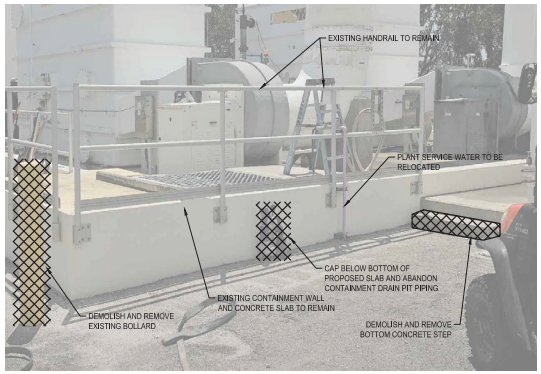


EXISTING ODOR CONTROL DEMOLITION PLAN

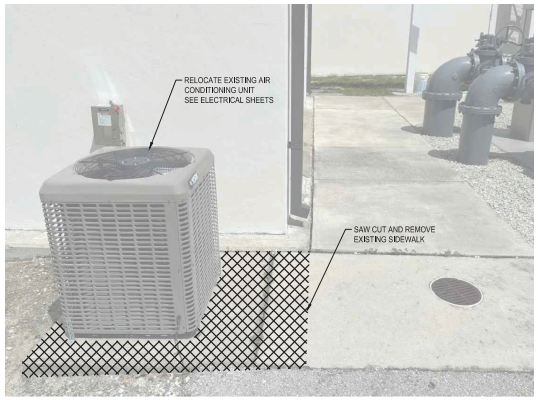
SCALE: 1" = 10'

894 SF = New concrete pad
-145 SF = Existing grass area covered by new concrete pad

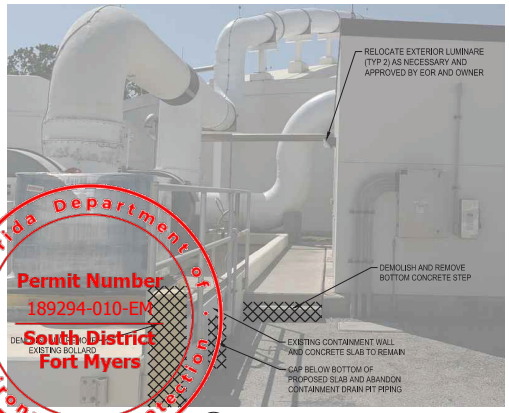
749 SF = Existing asphalt surface eliminated from site



1 EXISTING CONTAINMENT WALL

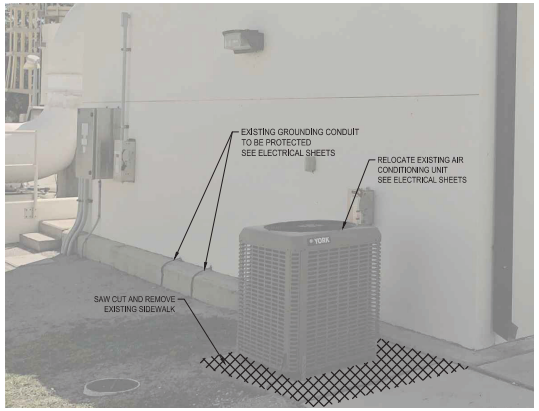


2 EXISTING A/C UNIT



3 WEST ELEVATION

4 EAST ELEVATION



5 SOUTH ELEVATION

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NOTES:

1. CONTRACTOR SHALL COORDINATE WITH PLANT STAFF TO DRAIN AND DISPOSE OF CHEMICALS IN EXISTING TANKS.
2. DUCT SHALL BE CUT AS CLOSE TO TOP 90 BEND AS POSSIBLE. CONTRACTOR SHALL STABILIZE EXISTING DUCT WHILE CONDUCTING INSTALLATION ACTIVITIES. PORTION OF DUCT THAT IS CUT SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR.CONTRACTOR SHALL CUT EXISTING FRP DUCT FOR CONNECTION TO PROPOSED DUCT WORK. CONTRACTOR SHALL COORDINATE WITH PLANT MANAGER TO ENSURE AIR FLOW IS VALVED TO SCRUBBER #1 AND #2.
3. REMOVAL OF THE EXISTING CONCRETE PAD SHOULD INCLUDE ANY CHEMICAL TRENCHES, PIPING, ELECTRICAL, CHEMICAL FEED LINES, CHEMICAL STORAGE TANKS, EXISTING ODOR CONTROL EQUIPMENT, AND OTHER EQUIPMENT TO BE DEMOLISHED AS INTENDED ON THE PLANS. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING AND DISPOSING DEMOLISHED EQUIPMENT.
4. TO BE REMOVED PER KEY NOTE 3 ON E-101.
5. ALL EXTERIOR BUILDING ELECTRICAL APPURTENANCES TO BE PROTECTED UNLESS OTHERWISE NOTED.

0			
Revision	By	Appd	Date
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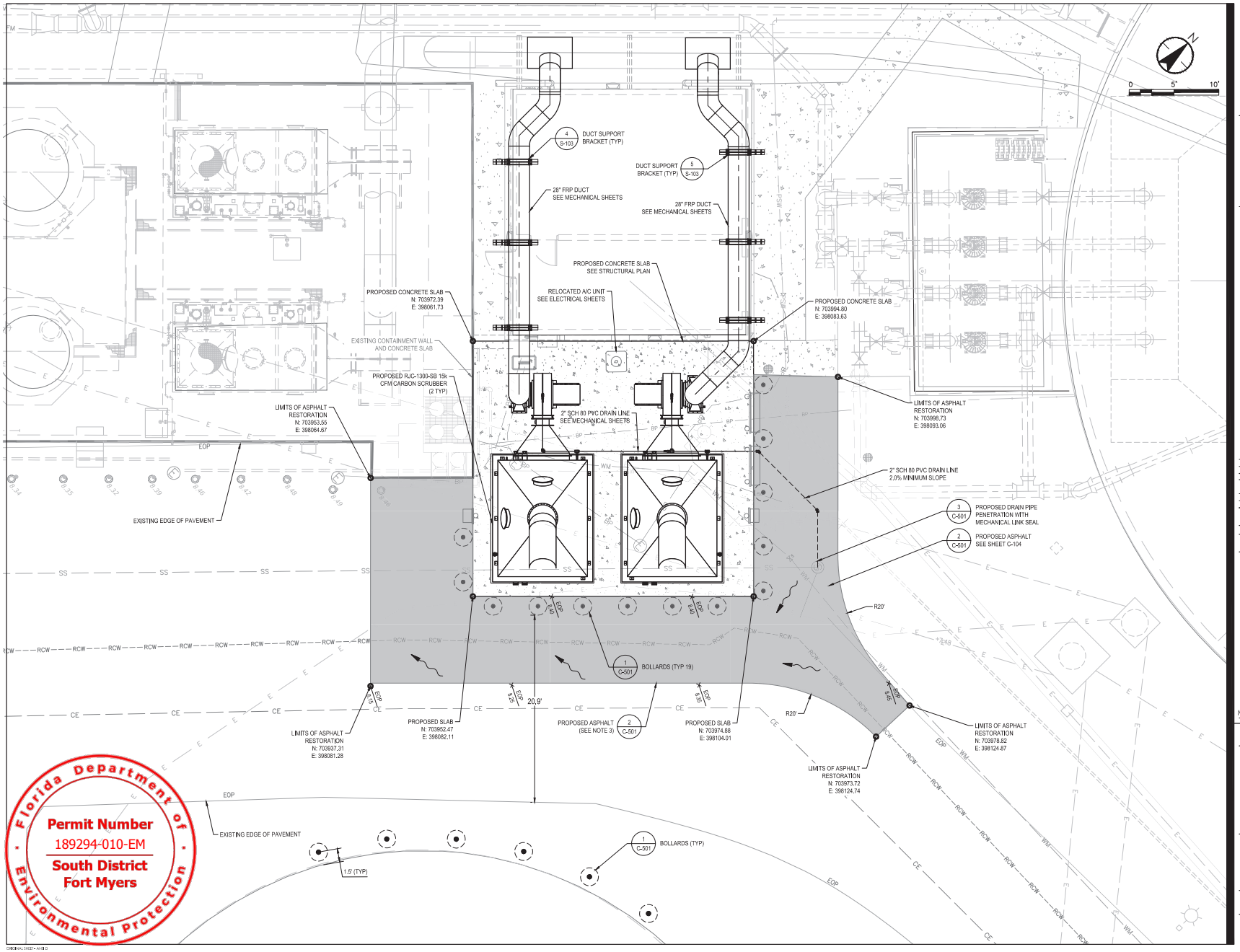
Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
DEMOLITION PLAN

Project No.	Scale
177311697	AS SHOWN
Phase	Drawing No.
100% PLANS	5 of 28 C-102



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NOTES:

1. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988, NAVD 88, (+1.23') to = NGVD 29.
2. THE HORIZONTAL DATUM IS THE FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM 1983 (2011).
3. CONTRACTOR TO REPAIR ASPHALT DAMAGE BEYOND LIMITS AT NO ADDITIONAL COST.

Revision	By	Appd	Date
100% PLANS			JULY 2023

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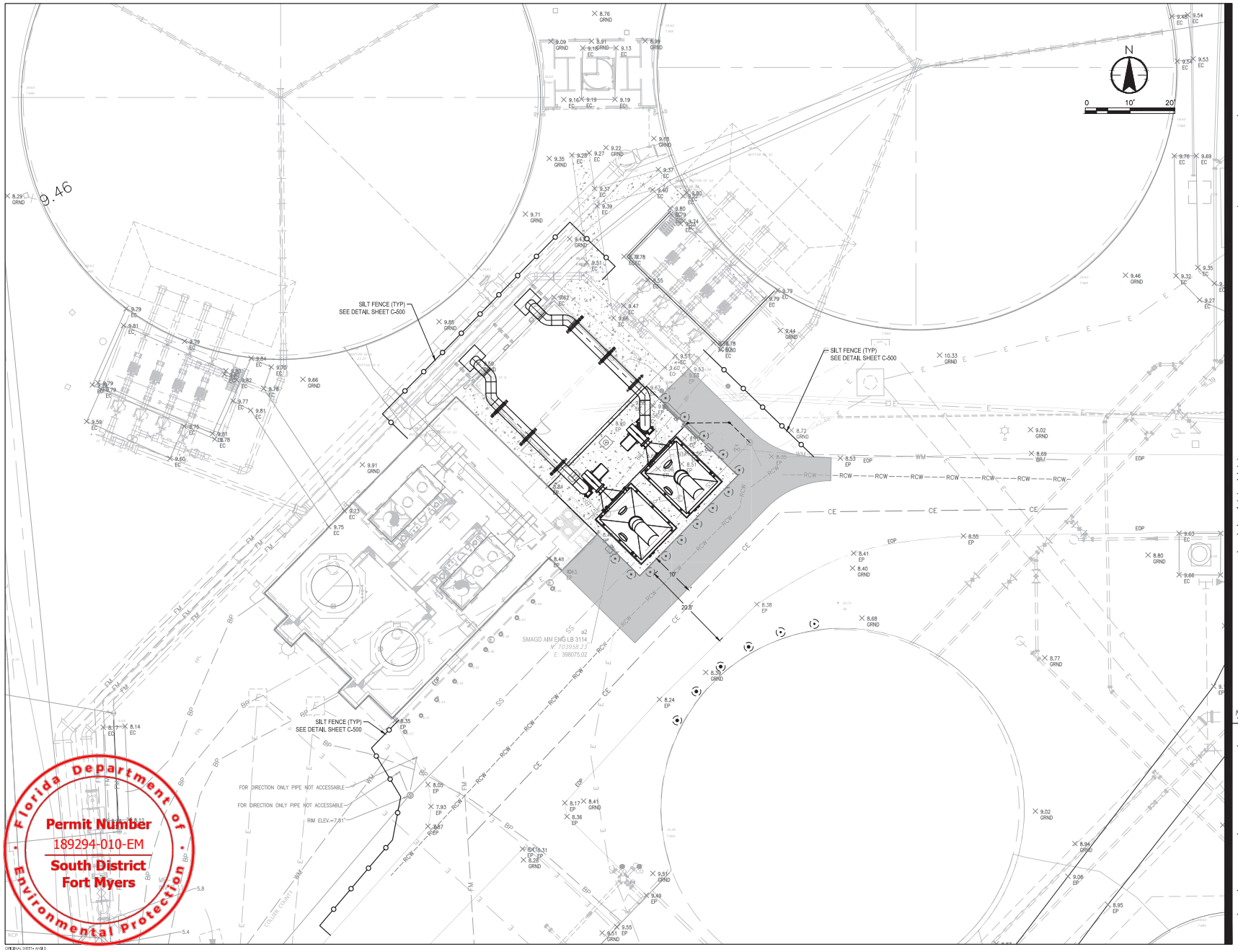
Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
PROPOSED SITE PLAN AND ASPHALT RESTORATION

Project No.	Scale
177311697	AS SHOWN
Phase	Drawing No.
100% PLANS	6 of 28 C-103

ORIGINAL SHEET - ANSI D



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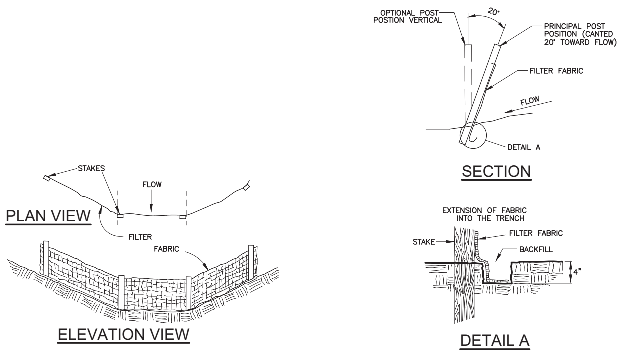
Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
STORMWATER POLLUTION PREVENTION PLAN

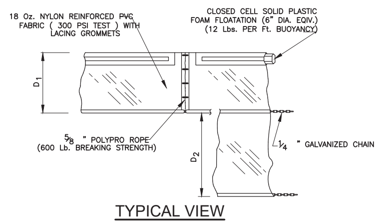
Project No.	Scale
177311697	AS SHOWN
Phase	Drawing No.
100% PLANS	7 of 28 C-104



1. FILTER BARRIERS MUST BE INSTALLED, AS INDICATED HEREIN, PRIOR TO CONSTRUCTION.
2. FILTER BARRIERS SHALL NOT BE INSTALLED IN ANY CONFIGURATION THAT BLOCKS THE THROAT OF ANY STORMWATER INLET.
3. INSPECTIONS AND REPAIRS TO BARRIERS SHALL BE MADE DAILY.
4. FILTER BARRIERS SHALL BE REMOVED UNTIL APPROVED BY ENGINEER.

STAKED SILT BARRIER

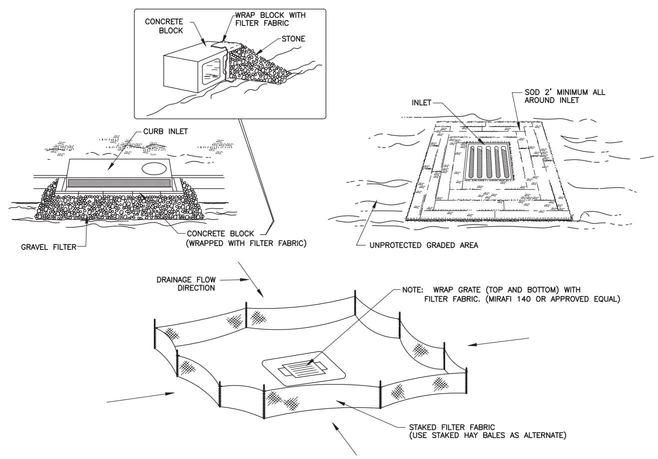
(DURING CONSTRUCTION ONLY)



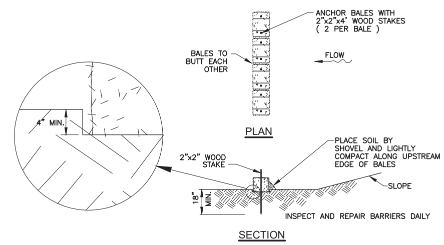
NOTES:

1. D = 5' STANDARD (SINGLE PANEL FOR DEPTH 5' OR LESS). D = 5' STANDARD (ADDITIONAL PANEL FOR DEPTHS >5'). CURTAIN TO REACH BOTTOM UP TO DEPTHS OF 10 FEET. TWO (2) PANELS TO BE USED FOR DEPTHS GREATER THAN 10 FEET UNLESS SPECIAL DEPTH CURTAINS SPECIFICALLY CALLED FOR IN THE PLANS OR AS DETERMINED BY THE ENGINEER.
2. TURBIDITY BARRIERS ARE TO BE USED IN ALL PERMANENT BODIES OF WATER REGARDLESS OF WATER DEPTH WHEN ADJACENT TO CONSTRUCTION ACTIVITIES.
3. NUMBER AND SPACING OF ANCHORS DEPENDENT ON WATER VELOCITIES.
4. BARRIERS TO REMAIN IN PLACE UNTIL APPROVED FOR REMOVAL BY ENGINEER.

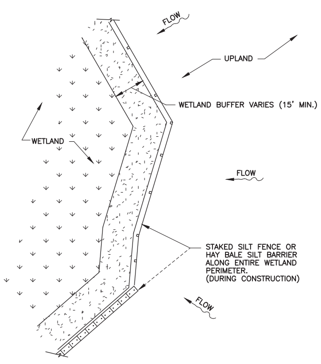
FLOATING TURBIDITY BARRIER



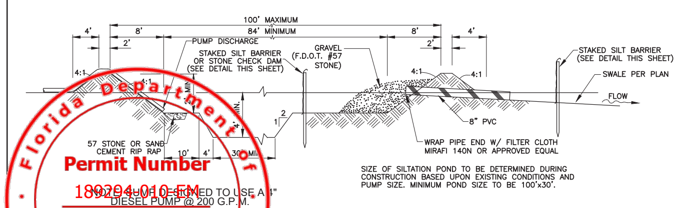
PROTECTION OF INLETS



HAY BALE SILT BARRIER



WETLAND PROTECTION



SIZE OF SILTATION POND TO BE DETERMINED DURING CONSTRUCTION BASED UPON EXISTING CONDITIONS AND PUMP SIZE. MINIMUM POND SIZE TO BE 100'x30'.

NOTE: SUMP DESIGNED TO USE A 4" DIESEL PUMP @ 200 G.P.M.

SILTATION POND DETAILS

(REQUIRED DURING DEWATERING FOR SUMP EXCAVATION ONLY)

Florida Department of Environmental Protection
Permit Number
189294-010-EM
South District
Fort Myers

EROSION CONTROL NOTES

1. GENERAL

THE CONTRACTOR SHALL PROVIDE ALL LABOR, EQUIPMENT, TOOLS, MATERIALS AND SERVICES NEEDED TO INSTALL ALL EROSION AND SEDIMENT CONTROL MEASURES. THESE MEASURES SHALL CONFORM TO THE PLANS AND SPECIFICATIONS AND ALL APPLICABLE STATE AND LOCAL REQUIREMENTS.

2. WETLAND PROTECTION

IN AREAS OF CONSTRUCTION ADJACENT TO WETLANDS, THE FOLLOWING SHALL BE PERFORMED:

a) THE ACTUAL WETLAND AND REQUIRED BUFFERS, AS SHOWN ON THE PLANS, MUST BE ESTABLISHED AND ROPED OFF PRIOR TO THE START OF ANY CONSTRUCTION ACTIVITY ADJACENT TO SAID AREAS.

b) PRIOR TO THE PLACEMENT OF ANY FILL MATERIAL ADJACENT TO WETLANDS OR BUFFER AREAS, A SILTATION BARRIER SHALL BE CONSTRUCTED.

c) NO RIM DITCHING OF THE WETLANDS SHALL BE PERFORMED. WATER LEVELS IN THE WETLANDS SHALL BE MAINTAINED ACCORDING TO LEVELS EXISTING PRIOR TO SITE DISTURBANCE.

d) IN AREAS OF WETLANDS IN WHICH WORK IS TO BE PERFORMED, SUCH AREAS MUST BE CLEARLY STAKED AND ROPED OFF. ALONG SUCH LIMITS, A SILTATION BARRIER MUST BE CONSTRUCTED.

e) THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF BARRIERS. BARRIERS SHALL REMAIN IN PLACE UNTIL ALL AREAS ARE STABILIZED.

f) THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY UPON DISTURBANCE OF WETLAND AREAS. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO ALL PROTECTED AREAS.

g) AREAS WHERE IMPACTS WILL BE PERFORMED SHALL BE STRIPPED OF EXISTING MATERIAL AND STOCKPILED FOR USE IN THE RE-CREATION OF THE DISTURBED AREAS OR IN LITTORAL ZONES.

3. EARTH MOVING ACTIVITIES

a) THE CONTRACTOR SHALL EXERCISE CARE TO PRESERVE THE NATURAL LANDSCAPE AND SHALL PLAN CONSTRUCTION OPERATIONS SO AS TO PREVENT ANY UNNECESSARY DESTRUCTION, SCARRING, OR DEFACING OF THE NATURAL SURROUNDINGS. EXCEPT WHERE CLEARING IS REQUIRED FOR PERMANENT WORK, FOR APPROVED CONSTRUCTION ROADS, OR FOR EXCAVATION OPERATIONS, ALL TREES, NATIVE SHRUBBERY AND VEGETATION SHALL BE PRESERVED AND SHALL BE PROTECTED FROM DAMAGE WHICH MAY BE CAUSED BY THE CONTRACTOR'S CONSTRUCTION OPERATIONS AND EQUIPMENT.

b) THE FIRST STAGE OF THE EARTH MOVING ACTIVITY SHALL BE CONFINED TO THE EXCAVATION OF THE STORMWATER FACILITY.

c) TOPSOIL SHOULD BE TAKEN FROM THE CONSTRUCTION AREAS AND SHOULD BE STOCKPILED FOR REUSE IN FINISHED GRADING. STOCKPILES SHOULD BE PLACED SO AS NOT TO ADD ANY ADDITIONAL SEDIMENT TO THE CONSTRUCTION. THE STOCKPILES SHOULD BE MULCHED AND/OR SEEDED WHEN EXPOSED BEYOND THIRTY (30) DAYS.

d) GRADED AREAS ARE TO BE SEEDED AND/OR SODDED WITHIN THIRTY (30) DAYS FOLLOWING EARTH MOVING PROCEDURES. IF THE TIME OF YEAR IS NOT CONDUCIVE FOR PERMANENT SEEDING, A TEMPORARY MULCH AND/OR SEEDING SHOULD BE USED.

e) TEMPORARY DIVERSION BERMS AND/OR BARRIERS SHALL BE REMOVED ONLY AFTER THE CONSTRUCTION OF THOSE AREAS DIRECTED TO THE BERMS AND/OR BARRIERS HAVE BEEN COMPLETED.

f) THE SILT COLLECTION PONDS SHOULD BE REMOVED AND/OR REGRADED FOR PERMANENT USE, AS THE FINAL GRADING AND SEEDING OVERLAP THE AREA USED BY SAME.

4. FILLS

a) LAND TO BE CUT OR FILLED SHOULD BE CLEARED OF TREES, STUMPS, ROOTS, BRUSH, BOULDERS, SOD AND DEBRIS.

b) FILL AREAS SHOULD BE SCARIFIED, KEYED AND DRAINED.

c) FILL MATERIAL SHOULD BE FREE OF SOD, ROOTS, OR OTHER DECOMPOSABLE MATERIAL.

d) THE PLACING AND SPREADING OF FILL MATERIAL SHOULD BE STARTED AT THE LOWEST POINT.

e) GENERALLY, A 6:1 SLOPE SHOULD BE USED UNLESS SPECIFIC ENGINEERING DATA SHOWS A STEEPER SLOPE IS STABLE. SLOPES OF 4:1 OR FLATTER ARE DESIRABLE FOR EROSION CONTROL AND MAINTENANCE.

f) FILLS SHOULD BE SEEDED AND/OR MULCHED IMMEDIATELY UPON COMPLETION OF EARTH PLACEMENT.

g) WATER MANAGEMENT SYSTEMS SHOULD BE PROVIDED TO PREVENT WATER CONCENTRATION AND ERODING THE FACE OF THE SLOPE. KEEP SURFACE WATER OFF THE FACE OF THE SLOPE.

5. CUTS

a) DIVERSIONS SHOULD BE CONSTRUCTED AT TOP OF THE SLOPES PRIOR TO CUTTING OPERATIONS TO CONVEY WATER FROM FACE OF SLOPE.

b) STEEPNESS OF CUTS WILL DEPEND ON SOIL TYPE AND DESIGN; HOWEVER, CUT SLOPES OF 4:1 OR FLATTER ARE DESIRABLE FOR EROSION CONTROL AND STABILITY.

c) CUT SLOPES SHOULD BE BENCHED TO PROVIDE ACCESS FOR SEEDING AND MULCHING EQUIPMENT.

d) CUT SLOPES SHOULD BE SEEDED AND/OR MULCHED IMMEDIATELY AFTER REMOVAL OF EARTH.

6. TEMPORARY SEDIMENT BASIN AND PERMANENT STORMWATER BASINS

a) SITE PREPARATION

AREAS UNDER THE EMBANKMENT AND ANY STRUCTURAL WORKS SHALL BE CLEARED, GRUBBED AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS AND OTHER OBJECTIONABLE MATERIALS. IN ORDER TO FACILITATE CLEAN-OUT AND RESTORATION, THE POOL AREA (MEASURED AT THE TOP OF THE SPILLWAY) WILL BE CLEARED OF ALL BRUSH AND TREES.

b) CUT-OFF TRENCH

A CUT-OFF TRENCH, WHEN POND DEPTHS ARE IN EXCESS OF THREE FEET, SHALL BE EXCAVATED ALONG THE CENTERLINE OF EARTH FILL EMBANKMENTS. THE MINIMUM DEPTH SHALL BE TWO FEET. THE CUT-OFF TRENCH SHALL EXTEND UP BOTH ABUTMENTS TO THE RISER CREST ELEVATION. THE MINIMUM BOTTOM DEPTH SHALL BE FOUR FEET, BUT WIDE ENOUGH TO PERMIT OPERATION OF EXCAVATION AND COMPACTION EQUIPMENT. THE SIDE SLOPES SHALL BE NO STEEPER THAN 1:1. COMPACTION REQUIREMENTS SHALL BE THE SAME AS THOSE FOR THE EMBANKMENT. THE TRENCH SHALL BE DEWATERED DURING THE BACKFILLING-COMPACTING OPERATIONS.

c) EMBANKMENT

THE FILL MATERIAL SHALL BE TAKEN FROM APPROVED BORROW AREAS. IT SHALL BE CLEAN SOIL FREE OF ROOTS. WOODY VEGETATIONS, OVER-SIZED STONES, ROCKS OR OTHER OBJECTIONABLE MATERIAL. AREAS ON WHICH FILL IS TO BE PLACED SHALL BE SCARIFIED PRIOR TO PLACEMENT OF FILL. FILL MATERIAL SHALL BE PLACED IN SIX TO EIGHT INCHES THICK CONTINUOUS LAYERS OVER THE ENTIRE LENGTH OF THE FILL. COMPACTION SHALL BE OBTAINED BY ROUTING HAULING EQUIPMENT OVER THE FILL SO THAT THE ENTIRE SURFACE OF EACH LAYER OF THE FILL IS TRAVERSED BY AT LEAST ONE WHEEL OF TREAD TRUCK OF THE EQUIPMENT OR BY THE USE OF A COMPACTOR. THE EMBANKMENT SHALL BE CONSTRUCTED TO AN ELEVATION OF 10% HIGHER THAN THE DESIGN HEIGHT TO ALLOW FOR SETTLEMENT IF COMPACTION IS OBTAINED WITH HAULING EQUIPMENT. IF COMPACTORS ARE USED FOR COMPACTION, THE OVERBUILD MAY BE REDUCED TO NOT LESS THAN 5%.

d) PIPE SPILLWAYS

THE RISER SHALL BE SECURELY ATTACHED TO THE BARREL OF THE OUTFALL PIPE. THE BARREL AND RISER SHALL BE PLACED ON A FIRM, SMOOTH SOIL FOUNDATION. THE CONNECTION BETWEEN THE RISER AND RISER BASE SHALL BE WATERTIGHT. THE FILL MATERIAL AROUND THE PIPE SPILLWAY SHALL BE PLACED IN FOUR INCH LAYERS AND COMPACTED UNDER THE SHOULDERS AND AROUND THE PIPE TO AT LEAST THE SAME DENSITY AS THE ADJACENT EMBANKMENT. HAND COMPACTED BACKFILL SHALL BE PLACED OVER THE PIPE SPILLWAY BEFORE CROSSING IT WITH CONSTRUCTION EQUIPMENT.

e) EROSION POLLUTION CONTROL

CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND WATER POLLUTION WILL BE MINIMIZED. STATE AND LOCAL LAWS CONCERNING POLLUTION ABATEMENT SHALL BE COMPLIED WITH.

7. MAINTENANCE

a) REPAIR ALL DAMAGES CAUSED BY SOIL EROSION OR CONSTRUCTION EQUIPMENT AT OR BEFORE THE END OF EACH WORK DAY.

b) SEDIMENT SHALL BE REMOVED FROM SUMP AREAS. THE SEDIMENT SHALL BE PLACED IN SUCH A MANNER THAT IT WILL NOT ERODE FROM THE SITE. THE SEDIMENT SHALL NOT BE DEPOSITED DOWNSTREAM FROM THE EMBANKMENT OR IN OR ADJACENT TO A STREAM OR FLOOD PLAIN.

c) AFTER CONSTRUCTION IS COMPLETED AND AREAS ARE SEEDED AND/OR SODDED, MAINTENANCE IS LIMITED TO VISUAL INSPECTIONS ON A ROUTINE BASIS. ANY DAMAGE TO THE BERM SHALL BE REPAIRED AT ONCE AND RE-SODDED AND/OR RE-SEEDED. IF THE LEVEL OF WATER IS BEING MAINTAINED OVER THE EXPECTED DRAW DOWN TIME, THE OUTFALL SYSTEM SHALL BE CLEANED AND REPAIRED.

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NOTES:

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	Dwn.	Dsgn.	Chkd.	Date

Permit/Seal

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MARC LEAN, PE 66473

Client/Project
COLLIER COUNTY PUBLIC UTILITIES

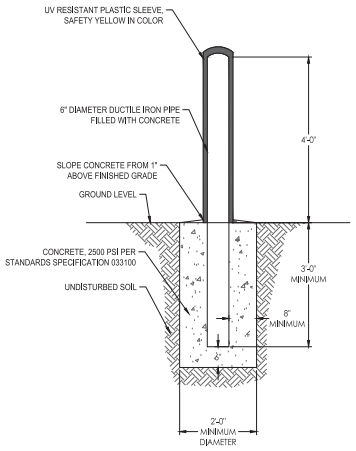
NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
BEST MANAGEMENT PRACTICES

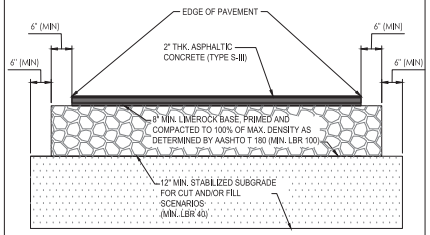
Project No. 177311697
Scale

Phase 100% PLANS

Drawing No. C-500



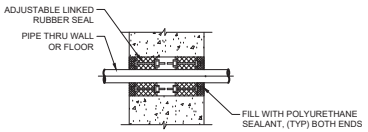
1 BOLLARD
NTS



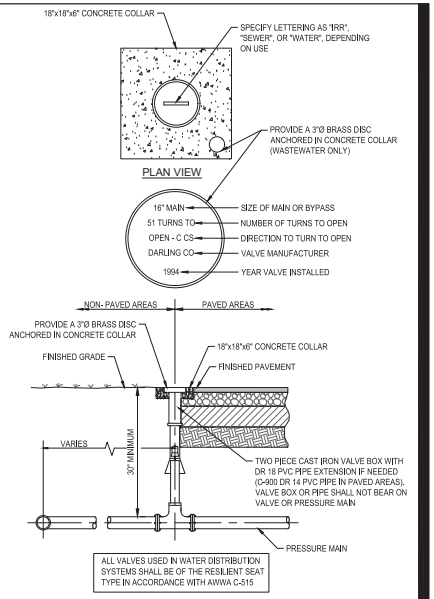
ROADWAY COMPACTION NOTES:

1. THE STABILIZED SUBGRADE SHALL BE COMPACTED TO 100% OF THE MAXIMUM DENSITY, IN ACCORDANCE WITH AASHTO T-180 AND THE ENGINEERS TECHNICAL SPECIFICATIONS. 5-1/2" LIMEROCK BASE MATERIAL MAY BE SUBSTITUTED AS AN ALTERNATE DESIGN TO THE 12" STABILIZED SUBGRADE. ALL SPECIFICATIONS FOR LIMEROCK BASE SHALL BE ADHERED TO.
2. THE LIMEROCK BASE SHALL BE COMPACTED IN 6" LIFTS TO 100% OF THE MAXIMUM DENSITY, IN ACCORDANCE WITH AASHTO T-180 AND THE ENGINEERS TECHNICAL SPECIFICATIONS.
3. ASPHALTIC CONCRETE PAVEMENT (TYPE S-III) SHALL BE PLACED IN TWO 1" LIFTS, ACCORDING TO AASHTO ASPHALT MANUAL.

2 TYPICAL ASPHALT PAVEMENT SECTION DETAIL
NTS



3 MECHANICAL LINK SEAL
NTS



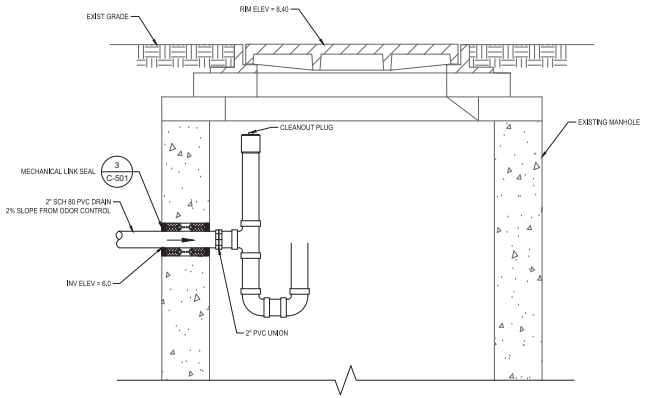
5 TYPICAL VALVE SETTING
NTS

PIPE SIZE IN INCHES	RESTRAINED PIPE LENGTH IN FEET (1)						
	HORIZONTAL BENDS				DEAD ENDS (2)	45° VERTICAL BENDS	
	90°	45°	22-1/2°	11-1/4°		UPPER	LOWER
4	23	9	5	2	55	23	8
6	32	13	6	3	77	32	11
8	40	17	8	4	100	41	14
10	48	20	10	5	120	50	17
12	56	23	11	6	141	58	20
16	71	29	14	7	181	75	25
18 20	77	32 35	15	8	200	83	28 30
24 30	84	40 47	17	8	218	90	35
36	96	53	19	10	253	105	41
	112 127		22 25	11	303	125 145	47
				13	350		

PIPE SIZE IN INCHES	RESTRAINED PIPE LENGTH IN FEET (1)	
	TEE (3)	REDUCER (4)
6 x 4	0	40
6 x 6	34	
8 x 4	0	72
8 x 6	55	
10 x 6 10	3	74
x 10 12 x	75	
4	0	122
12 x 8	31	75
12 x 12	95	
16 x 6	0	153
16 x 10	44	107
16 x 16	134	
18 x 8	0	157
18 x 12	58	108
18 x 18	172	
20 x 10	60	161
20 x 16	160	
20 x 20	170	
24 x 12	37	187
24 x 18	132	109
24 x 24	204	
30 x 16	78	213
30 x 20	138	165
30 x 30	259	94
36 x 18	84	259
36 x 24	170	184
36 x 36	290	

NOTES:
1. RESTRAIN ALL PIPE JOINTS WITHIN THE DISTANCE SHOWN ON THE TABLES MEASURED FROM THE POINT OF CONNECTION.
2. ISOLATION VALVES SHALL BE TREATED AS DEAD ENDS.
3. WITH RESTRAINT ON BOTH SIDES OF THE VALVE. RESTRAINT IS FOR BRANCH OF TEE. IF BRANCH SIZE IS NOT ON TABLE, USE NEXT LARGEST BRANCH.
4. RESTRAINT IS FOR LARGE DIAMETER SIDE OF REDUCER. IF REDUCER SIZE IS NOT ON TABLE, USE NEXT SMALLER REDUCER (SMALL END).
THIS SCHEDULE IS TO BE USED FOR DUCTILE IRON AND PVC PIPE.

PIPE RESTRAINT SCHEDULE



7 P-TRAP CONNECTION TO EXISTING MANHOLE
NTS

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Client/Project Logo

Collier County

NOTES:

Revision	By	Appd	Date
0			
100% PLANS			JULY 2023

Issued	By	Appd	Date
File Name: 11697-C-501	MPL Dwn.	ML Dsgn.	SM Chkd.	JULY 2023 Date

Permit/Seal

NOT FOR CONSTRUCTION

MARC LEAN, PE 66473

Client/Project
COLLIER COUNTY PUBLIC UTILITIES

NORTH COUNTY WATER RECLAMATION FACILITY ODOR CONTROL - PHASE II

Title
CIVIL DETAILS

Project No.	Scale
177311697	AS SHOWN
Phase	Drawing No.
100% PLANS	9 of 28 C-501