
IFB NO. Y20-724-RM

ISSUED: October 11, 2019

INVITATION FOR BIDS

FOR

ORANGE COUNTY LANDFILL CELL 11 BAY 17-19 EXPANSION

**PART H
TECHNICAL SPECIFICATIONS**

**PART H
Volume II**

.....

CONTRACT DOCUMENTS
FOR
ORANGE COUNTY LANDFILL CELL 11
BAY 17-19 EXPANSION

CIP NO 4410-038-1107-02-6310 SEQ NO 91526



BYRON W. BROOKS, A.I.C.P.
COUNTY ADMINISTRATOR

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PREPARED FOR:

UTILITIES SOLID WASTE DIVISION
ORANGE COUNTY, FLORIDA
SPECIFICATIONS
VOLUME 2 OF 4



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Project No.
676802

SEPTEMBER 2019

BID DOCUMENTS

UTILITIES SOLID WASTE DIVISION

ORANGE COUNTY, FLORIDA

CONTRACT DOCUMENTS

for the construction of

**ORANGE COUNTY LANDFILL CELL 11
BAY 17 - 19 EXPANSION**

Contract No. _____

CH2M
Orlando, Florida
September 2019

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Project No. 676802

Copy No. _____

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END OF SECTION

**TECHNICAL
SPECIFICATIONS**

**SECTION 01 11 00
SUMMARY OF WORK**

PART 1 GENERAL

1.01 NOTICE TO CONTRACTOR

- A. Prior to the construction of Cell 10, the previous landfill expansion in the Southern Expansion Area (SEA), the U. S. Army Corps of Engineers (USACOE) informed Orange County, Florida (Owner) that portions of the SES were included in the historical Pinecastle Jeep Range, a former World War II arms practice range and training facility. The Pinecastle Jeep Range was used for small arms firing, air tactics evaluations, and training demonstrations of strafing, practice bombing, air-to-ground rocket firing and high explosive bombing. USACOE Fact Sheet titled “Formerly Used Defense Site Program, Pinecastle Jeep Range,” dated July 2007, identifies two target areas on the SES east of State Road 417, one centered on the proposed Cell 11 area and one near the proposed Western Borrow Area (WBA).

- B. Orange County had munitions Remedial Investigations (RIs) performed on three different occasions in 2008, 2009, and 2013. More than 5,000 subsurface anomalies were investigated during these RIs of which approximately 99 percent were culture debris (nails, railroad spikes, metal scrap). Further information and requirements regarding munitions are provided in Section 01 35 00, Health and Safety Requirements.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work shall include, but not be limited to:
 - 1. Construction of Bays 17, 18 and 19, encompassing approximately 31 plus or minus acres of lined Class I disposal area adjacent to existing Bay 16 which will be operational at the time of construction. The Work includes exposing Bay 16 liner system and construction of the interface with Bay 17 liner for a contiguous lined disposal area.
 - 2. The U. S. Army Corps of Engineers (USACOE) informed Orange County, Florida (Owner) that portions of the Southern Expansion Site (SES) were included in the Pinecastle Jeep Range, a former World War II arms practice range and training facility. The current risk level overall for the SES is “low risk” based on the hazard severity and an incident “probability of occurrence,” making the site suited for future planned activities. Prudent procedures working within the site should include 3R (recognize, retreat, and report) training, and a standard operating procedure for reporting future potential munitions and explosives of concern (MEC) and materials potentially presenting an explosive hazard (MPPEH) to the appropriate authorities. An area referred to as the “disturbed area” in the eastern portion of Bays 17, 18 and 19 was

partially investigated and is considered as a “moderate risk.” This area shall be considered as potentially containing hazardous munitions, which will require “construction support” during this project. Contractor shall provide “construction support” as defined in Section 01 35 00, Health and Safety Equipment.

3. The bottom liner system for Bays 17, 18 and 19 disposal area is designed and permitted to be lined with two different liner system. The western portion of the bays will be lined with a double liner system, and the eastern portion of the bays will be lined with a double composite liner system. The portion of the liner system located below the high seasonal groundwater table, as shown on the plans, is required to be constructed with the double composite liner system. The portion of the liner located above the high seasonal groundwater table, as shown on the plans, is required to be constructed with double liner system. The details of these liner systems are shown on the plans and summarized as follows:
 - a. The double liner system consists of (from bottom to top) prepared subgrade, a geosynthetic clay liner (GCL) layer, a 60-mil high density polyethylene (HDPE) geomembrane secondary layer, a composite drainage net secondary layer, a 60-mil HDPE geomembrane primary layer, a composite drainage net primary layer, and a sand drainage layer.
 - b. The double composite liner system consists of (from bottom to top) prepared subgrade, a GCL, a 60-mil HDPE geomembrane, a composite drainage net, a GCL, a 60-mil HDPE geomembrane, a composite drainage net, and a sand drainage layer.
4. Construction of the leachate gravity collection system consisting of primary and secondary HDPE leachate collection drain gravel, pipes, and sumps. The leachate gravity line is designed and permitted to penetrate the liner system at the sump as shown on the plans.
5. Construction of the leachate collection manholes and gravity main to the proposed Leachate Pump Station No. 2.
6. Construction of the Pump Station No. 2 complete with embankment, driveway, all piping and connections, all electrical and controls, generator and other pertinent features as shown on the plans and as specified. Construction of the leachate pump station includes among other things two wet wells, two sets of duplexed pumps, an emergency generator and an air compressor station. The pump station will be located on a constructed peninsula extending into existing Pond 8. Permanent sheet piling will be installed on the pond side of the peninsula to provide support for the structural fill beneath the pump station.

7. Construction of proposed monitoring well peninsula extending in places shown into Pond 8 as shown on the plans complete in place, graded, compacted and ready for monitoring well installations. The monitoring wells will be installed by others.
8. Construction of the primary and secondary stormwater management system including construction of Pond 9A to the limits shown with energy dissipaters, discharge structures, and permitted control structures and culverts to existing Pond 7, perimeter ditches with culverts, berms, energy dissipaters and culverts to Pond 8 with associated discharge structures, and sideslope erosion control features.
9. Construction of landfill gas (LFG) main extensions on the east and west side of the proposed Cell 11 to the limits shown with air supply line, connections to the leachate cleanouts, condensate stations, valves, wellheads and other pertinent features as shown on the plans. The proposed LFG main also includes excavation an existing 24-inch LFG loop pipe running the entire south boundary of Bay 16 and relocating to the southern portion of the project site and connect with the proposed LFG main on both east and west side to complete the loop as shown on the plans.
10. Construction of 28-foot-wide asphalt paved Cell 11 Perimeter Road on the east side, and construction of 16-foot wide asphalt paved Cell 11 Perimeter Road on the west side.
11. Construction of limerock road along the southern boundary to connect the east and west perimeter roads, and limerock road along Pond 9A as shown on the plans.
12. Construction includes repair and resurfacing of landfill entrance road and the incoming and outgoing transfer trailer staging areas. The work will include complete re-construction of portions of the road, milling and resurfacing of other portions of the road and the trailer staging area, and repairs to stormwater inlets and truck wash concrete structures as shown on the plans and as specified.
13. Bidders are notified that dewatering will be required for the construction of the liner system, installation of the landfill gas piping, leachate gravity and forcemain piping, manholes and wet wells, roads and stormwater structure installation and repairs and other construction included in this project. The Contractor is required to employ a professional engineer registered in State of Florida to prepare a dewatering plan and obtain all permits necessary for dewatering operations during construction.

B. Pumping:

1. The Contractor using Contractor's equipment shall perform all dewatering and pumping necessary to prevent flotation of any part of the structures, including, but not limited to the landfill liner system, manholes and pump station wetwells, and condensate sumps during construction operations.
2. If dewatering exceeds St. Johns River Water Management District (SJRWMD) construction thresholds, a dewatering plan must be prepared by the Contractor and submitted and approved by the SJRWMD prior to commencement of Work. Determination of dewatering beyond the construction threshold, any permitted dewatering and compliance with dewatering regulations shall be the sole responsibility of the Contractor.
3. Contractor shall base their bid price on "worst case" conditions for dewatering requirements.

C. All quality assurance and quality control test data and certifications, Record Drawings, surveys, special warranties and/or guarantees, and other submittals necessary to file for FDEP Certification of Construction Completion for the above facilities shall be submitted to the Engineer by the Contractor prior to requesting the Substantial Completion inspection.

D. Where manufacturer's products are referenced by name and/or model number in these Specifications, the intent is to provide a basis of design for general characteristics of the product. The Contractor shall be aware that reference to a product by manufacturer's name and/or model number is not intended to and does not imply that the named product is the standard "off-the-shelf" product to be provided by the manufacturer or supplier. The Contractor shall note that these specifications may include performance requirements, components, enhancements, warranties and guarantees, and control systems that exceed those typically provided by the manufacturer or supplier for the named product, and that it is the Contractor's responsibility to provide the specified product with any and all enhanced components and features described in these Contract Documents at no additional cost to the Owner. The Contractor shall have full responsibility to coordinate with the manufacturers and suppliers to obtain the products specified on a timely manner within the approved schedule.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 26 57
CHANGE ORDER PROCEDURES**

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Promptly implement Change Order procedures.
 - 1. Provide full written data required to evaluate changes.
 - 2. Maintain detailed records of work done on a time and material/force account basis.
 - 3. Provide full documentation and breakdown of costs to Engineer on request.
- B. Designate in writing the member of Contractor's organization:
 - 1. Who has been authorized to accept changes in the Work.
 - 2. Who has the responsibility for informing others in the Contractor's employ of the authorization of changes in the Work.

1.02 RELATED REQUIREMENTS

- A. Schedule of Prices from Bid Form.
- B. General and Supplemental Conditions of the Contract.
- C. Section 01 29 73, Schedule of Values.
- D. Section 01 29 75, Applications for Payment.
- E. Section 01 77 00, Contract Closeout.
- F. Forms attached to this Section will be used for this Project.

1.03 DEFINITIONS

- A. Change Order: See Orange County General Conditions.

1.04 PRELIMINARY PROCEDURES

- A. Owner and Engineer may initiate changes by submitting a Request for Proposal (RFP) to the Contractor. Request will include:
 - 1. Detailed description of the change, products, and location of the change in the Project anticipated.
 - 2. Supplementary or revised Drawings and Specifications.

3. The project time span for making the change and a specific statement as to whether overtime work is or is not authorized.
 4. A specific period of time during which the requested price will be considered valid.
- B. Contractor may initiate changes by submitting a written Notice of Proposed Change (NPC) to the Engineer, containing:
1. Description of the proposed changes.
 2. Statement of the reason(s) for making the proposed changes.
 3. Statement of the effect on the Contract Sum and the Contract Time.
 4. Statement of the effect on the work of separate Contractors.
 5. Documentation supporting any changes in Contract Sum or Contract Time, as appropriate.
- C. The Contractor's NPC does not constitute a change in Contract, and the Contractor shall not proceed with any change in Work initiated by him until approved in writing by the Owner. The Owner may request the Engineer to issue an RFP to the Contractor for the proposed NPC.
- D. The Contractor's response to the Engineer's RFP, once accepted by the Owner, will be an "Accepted Change in Contract" and will be incorporated into a Change Order. Contractor's response to the Engineer's RFP shall include a detailed breakdown of costs for each category of work showing the cost of labor, material, and O&P expenses. Submittal of response to RFP with insufficient cost breakdown detail will not be acceptable.
- E. The Contractor shall not proceed with any change in Work unless the Engineer notifies him in writing that his response to RFP has been accepted by the Owner.

1.05 CONSTRUCTION CHANGE AUTHORIZATION

- A. RFP's that may result in a change will describe changes in the Work, both additions and deletions with attachments of revised Contract Documents to define details of the change and will designate the method of determining change in the Contract Sum and change in Contract Time.
- B. The RFP, response to RFP from the Contractor, and letter of Owner acceptance from the Engineer shall be preliminary documents to a formal Change Order. All "Accepted Change in Contract" will be incorporated into a Change Order for approval by the Board of County commissioners.

1.06 DOCUMENTATION OF PROPOSALS AND CLAIMS

- A. Support each quotation for a lump sum proposal, and for each unit price which has not previously been established, with sufficient substantiating data to allow the Engineer to evaluate the quotation.

B. On request, provide additional data to support time and cost computations:

1. Labor required.
2. Equipment required.
3. Products required.
 - a. Recommended source of purchase and unit cost.
 - b. Quantities required.
4. Taxes, insurance, and bonds.
5. Credit for work deleted from Contract, similarly documented.
6. Overhead and profit.
7. Justification for any change in Contract Time in accordance with Section 01 32 00, Progress Schedules.

C. Support each claim for additional costs, and for work done on a time-and-material/force account basis, with documentation as required for a lump sum proposal, plus additional information.

1. Name of the Owner's authorized agent who ordered the work and date of the Order.
2. Dates and times work was performed and by whom.
3. Time record, summary of hours worked, hourly rates paid, and a copy of certified payroll documentation.
4. Receipts and invoices for:
 - a. Equipment used listing dates, and times of use.
 - b. Products used, listing of quantities.
 - c. Similar supporting documentation from subcontractors.

1.07 PREPARATION OF CHANGE ORDERS

- A. Engineer will prepare each Change Order.
- B. Form: Attached to this section.
- C. Change Order will describe changes in the work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
- D. Change Order will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.

1.08 LUMP SUM/FIXED PRICE CHANGE ORDER

- A. Engineer initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

- B. Once Engineer has completed the form, all copies will be sent to Contractor for signature and return to Engineer for approval. After endorsement by Engineer, all copies will be sent to Owner for approval. Engineer will distribute executed copies.

1.09 UNIT PRICE CHANGE ORDER

- A. Content of Change Orders will be based on either:
 - 1. Engineer's definition of the scope of the required changes.
 - 2. Contractor's proposal for a change, as recommended by Engineer.
 - 3. Survey of complete work.
- B. The amounts of the unit prices to be:
 - 1. Those stated in the Agreement.
 - 2. Those mutually agreed upon between Owner and Contractor.
 - 3. Those contained in the Schedule of Unit Prices for Change Orders.
- C. When quantities of each of the items affected by the Change Order can be determined prior to start of the work:
 - 1. Owner and Engineer will execute a Work Directive Change as authorization for Contractor to proceed with the changes.
- D. When quantities of the items cannot be determined prior to start of the work:
 - 1. Owner will issue a Work Directive Change directing the Contractor to proceed with the change on the basis of established unit prices.
 - 2. Upon completion of the change, the Engineer will determine the cost of such work based on the unit prices and quantities used.
 - 3. Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time.
 - 4. Contractor will sign and date the Change Order to indicate their agreement with the terms therein.
 - 5. Owner will then sign the change order.

1.10 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/CONSTRUCTION CHANGE AUTHORIZATION

- A. Engineer and Owner will issue a Work Directive Change directing Contractor to proceed with the changes.
- B. Upon completion of the change, the Contractor shall submit itemized accounting and supporting data as provided in the Article "Documentation of Proposals and Claims" of this Section.

- C. Engineer will determine the allowable cost of such work, as provided in General Conditions and Supplementary Conditions.
- D. Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time.
- E. Contractor will sign and date the Change Order to indicate agreement therewith.
- F. Owner will then sign the Change Order.

1.11 CORRELATION WITH CONTRACTOR'S SUBMITTALS

- A. Monthly, revise Schedule of Values and Request for Payment forms to record each change as a separate item of work and to record the adjusted Contract Sum.
- B. Monthly, revise the Construction Schedule to reflect each change in Contract Time.
- C. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

1.12 SUPPLEMENTS

- A. The supplements listed below, following "END OF SECTION," are part of this Specification.
 - 1. Supplement 1, Work Change Directive Form.
 - 2. Supplement 2, Change Order Form.
 - 3. Supplement 3, Field Order by RPR Form.
 - 4. Supplement 4, Request for Proposal Form

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

WORK CHANGE DIRECTIVE

WORK CHANGE DIRECTIVE NO. _____

Directive Prepared By: _____
 (Name) (Title)

Date Prepared: _____

PROJECT DATA		CONTRACT DATA		
Name:		Contract Document Page Number:		
Location: Orange County Landfill		Drawing Number:		
Owner's Bid Number:		Specification Section/Number:		
WORK CHANGE DIRECTIVE DISTRIBUTION:				
Owner's Home Office: Attn.:	No. Copies		Date Sent:	
Contractor's Home Office: Attn.:	No. Copies		Date Sent:	
Owner's Field Office:	No. Copies		Date Sent:	
Engineer's Field Office:	No. Copies		Date Sent:	
Contractor's Field Office:	No. Copies		Date Sent:	

You are hereby directed to execute promptly this WORK CHANGE DIRECTIVE which orders an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in the General Conditions, or emergencies as provided in the General Conditions, without change in Contract Price or Contract Time.

If CONTRACTOR determines that a change in Contract Price or Contract Time is required as a result of this WORK CHANGE DIRECTIVE, CONTRACTOR must make such a claim prior to starting the Work in accordance with the General Conditions of the Contract Documents. If a Change Order is issued in accordance with the Contract Documents, this WORK CHANGE DIRECTIVE will be invalidated; otherwise, CONTRACTOR shall promptly proceed with the Work described in this WORK CHANGE DIRECTIVE pursuant to the applicable conditions of the Contract Documents.

DESCRIPTION OF CHANGE IN WORK:

ORANGE COUNTY CELL 11

DESCRIPTION OF CHANGE IN WORK:

ATTACHMENTS:

	Description of Item Attached	No. of Copies
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

END OF WORK CHANGE DIRECTIVE FORM

ORANGE COUNTY UTILITIES

Contractor: _____ Change Order Number _____ Page 1 of _____
 Vendor Code _____ Date _____
 Contract No. _____ Original Contract Amount _____
 Project Name _____ Revised Contract Amount _____ \$0.00
 _____ Engineer _____
 Sequence No. _____

Item No.	Quantities	Unit	Description	Unit Price	Additions	Deductions

		Totals	\$0.00	\$0.00
Percent Complete Time	Percent Complete Cost:	Net Dollars This Change Order	\$0.00	
Total Time Previous Change Orders	Days	Net Dollars Previous Change Order		
Total Time This Change Order	Days	Net Dollar Changes to Date	\$0.00	
Original Contract Time	Days	Original Contract Dollar Amount	\$0.00	
Revised Contract Time	0 Days	Revised Contract Dollar Amount	\$0.00	

CONTRACTOR

This change order includes not only all direct costs of contractor such as labor, material, job overhead, and profit markup but also includes any costs for modifications or changes in sequence of work to be performed, delays rescheduling, disruptions, extended direct overhead, acceleration, material, or other escalation which includes wages, and other impact costs.

BY _____ Date _____
Contractor's Signature

BY _____
Accepted for Contractor By: Print Name & Title

ORANGE COUNTY UTILITIES

Approval Recommended:

By _____ Date _____
Chief Inspector Name:

By _____ Date _____
Manager

By _____ Date _____
Director Utilities

By _____ Date _____
Orange County Mayor

FIELD ORDER BY RPR

PROJECT DATA		CONTRACT DATA	
Name:		Contract Document Page Number:	
Location: Orange County Landfill		Drawing Number:	
Owner's Bid Number:		Specification Section/Number:	

FIELD ORDER DISTRIBUTION:				
Owner's Home Office:	No. Copies		Date Sent:	
Attn.:				
Contractor's Home Office:	No. Copies		Date Sent:	
Attn.:				
Owner's Field Office:	No. Copies		Date Sent:	
Engineer's Field Office:	No. Copies		Date Sent:	
Contractor's Field Office:	No. Copies		Date Sent:	

You are hereby directed to execute promptly this Field Order which interprets the Contract Documents or orders minor changes in the work without change in contract price or contract time.

If CONTRACTOR determines that a change in Contract Price or Contract Time is required as a result of this FIELD ORDER, CONTRACTOR must make such a claim prior to starting the Work in accordance with the General Conditions of the Contract Documents. If a Change Order is issued in accordance with General Conditions of the Contract Documents, this FIELD ORDER will be invalidated; otherwise, CONTRACTOR shall promptly proceed with the Work described in this FIELD ORDER pursuant to the applicable conditions of the Contract Documents.

DESCRIPTION OF CHANGE IN WORK:

ATTACHMENTS:

	Description of Item Attached	No. of Copies
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

END OF FIELD ORDER

REQUEST FOR PROPOSAL

REQUEST FOR PROPOSAL (RFP) FOR PROPOSED CHANGE NO. _____

RFP Prepared By: _____
 (Name) (Title)

Date Prepared: _____

PROJECT DATA	CONTRACT DATA
Name:	Contract Document Page Number:
Location: Orange County Landfill	Drawing Number:
Owner's Bid Number:	Specification Section/Number:

RFP DISTRIBUTION BY ENGINEER:				
Owner's Home Office:	No. Copies		Date Sent:	
Attn.:				
Contractor's Home Office:	No. Copies		Date Sent:	
Attn.:				
Owner's Field Office:	No. Copies		Date Sent:	
Engineer's Field Office:	No. Copies		Date Sent:	
Contractor's Field Office:	No. Copies		Date Sent:	
Other:	No. Copies		Date Sent:	
Attn.:				

Please provide the undersigned a proposal for the following change in the work within thirty (30) calendar days from the above date of this request that this by the ____ day of _____, 20____. The written proposal must clearly delineate the scope of the proposed change in work by providing an itemized estimate of time and costs broken down by materials, labor (by trade), subcontracts, overhead costs, and profit. Any amount claimed for subcontracts must be similarly supported in detail. If this proposal is accepted and approved by the Owner, a change order will be issued for changes in the work of the Contract in accordance with the Contract Documents.

Type of Change Proposed:

_____ (Deletion of Work) _____ (Addition of Work) _____ (Revision of Work) _____ (Other)

Please see reverse side for a detailed description of the proposed change in Work.

DESCRIPTION OF PROPOSED CHANGE IN WORK:

ATTACHMENTS:

	Description of Item Attached	No. of Copies
1.	<hr/>	<hr/>
2.	<hr/>	<hr/>
3.	<hr/>	<hr/>
4.	<hr/>	<hr/>
5.	<hr/>	<hr/>

END OF REQUEST FOR PROPOSAL FORM

**SECTION 01 29 00
MEASUREMENT AND PAYMENT**

PART 1 GENERAL

1.01 WORK REFERS TO FDOT SPECIFICATIONS

- A. For work that refers to FDOT Specifications, measurement and payment specified in these Contract Documents, shall take precedence over the measurement and payment specified in the FDOT Specifications.

1.02 ADMINISTRATIVE SUBMITTALS

- A. Schedule of Values: Submit schedule as specified in Section 01 29 73, Schedule of Values.
- B. Schedule of Estimated Progress Payments:
 - 1. Submit with initially acceptable schedule of values in conformance with the lump sum and unit price breakdown submitted with the Bid.
 - 2. Submit adjustments thereto with Application for Payment.
- C. Application for Payment: Submit as specified in Section 01 29 75, Applications for Payment.
- D. Final Application for Payment: Submit as specified in Section 01 29 75, Applications for Payment.

1.03 MEASUREMENT—GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.
- B. Units of measure shown on the Bid Form shall be as follows unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within the limits specified or shown
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour

<u>Item</u>	<u>Method of Measurement</u>
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
LS	Lump Sum—Unit is one; no measurement will be made
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

- C. Quantities for the Lump Sum portion of the contract will be based on ground profiles shown on the drawings. Field surveys will not be made by the Owner to confirm accuracy of elevations shown for this part of the Contract.

1.04 PAYMENT

A. General:

1. Progress payments will be made monthly.
2. The date for Contractor's submission of monthly Application for Payment shall be established at the Preconstruction Conference.

- B. This Contract includes both Lump Sum and Unit Prices. Payment for all Work shown or specified in the Contract Documents is included in the Contract Price.

- C. No measurement or payment will be made for individual Lump Sum Work items. Payment for Lump Sum Work covers all Work specified or shown on the Drawings and Specifications except for those items specifically designated on the Bid Form and in this Section as Unit Price items.

- D. No Separate Payment shall be Made for the Following Work, and its Cost shall be included in appropriate payment items:

1. Trench excavation, sheeting, shoring and bracing.
2. Dewatering, stormwater runoff management, and disposal of water during construction.
3. Erosion control, protection of work, and construction of temporary structures during construction.
4. Surveys, engineering, and Record Drawings.
5. Field verifications or locating buried utilities.
6. Hauling and disposal of vegetative waste.
7. Traffic control.
8. Silt fencing and turbidity barriers.
9. Taxes, insurance, overhead, and profit.
10. All other work required and incidental to the Lump Sum portion of the Contract.

- E. Payment will Not be Made for Following:
1. Loading, hauling, and disposing of rejected material.
 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
 3. Rejected loads of material, including material rejected after it has been placed due to failure of Contractor to conform to provisions of Contract Documents.
 4. Material not unloaded from transporting vehicle.
 5. Defective Work not accepted by Owner.
 6. Material remaining on hand after completion of Work.
 7. Work not in compliance with the Drawings and/or Specifications.
- F. Payment for Unit Price Items Covers all Work Necessary to Furnish and Install the Following Items:

Item	Description
Grate for Stormwater Inlet at Trailer Staging Area	The unit price shall include furnishing and installing a grate at a stormwater inlet at the trailer staging area. The unit price for this item shall include demolition and disposal of existing material required to install the new grate. Installation shall be in accordance with the Drawing C-3.6. Payment shall be per grate installed.
Stormwater Inlet at Trailer Staging Area	The unit price shall include furnishing and installing a new stormwater inlet including pipe sections and fittings required to connect the new inlet to the existing stormwater pipe at the trailer staging area. The unit price for this item shall include demolition and disposal of existing material required to install the new inlet. Installation shall be in accordance with the Drawing C-3.6. Payment shall be per inlet installed.
Removal of Spoil with Offsite Disposal	The unit price shall include excavation, removal, and disposal of muck and other deleterious materials and backfilling with granular fill. The unit price for this item shall include off site disposal. The backfill shall be compacted and graded in accordance with Section 31 23 23, Fill and Backfill, Section 31 23 13, Subgrade Preparation and/or Section 31 23 23.15, Trench Backfill depending on applicability. Payment shall be per cubic yard of material removed and replaced.

Item	Description
Removal of Spoil with Onsite Disposal or Stockpiling	The unit price shall include excavation, removal and disposal of muck and other deleterious materials and backfilling with granular fill. The unit price for this item shall include onsite disposal or stockpiling in an area designated by the Owner within a one mile haul distance of the excavation site. The backfill shall be compacted and graded in accordance with Section 31 23 23, Fill and Backfill, Section 31 23 13, Subgrade Preparation and/or Section 31 23 23.15, Trench Backfill depending on applicability. Payment shall be per cubic yard of material removed and replaced.

1.05 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings, Submittals, or preliminary operation and maintenance manuals are acceptable to Engineer.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, which have not been incorporated in the Work, and for which partial payments have been made, shall revert to Contractor unless otherwise agreed. Amounts of payments made for items not incorporated into the work will be deducted from final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 29 73
SCHEDULE OF VALUES**

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Prepare a separate Schedule of Values for each schedule of Work under the Contract.
2. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
3. Lump Sum Work:
 - a. Reflect Schedule of Values format included in conformed Bid Form, specified allowances, alternates, and equipment selected by Owner, as applicable.
 - b. List bonds and insurance premiums, mobilization, demobilization, facility startup, and Contract Closeout separately.
 - c. Break down by Divisions 2 through 49, for each Project facility.
4. An unbalanced or front-end loaded schedule will not be acceptable.
5. The total amount for both mobilization and demobilization shall not exceed 5 percent of the Total Bid Price.
6. At least 25 percent of the mobilization and demobilization value shall be designated for demobilization.
7. The Schedule of Value shall include a line item price for Progress Schedule Updates.
8. Summation of the complete Schedule of Values representing all Work shall equal the Contract Price.
9. Submit Schedule of Values at the preconstruction meeting, and as otherwise specified or as may be requested to be submitted earlier as evidence of the apparent low Bidder's qualifications.
10. Upon request of the Engineer, support the values with data, which will substantiate their correctness including the cost of material, labor and O&P.
11. The Schedule of Values shall establish the actual value of the component parts of the Work to be completed and shall be used as the basis of the Contractor's Application for Payment.

1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. The Schedule of Values shall be typed on an 8-1/2 inch by 11-inch white paper. Standard construction forms and computer format in MS-Excel spreadsheet will be considered acceptable by the Engineer. Identify schedule with:
 - 1. Title of Project, location, Owner, Bid Number.
 - 2. Engineer and Engineer's project number.
 - 3. Name and address of Contractor.
 - 4. Date of submission.
- B. Identify each line item with the number and title of the respective major section of the Specifications.
- C. For each major line item, list sub-values of major products or operations under the item.
- D. For the Various Portions of the Work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For Items on which Progress Payments will be Requested for Stored Materials provide:
 - a. The total installed value.
 - b. Information required under Paragraph 1.03.
 - 3. Installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.
- E. The sum of all lump sum values plus all unit price values times the corresponding quantity of units to be constructed/installed shall equal the total Contract sum.

1.03 SUBSCHEDULE OF UNIT MATERIALS VALUES

- A. Submit a sub-schedule of unit costs and quantities for products on which progress payments will be requested for stored products.
- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.
- C. The unit values for the materials shall be broken down into the cost of the material, delivered and unloaded at the site, with taxes paid. Copies of paid invoices for component material shall be included with the payment request in which the material first appears.

1.04 REVIEW AND RESUBMITTAL

- A. After review by Engineer, revise, and resubmit Schedule of Values and Schedule of Unit Material Values, as required.
- B. Resubmit revised Schedules in same manner as previously submitted schedules.

1.05 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

- A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.
- B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

END OF SECTION

**SECTION 01 29 75
APPLICATIONS FOR PAYMENTS**

PART 1 GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Submit applications for payment to the Engineer in accordance with schedule established by Conditions of the Contract and Agreement between Owner and Contractor.
- B. The accepted Section 01 29 73, Schedule of Values, shall be used as the basis for the Contractor's Application for Payment.

1.02 FORMAT AND DATA REQUIRED

- A. Submit applications on electronic Payment Application Files to be provided by the County in Excel format. Example copies of the forms are provided in Supplements 1 through 5 following this Section.
- B. Provide itemized data on continuation sheets.
- C. Provide an electronic file of the approved construction progress schedule in primavera schedule software showing the work performed to the date of the Application for Payment.
- D. Contractor shall provide construction photographs in accordance with Section 01 31 13, Coordination. Submit construction photographs with each copy of Application for Payment.
- E. Contractor shall maintain an updated set of Drawings to be used as Record Drawings in accordance with Section 01 77 00, Contract Closeout. As a prerequisite for monthly progress payments, Contractor shall exhibit updated Record Drawings for review by Owner and Engineer.

1.03 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

- A. Application Form:
 - 1. Fill in required information, including that for Change Orders executed prior to date of Submittal of Application.
 - 2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.
 - 3. Execute certification with signature of a responsible officer of Contract firm.
 - 4. If applicable, submit a stored material log with each Application for Payment.

B. Continuation Sheets:

1. Fill in total list of all schedule component items or work, with item number and scheduled dollar value for each item.
2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored. Round off values to nearest dollar, or as specified for Schedule of Values.
3. List each Change Order executed prior to date of submission, at the end of the continuation sheets. List by Change Order Number and description, as for an original component item of work.
4. To receive approval for payment on component material stored onsite, submit copies of the original invoices with the Application for Payment. Provide a log sheet for all stored materials, which identifies the type, quantity, and value of all stored material.
5. The Contractor shall certify, for each current pay request, that all previous progress payments received from the Owner, under this Contract, have been applied by the Contractor to discharge in full all obligations for the Contractor in connection with Work covered by prior Applications for Payment, and all materials and equipment incorporated into the Work are free and clear of all liens, claims, security interest, and encumbrances. Contractor shall attach to each Application for Payment like affidavits by all subcontractors and suppliers. Contractor shall also attach a "Consent of Surety" to each Application for Payment. Additionally, a "Partial Release of Lien" from each subcontractor and supplier shall be attached to each Application for Payment.

1.04 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. Contractor shall submit with each Application for Payment the following information, with a cover letter identifying:
1. Project.
 2. Application number and date.
 3. Detailed list of enclosures.
 4. For Stored Products:
 - a. Item number and identification as shown on application.
 - b. Description of specific material.
 - c. Proof that stored products paid for on previous estimates have been paid for by Contractor.
- B. Submit one copy of data and cover letter for each copy of application.
- C. Contractor shall submit evidence of compliance with subconsultant requirements and conformance with General Conditions for payment of Subcontractors.

1.05 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Fill in application form as specified for progress payments. Use continuation sheet for presenting final statement of accounting to the Engineer.
- B. Final Statement of Accounting shall reflect all Adjustments to the Contract Sum:
 - 1. The original Contract Sum.
 - 2. Additions and Deductions Resulting From:
 - a. Previous Change Orders.
 - b. Authorized Allowance Adjustments.
 - c. Unit Price work final quantity adjustments.
 - d. Deductions for uncorrected Work.
 - e. Deductions for penalties and fines.
 - f. Deductions for liquidated damages.
 - g. Other adjustments.
 - 3. Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- C. Engineer will prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders, if any.
- D. The Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the General Conditions.
- E. Submit a "Consent of Surety," "Final Release of Lien," "Warranty of Title," and "Asbestos Letter" with the final Application for Payment. Additional submittal requirements are stated throughout these Contract Documents. All submittal requirements shall be complete to the satisfaction of the Engineer and Owner before the final Application for Payment will be approved.

1.06 SUBMITTAL PROCEDURE

- A. Submit applications for payment to the County at the time determined at the Preconstruction Conference.
- B. When the Engineer finds application properly completed and correct, he will transmit certificate for payment to Owner, with copy for Contractor.

1.07 SUPPLEMENTS

A. The supplements listed below, following “END OF SECTION,” are part of this Specification.

1. Supplement 1, Estimate for Progress Payment.
2. Supplement 2, Materials Stored On Site.
3. Supplement 3, Partial Waiver of Lien.
4. Supplement 4, Waiver of Lien.
5. Supplement 5, Notice of Acceptance and Recommendation for Final Payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

New Pay App Template

This document is intended to help aid in the process of completing the new Pay App spreadsheet with added programming and error checking. It will discuss the additional buttons found on the spreadsheet and explain their purpose.

Schedule of Values:

The biggest change to this sheet and the workbook in general is the button found on the “Schedule of Values” sheet that says “New” circled in red. This button will create the next Pay app moving the ‘Work Performed to Date’ quantities to the ‘Work Performed Previous’ and clear the ‘Work Performed This Payment’ fields. It will create an additional workbook and automatically name it “PR# *pr* – contract#” where *pr* is the next Pay App. It would be beneficial not to change the name that gets saved. Throughout this guide there will be further changes that come from this button that will be explained in the appropriate sections. Prior to proceeding to the next Pay App there will also be error checks, which all errors will be explained in the last section labeled “Errors:”

You will not be able to enter anything until you import from the “Import” sheet.

CONTRACT NO. _____ -
 PAY REQUEST NO. _____ 1
 FROM _____ - TO _____ -



CONTRACT QUANTITIES					WORK PERFORMED (previous payment)		WORK PERFORMED THIS (current payment)		WORK PERFORMED TO DATE (total to date)		
DESCRIPTION	QUAN	UNIT	COST PER UNIT	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	% COMP.
TOTAL COST OF COLUMNS:				\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

CHANGE ORDER _____ 01 _____ - CONTRACT QUANTITIES

CONTRACT QUANTITIES					WORK PERFORMED (previous payment)		WORK PERFORMED THIS (current payment)		WORK PERFORMED TO DATE (total to date)		
DESCRIPTION	QUAN	UNIT	COST PER UNIT	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	% COMP.
TO				\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
TOTAL COST CONTRACT TO DATE:				\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

New Line
 After entering a description, press tab to create a new line.

On the Change Orders there is only one available line to type, after entering or pressing tab an additional line will be added

At the end of the last Change Order you will see this button. When clicked it will automatically create an additional Change Order block and contain the appropriate formulas and the ‘Cover Sheet’ will also recognize this new Change Order

Import Sheet:

The “Schedule of Values” section will be locked and unable to enter anything prior to importing the items from the “Import” sheet. You may either enter the items manually, copy and paste them, or **if you have your version of schedule of values open along with this workbook then you may click Extract to pull the values automatically.** Ensure there are no empty cells prior to clicking on the ‘Import’ button. See example below to see the correct format for the entry of values.

You enter the group name and then all entries beneath that name will be part of that group. The same applies for the subgroup.

Belongs to Mobilization Group

Import

Extract <- This button is meant to extract the values from the un-official schedule of values to import directly in here

CONTRACT QUANTITIES

MAIN GROUP	SUB GROUP	ACTIVITY NO.	DESCRIPTION
MOBILIZATION/DEMOBILIZATION			Mobilization
			Demobilization
	MOBILIZATION - SUB GROUP		DIP Pipe and Fittings Approved Submittal
			Floor Grating
			Coatings Approved Submittal
PROJECT RECORD DOCUMENTS			Project Record Documents
IDEMNIFICATION			Idemnification
CLEARING AND GRUBBING			Clearing and Grubbing

After sheet is in this layout click import to transfer to schedule of

After import the Schedule of values will look like this. You do not NEED to fill in the Main Group and Sub Group columns.

Observe what is meant by main group and sub group

ACTIVITY	DESCRIPTION	QUAN	UNIT	COST PER UNIT	TOTAL COST OF ITEM	(previous payment)	
						QUAN	TOTAL COST OF ITE
MOBILIZATION/DEMOBILIZATION							
	Mobilization	1	LS	\$ 120,000.00	\$ 120,000.00		\$ -
	Demobilization	1	LS	\$ 5,000.00	\$ 5,000.00		\$ -
Mobilization - Sub Group							
	DIP Pipe and Fittings Approved Submittal	1	LS	\$ 7,500.00	\$ 7,500.00		\$ -
	Floor Grating	1	LS	\$ 3,000.00	\$ 3,000.00		\$ -
	Coatings Approved Submittal	1	LS	\$ 2,500.00	\$ 2,500.00		\$ -
PROJECT RECORD DOCUMENTS							
	Project Record Documents	1	LS	\$ 35,000.00	\$ 35,000.00		\$ -
IDEMNIFICATION							
	Idemnification	1	LS	\$ 100.00	\$ 100.00		\$ -
CLEARING AND GRUBBING							
	Clearing and Grubbing	1	LS	\$ 15,000.00	\$ 15,000.00		\$ -
EARTHWORK AND GRADING							
	Install 5' Berm for Retention Pond	1	LS	\$ 35,000.00	\$ 35,000.00		\$ -
	Dig Spreader Swale for Overflow Weir	1	LS	\$ 8,000.00	\$ 8,000.00		\$ -
	Install Rip Rap for Overflow Weir	1	LS	\$ 2,000.00	\$ 2,000.00		\$ -
	Final Grading Site	1	LS	\$ 8,500.00	\$ 8,500.00		\$ -
PUMP STATION STRUCTURE							
	Form and Pour Pipe Supports	1	LS	\$ 20,000.00	\$ 20,000.00		\$ -
	Form and Pour Pipe Trench	1	LS	\$ 35,000.00	\$ 35,000.00		\$ -
	Form and Pour Continuous Footing	1	LS	\$ 50,000.00	\$ 50,000.00		\$ -
	Form and Pour Slab on Grade	1	LS	\$ 75,000.00	\$ 75,000.00		\$ -
	Install Masonry to First Tie Beam	1	LS	\$ 20,000.00	\$ 20,000.00		\$ -
	Form and Pour First Tie Beam	1	LS	\$ 20,000.00	\$ 20,000.00		\$ -

Notes:

For the easiest and quickest method, you just need to have your version of the schedule of values and this workbook open and then click the 'Extract' button near the top of the sheet.

NO.	DESCRIPTION OF WORK	Unit	Qty	Price
1	Mobilization/Demobilization			
	Mobilization	LS	1	\$120,000.00
	Demobilization	LS	1	\$5,000.00
	SCADA Approved Submittal	LS	1	\$10,000.00
	DIP Pipe and Fittings Approved Submittal	LS	1	\$7,500.00
	Floor Grating	LS	1	\$3,000.00

Example of 'Un – official workbook, when both workbooks are open and you click on the 'Extract' button all of this information gets imported directly into the import sheet in the correct format.

Most of the error messages will appear after attempting to click “New” found on the “Schedule of Values” sheet, if there are still errors on some of the sheets.

Draw Schedule Errors:

Microsoft Excel

You must fill in an actuals value for this current pay app

Pay App: 1

OK

PAY REQUEST #	PERIOD FROM (Date)	PERIOD TO (Date)	ACTUALS (Previous Paid / Approved Pay Request Balance Due)	ESTIMATED DRAWS (Estimated Total Work Performed + Estimated Stored Materials + Retainage)
1				

After clicking the 'New' button in the 'Schedule of Values' tab you will receive this error message if both the 'Actuals' and 'Estimated Draws' fields are left blank for the current Pay App. Simply enter a value to correct this.

Import Sheet Errors:

Microsoft Excel

Could not complete import because certain cells are blank

Please fix cells in red

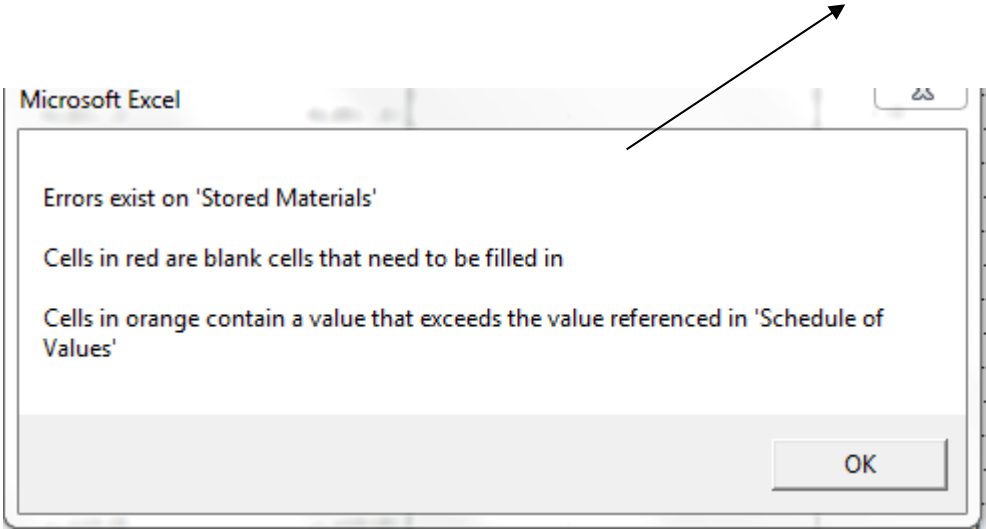
OK

DESCRIPTION	QUANTITY	UNIT	PRICE
1 PIPE	1 LF	\$	100.00
Q			

If you leave any blank cells in between the first row and the last entered item you will receive this error. If the last entered item is an accident, for example the “Q” on row three, then proceed to delete it and ignore the red cells, as long as each row is entered completely when you click the button “Import” all items will be directly entered into the Schedule of Values.

Stored Materials Errors:

After clicking on the “New” button on the “Schedule of Values” sheet, this error message will appear if there are the following errors found on the “Stored Materials” sheet.



ITEM NO.	DESCRIPTION	SOV ACTIVITY NO.	VALUE OF STORED MATERIAL LAST PERIOD		
			QUAN.	UNIT PRICE	INVOICE AMOUNT
1	30" SDR 21 CL200 GREEN PIPE	7	1	\$ 100.00	\$ 100.00
2	30" SDR 21 CL200 GREEN PIPE	7		\$ 75.11	\$ -
3	30" SDR 21 CL200 GREEN PIPE	7		\$ 75.11	\$ -
4	30" SDR 21 CL200 GREEN PIPE	7		\$ 75.11	\$ -
5	10 GA COPPER WIRE SOLID GREEN 500'			\$ 0.26	\$ -
6	LOCKING NYLON ZIPTIES 48"	7			\$ -
7	30" BELL RESTRAINT BELL X SPIGOT	7		\$ 332.30	\$ -
8	30" MJ 22 1/2 BEND C153 PR401 DI	7		\$ 1,819.29	\$ -
9	30" MJ 11 1/4 BEND C153 PR401 DI	7		\$ 1,844.46	\$ -
10	30" MJ 5 5/8 BEND C153 PR401	7		\$ 2,522.28	\$ -
11	30" X 16" MJ REDUCER P401 DI C153	7		\$ 1,760.82	\$ -

This error marks these cells in orange because SOV Act. # 7 is found in the 'Schedule of Values' tab. However, the total amount found on this sheet is \$100 while the total found on the 'Schedule of Values' is \$50. The total value for the same SOV Act.# on this sheet can not surpass the total on the 'Schedule of Values'.

The cells in red are just blank cells that need to be filled in to obtain accurate information



CONTRACT NO.:

PROJECT:

CONTRACTOR:

CONTRACTOR ADDRESS:

PROJECT NO:

DATE: **8/22/2019**

FINAL COMPLETION DATE:

NTP DATE:

ESTIMATE NO: **1**

FOR PERIOD FROM:

PERIOD TO:

CONTRACT CHANGE ORDER				
NO.	DATE	DESCRIPTION (DO NOT INCLUDE UNTIL BOARD OF COUNTY COMMISSIONERS APPROVES)	COST OF ITEMS ADDED BY C.O.	COST OF ITEMS DELETED BY C.O.
			\$ -	\$ -

ANALYSIS OF ADJUSTED CONTRACT AMOUNT TO DATE

A. ORIGINAL CONTRACT AMOUNT	\$ -
B. PLUS: ADDITIONS SCHEDULED IN COLUMN ABOVE	\$ -
C. LESS: DEDUCTIONS SCHEDULED IN COLUMN ABOVE	\$ -
D. ADJUSTED CONTRACT AMOUNT TO DATE	\$ -

ANALYSIS OF WORK PERFORMED

A. COST OF ORIGINAL CONTRACT WORK PERFORMED TO DATE	\$ -
B. EXTRA WORK PERFORMED TO DATE	\$ -
C. TOTAL COST OF WORK PERFORMED TO DATE	\$ -
D. LESS: AMOUNT RETAINED <u>10%</u> TOTAL CONTRACT WORK	\$ -
E. NET AMOUNT EARNED ON CONTRACT WORK TO DATE	\$ -
F. ADD: MATERIALS STORED AT CLOSE OF PERIO <u>90%</u> OF <u>\$0.00</u>	\$ -
G. SUBTOTAL OF E. AND F.	\$ -
H. LESS AMOUNT OF PREVIOUS ESTIMATES FOR PAYMENT	\$ -
I. BALANCE DUE THIS PAYMENT	\$ -

I certify that all work and /or materials under the contract has been inspected by me and that it has been performed and/or supplied in full accordance with the requirements of the contract. _____ UTILITIES INSPECTOR DATE

CERTIFICATION OF CONTRACTOR

According to the best of my knowledge and belief, I certify that all items and amounts shown on the face of this Periodic Estimate for Partial Payment are correct; that all work has been performed and/or material supplied in full accordance with the requirements of the referenced Contract, and/or duly authorized deviations, substitutions, alterations, and/or additions; that the foregoing is a true and correct statement of the contract account up to and including the last day of the period covered by this Periodic Estimate; that no part of the "Balance Due This Payment" has been received, and that the undersigned and his subcontractors have - (check applicable line)

- a. Complied with all the labor provisions of said contract.
- b. Complied with all the labor provisions of said contract except in those instances where an honest dispute exists with respect to said labor provisions. (If (b) is checked, describe briefly the nature of the dispute.)

(CONTRACTOR & NAME OF AUTHORIZED REPRESENTATIVE) DATE

(SIGNATURE of AUTHORIZED REPRESENTATIVE) TITLE

CERTIFICATION OF ORANGE COUNTY UTILITIES CONSTRUCTION

I certify that I have checked and verified the above and foregoing Periodic Estimate for Partial Payment; that to the best of my knowledge and belief it is a true and correct statement of work performed and/or material supplied by the contractor; that all work and/or material included in this Periodic Estimate has been inspected by me and/or my duly authorized representative or assistants and supplied in full accordance with requirements of the referenced contract; and that partial payment claimed and requested by the contractor is correctly computed on the basis of work performed and/or material supplied to date.

SIGNEE _____ APPROVED: _____
(CHIEF INSPECTOR) (MANAGER UTILITIES DEPARTMENT)

DATE: _____ DATE: _____

APPROVED: _____ DATE: _____

SCHEDULE OF VALUES

PROJECT NAME: _____
 CONTRACTOR NAME: _____
 PROJECT NO. _____

CONTRACT NO. _____
 PAY REQUEST NO. **1**
 FROM _____ TO _____

CONTRACT QUANTITIES						WORK PERFORMED (previous payment)		WORK PERFORMED THIS (current payment)		WORK PERFORMED TO DATE (total to date)		
ACTIVITY NO.	DESCRIPTION	QUAN	UNIT	COST PER UNIT	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	% COMP.
					\$ -		\$ -		\$ -		\$ -	
TOTAL COST OF COLUMNS:					\$ -		\$ -		\$ -		\$ -	

CHANGE ORDER ____01____ - CONTRACT QUANTITIES						WORK PERFORMED (previous payment)		WORK PERFORMED THIS (current payment)		WORK PERFORMED TO DATE (total to date)		
ACTIVITY NO.	DESCRIPTION	QUAN	UNIT	COST PER UNIT	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	QUAN	TOTAL COST OF ITEM	% COMP.
					\$ -		\$ -		\$ -		\$ -	
TOTAL COST OF COLUMNS:					\$ -		\$ -		\$ -		\$ -	

	TOTAL COST OF SCHEDULE OF VALUES:	\$ -		\$ -		\$ -		\$ -		\$ -
	TOTAL COST OF CHANGE ORDERS:	\$ -		\$ -		\$ -		\$ -		\$ -
	TOTAL COST CONTRACT TO DATE:	\$ -		\$ -		\$ -		\$ -		\$ -

MATERIALS STORED ON SITE

PROJECT: _____ - _____ - _____ PAY REQUEST NO: 1

CONTRACTOR: _____ FOR PERIOD ENDING: _____ DATE PREPARED: 8/22/2019

ITEM NO.	DESCRIPTION	SOV ACTIVITY NO.	VALUE OF STORED MATERIAL LAST PERIOD			(-) VALUE OF MATERIAL INSTALLED			(+) VALUE OF MATERIAL DELIVERED			(=) VALUE OF STORED MATERIAL THIS PERIOD			VENDOR INVOICE NUMBER
			QUAN.	UNIT PRICE	INVOICE AMOUNT	QUAN.	UNIT PRICE	INVOICE AMOUNT	QUAN.	UNIT PRICE	INVOICE AMOUNT	QUAN.	UNIT PRICE	INVOICE AMOUNT	
1				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
2				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
3				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
4				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
5				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
6				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
7				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
8				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
9				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
10				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
11				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
12				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
13				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
14				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
15				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
16				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
17				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
18				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
19				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
20				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
21				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
22				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
23				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
24				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
25				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
26				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
27				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
28				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
29				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
30				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
31				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
32				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
33				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
34				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
35				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
36				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
37				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
38				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
39				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
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41				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
42				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
43				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
44				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
45				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
46				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
47				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
48				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
49				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
50				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
51				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	
52				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -	

MATERIALS STORED ON SITE

PROJECT: _____ - _____ PAY REQUEST NO: 1

CONTRACTOR: _____ FOR PERIOD ENDING: _____ DATE PREPARED: 8/22/2019

ITEM NO.	DESCRIPTION	SOV ACTIVITY NO.	VALUE OF STORED MATERIAL LAST PERIOD			(-) VALUE OF MATERIAL INSTALLED			(+) VALUE OF MATERIAL DELIVERED			(=) VALUE OF STORED MATERIAL THIS PERIOD			VENDOR INVOICE NUMBER		
			QUAN.	UNIT PRICE	INVOICE AMOUNT	QUAN.	UNIT PRICE	INVOICE AMOUNT	QUAN.	UNIT PRICE	INVOICE AMOUNT	QUAN.	UNIT PRICE	INVOICE AMOUNT			
53				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
54				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
55				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
56				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
57				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
58				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
59				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
60				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
61				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
62				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
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64				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
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66				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
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70				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
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81				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
TOTALS:				\$ -	\$ -		\$ -	\$ -		\$ -	\$ -		\$ -	\$ -			
													Sales Tax	\$ -			
													Total Dollar Amount of Stored Materials including sales tax is:			\$ -	

DRAW SCHEDULE

PROJECT NAME: - _____
 CONTRACTOR NAME: - _____
 CONTRACT NO.: - _____
 PROJECT NO. - _____
 CONTRACT AMOUNT: \$ - _____

PAY REQUEST NO. **1**
 FOR PERIOD ENDING: -

PAY REQUEST #	PERIOD FROM (Date)	PERIOD TO (Date)	ACTUALS (Previous Paid / Approved Pay Request Balance Due)	ESTIMATED DRAWS (Estimated Total Work Performed + Estimated Stored Materials + Retainage)	BALANCE TO FINISH
1					
2					
3					
4					
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47					
48					

RELEASE OF LIENS

PROJECT: _____

CONTRACT: - _____ PAY REQUEST NO: 1 _____

CONTRACTOR: _____

FOR PERIOD ENDING: - _____ DATE PREPARED: 8/22/2019 _____

NO.	SUBCONTRACTORS/SUPPLIERS/LIENORS (Maintain running list of Subcontractors, Vendors, Suppliers, etc. for entire project) (Company Name)	NOTICE TO OWNER (Date if provided to Contractor / OCU) (Date)	FINAL RELEASE OF LIENS (Date provided to Contractor. Provide additional copy for Final PR) (Date)	NOTICE OF NONPAYMENT RECEIVED (Date)	DESCRIPTION OF WORK (Trade & Type of Work performed this pay period) (Trade, Type, Description)	SOV ACTIVITY NO. (Work performed this Pay Period) (Activity ID)	Partial Release of Lien (Included for Work Performed During Previous Pay Period) (Yes or Blank)
1							
2							
3							
4							
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6							
7							
8							
9							
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RELEASE OF LIENS

PROJECT: _____

CONTRACT: - _____ PAY REQUEST NO: 1 _____

CONTRACTOR: _____

FOR PERIOD ENDING: - _____ DATE PREPARED: 8/22/2019 _____

NO.	SUBCONTRACTORS/SUPPLIERS/LIENORS (Maintain running list of Subcontractors, Vendors, Suppliers, etc. for entire project)	NOTICE TO OWNER (Date if provided to Contractor / OCU)	FINAL RELEASE OF LIENS (Date provided to Contractor. Provide additional copy for Final PR)	NOTICE OF NONPAYMENT RECEIVED	DESCRIPTION OF WORK (Trade & Type of Work performed this pay period)	SOV ACTIVITY NO. (Work performed this Pay Period)	Partial Release of Lien (Included for Work Performed During Previous Pay Period)
31							
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RELEASE OF LIENS

PROJECT: _____

CONTRACT: - _____ PAY REQUEST NO: 1 _____

CONTRACTOR: _____

FOR PERIOD ENDING: - _____ DATE PREPARED: 8/22/2019

NO.	SUBCONTRACTORS/SUPPLIERS/LIENORS (Maintain running list of Subcontractors, Vendors, Suppliers, etc. for entire project)	NOTICE TO OWNER (Date if provided to Contractor / OCU)	FINAL RELEASE OF LIENS (Date provided to Contractor. Provide additional copy for Final PR)	NOTICE OF NONPAYMENT RECEIVED	DESCRIPTION OF WORK (Trade & Type of Work performed this pay period)	SOV ACTIVITY NO. (Work performed this Pay Period)	Partial Release of Lien (Included for Work Performed During Previous Pay Period)
62							
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RELEASE OF LIENS

PROJECT: _____

CONTRACT: - _____ PAY REQUEST NO: 1 _____

CONTRACTOR: _____

FOR PERIOD ENDING: - _____ DATE PREPARED: 8/22/2019 _____

NO.	SUBCONTRACTORS/SUPPLIERS/LIENORS (Maintain running list of Subcontractors, Vendors, Suppliers, etc. for entire project)	NOTICE TO OWNER (Date if provided to Contractor / OCU)	FINAL RELEASE OF LIENS (Date provided to Contractor. Provide additional copy for Final PR)	NOTICE OF NONPAYMENT RECEIVED	DESCRIPTION OF WORK (Trade & Type of Work performed this pay period)	SOV ACTIVITY NO. (Work performed this Pay Period)	Partial Release of Lien (Included for Work Performed During Previous Pay Period)
93							
94							
95							
96							
97							
98							
99							
100							
101							
102							
103							
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123							

RELEASE OF LIENS

PROJECT: _____

CONTRACT: - _____ PAY REQUEST NO: 1 _____

CONTRACTOR: _____

FOR PERIOD ENDING: - _____ DATE PREPARED: 8/22/2019

NO.	SUBCONTRACTORS/SUPPLIERS/LIENORS (Maintain running list of Subcontractors, Vendors, Suppliers, etc. for entire project)	NOTICE TO OWNER (Date if provided to Contractor / OCU)	FINAL RELEASE OF LIENS (Date provided to Contractor. Provide additional copy for Final PR)	NOTICE OF NONPAYMENT RECEIVED	DESCRIPTION OF WORK (Trade & Type of Work performed this pay period)	SOV ACTIVITY NO. (Work performed this Pay Period)	Partial Release of Lien (Included for Work Performed During Previous Pay Period)
124							
125							
126							
127							
128							
129							
130							
131							
132							
133							
134							

[Word Document Guide](#)

Help on how to use this document

Partial Pay Request

Copies of all the following shall be in each copy of the pay request.

- 1 Pay Request Cover Page
- 2 Schedule of Values
- 3 Letter from Surety
- 4 Power of Attorney
- 5 Stored Materials with Invoices
- 6 Updated Draw Schedule each month
- 7 Updated Release of Liens Listing
Partial Release of Liens (starting with second Pay
8 Request)
- 9 Critical Path Method Schedule Update
- 10 Copy of all active Insurance Policies
Deflection Table (Hard Copy & Digital) as
11 applicable
- 12 Asset Table (Hard Copy & Digital)
- 13 Updated Monthly Contractor / Surveyor Asbuilts

1 PAY REQUEST COVER PAGE	Signed with the current date. Any revisions shall be resigned and re-dated.
--------------------------	---

2 SCHEDULE OF VALUES

3 LETTER FROM SURETY

Provide at least one original

4 Power of Attorney

6 DRAW SCHEDULE TAB	This shall be updated and provided for all pay requests beginning October 1, 2014
Estimated Draws (Balance Due)	draw includes the estimated Total Work Completed, Stored Materials and Retainage for that period and provide a projection for the entire project duration. Include the current pay request being submitted "amount due" in this column. Leave row blank if the pay request had been previously approved and paid. The last estimated draw for the final pay request is the final release of retainage.
Actuals (Previously Paid Balance Due)	Only Include actual "Balance Due to Contractor" from previously accepted partial pay requests. Include the current pay request balance due on the estimated draws column.

PARTIAL WAIVER OF LIEN

To All Whom It May Concern:

WHEREAS, the undersigned has been employed by (A) _____

to furnish labor and materials for (B) _____ work,

under a contract (C) _____

for the improvement of the premises described as (D) _____

in the _____ (City-Village) of _____

County of _____, State of _____

of which _____

is the Owner.

NOW, THEREFORE, this _____ day of _____, 20 _____

for and in consideration of the sum of (E) _____

Dollars paid simultaneously herewith, the receipt whereof is hereby acknowledged by the undersigned, the undersigned does hereby waive and release to the extent only of the aforesaid amount, any lien rights to, or claim of lien with respect to and on said above-described premises, and the improvements thereon, and on the monies or other considerations due or to become due from the owner by virtue of said contract, on account of labor, services, materials, fixtures, apparatus or machinery heretofore or which may hereafter be furnished by the undersigned to or for the above-described premises, but only to the extent of the payment aforesaid.

(F) _____ (SEAL)
(Name of Sole Ownership, Corporation or Partnership)

(Affix corporate seal here) _____ (SEAL)
(Signature of Authorized Representative)

TITLE: _____

INSTRUCTIONS FOR PARTIAL WAIVER

- (A) Name of person or firm with whom you agreed to furnish either labor, or services, or materials, or both.
- (B) Fill in nature and extent of work; strike the word labor or the word materials if not in your contract.
- (C) If you have more than one contract on the same premises, describe the contract by number if available, date and extent of work.
- (D) Furnish an accurate enough description of the improvement and location of the premises so that it can be distinguished from any other property.
- (E) Amount shown should be the amount actually received on that date.
- (F) If waiver is for a corporation, corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself as partner.

**WAIVER OF LIEN
(Materials, Supplies, Equipment, Subcontractors)**

STATE OF: _____)
) SS
COUNTY OF: _____)

_____, of _____
(SUBCONTRACTOR/SUPPLIER)

being first duly sworn, on oath deposes and says he is the _____ of
(TITLE)

_____ (hereinafter referred to as the "Company"), and is familiar
(PERSON, FIRM OR CORP, FURNISHING WORK OR MATERIAL)

with the facts herein stated: that said Company at the order or instance of _____
(PRIME CONTRACTOR)

has performed work or labor or furnished material or equipment for use in the construction of _____

_____ being constructed for _____
(DESCRIPTION OF PROJECT) (NAME OF OWNER OF PROJECT)

_____ at _____
(LOCATION)

in accordance with a contract with _____ dated _____ 20 ____
(PRIME CONTRACTOR)

that said Company has been paid in full for all said work, labor, material, machinery and equipment furnished by it or by its subcontractors or materialmen for the work under the above order and has likewise paid all its subcontractors and materialmen; that said Company hereby waives all liens and claims

against _____ and _____
(NAME OF OWNER) (PRIME CONTRACTOR)

for this work, and further he represents that to the best of his knowledge no other person or party has any right to a lien on account of any work performed for or material furnished to said Company. Company shall indemnify CH2M HILL and the Project Owner against claims or liens (including attorney's fees and expenses of litigation) made against CH2M HILL or the Project Owner by any of the Company's suppliers, vendors, subcontractors or employees for unpaid work or materials supplied to the Company.

(SIGNATURE)

Sworn to before me and subscribed in my presence this _____ day of _____ 20 ____

(NOTARY SEAL)

(NOTARY PUBLIC)

**NOTICE OF ACCEPTANCE AND
RECOMMENDATION FOR FINAL PAYMENT**

TO OWNER:

TO CONTRACTOR:

PROJECT:

PROJECT NO:

Notice is hereby given that, to the best of our knowledge, all work on the subject project is complete and acceptable and Contractor's other obligations have been fulfilled. We therefore recommend acceptance of the work and final payment to the Contractor, subject to and in compliance with the Contract Documents.

CH2M/G&R

Engineer:

Engineer

Date

It is understood that the making and acceptance of final payment constitutes a waiver on the part of both the Owner and Contractor of all claims against each other in accordance with the Contract Documents.

Owner:

Authorized Signature

Title

Date

Contractor:

Authorized Signature

Title

Date

Approval of this *Notice Of Acceptance and Recommendation for Final Payment* by the Orange County Board of County Commissioners shall constitute Certification of Final Completion per Part F, Articles 2 and 19 of the Contract Documents.

**SECTION 01 31 13
COORDINATION**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Electronic Media Release Form.
- B. Contractor's Affidavit Verifying Accuracy of Drawings and Specifications.

1.02 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor shall be responsible to provide all labor, materials, tools and other incidentals to perform and complete the entire Work required by the General Conditions, Plans, Detailed Drawings, Technical Specifications and Contract Documents from the date of the Notice to Proceed (NTP) until the date of Final Completion and acceptance by the Owner, as evidenced by approval of the Completion Certificate by the Owner. The Contractor shall be responsible for removals, renewals, and replacements due to action of the elements and all other causes except as otherwise provided in the Plans and Specifications. The Contractor shall have full custody of the project site and responsibility to protect the Work within the construction limit lines at all times and make all precautionary measures to protect the construction site and materials installed from damage.
- B. The Contractor shall have full responsibility to ensure that the Work is properly supervised, performed according to the Contract Documents and carried on faithfully and efficiently within the allocated Contract Time. The Contractor shall supervise the Work personally and shall have a qualified and competent English-speaking Superintendent with experience in landfill liner construction who shall be on the Project site at all working hours, and who shall be clothed with full authority by the Contractor to direct the performance of the work and make arrangement for all necessary materials, equipment and labor without delay.
- C. Renewals or repairs necessitated because of defective materials or workmanship, or due to action of the elements or other natural causes, including fire, flood, run-off, erosion, washouts and standing water prior to the acceptance by the Owner, as determined by the Completion Certificate, shall be done in accordance with the Contract Documents at the expense of the Contractor.

1.03 CONTRACTOR TO CHECK AND VERIFY DRAWINGS AND DATA

- A. The Contractor shall verify all site conditions, dimensions, quantities and details shown on the Drawings, Supplementary Drawings, Schedules, Specifications or other data received from the Engineer, and shall notify Engineer of all errors, omissions, conflicts, and discrepancies found therein. Contractor shall complete and certify the Contractor Verification Form attached to this section at the pre-construction meeting.
- B. Prior to Bidding the Contractor shall visit the project site and conduct any testing, surveying and measurement as may be necessary to verify the site conditions are as depicted on the plans.
- C. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction or improper operation resulting therefrom nor from rectifying such conditions at Contractor's own expense. Contractor will not be allowed to take advantage of any errors, or omissions, as full instructions will be furnished by the Engineer, should such errors or omissions be discovered.
- D. All schedules listed elsewhere within the Contract Documents are given for the convenience of the Owner, Engineer and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for making estimates of the size, kind, quantity and quality of materials and equipment included in Work to be done under the Contract.

1.04 PERSONNEL AND EQUIPMENT

- A. The Contractor shall furnish personnel and equipment which will be efficient, in good working condition, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will ensure the completion of the work within the contract time as stipulated in these Specifications.
- B. Submittal: Statement of Qualification (SOQ) for land surveyor, project engineer, Site Safety Officer, Contractor's Superintendent, specialty subcontractor site supervisors, and other SOQ required by the Specifications shall be submitted prior to starting work. Qualification documents for the Superintendent submitted as part of the Bid processing do not need to be resubmitted.
- C. If as a condition of the Bid, the Contractor was qualified for this project based on information and resume of Contractor's proposed staff (site superintendent or project manager) for this Project, Contractor is not allowed to change those members of his organization without advance notification to the Owner and Engineer, and prior written Owner's approval of an equally or more qualified replacement.

- D. Owner reserves the right to reject any of Contractor's staff from this project and request that they be transferred from this Project.

1.05 CONTRACTOR'S USE OF PROJECT SITE

- A. The Contractor shall not enter or occupy land outside of the project site, except by prior permission of the Owner. Contractor shall provide Owner a written request for such permission.
- B. Other work may be anticipated to be performed within the designated project limit lines by others prior to, during, and in sequence with scheduled performance of Work under these Contract Documents.

1.06 CLAIMS FOR PROPERTY DAMAGES

- A. In the event of any indirect or direct damaged to public or private property caused in whole or in part by an act, omission or negligence on the part of the Contractor, and Subcontractor, any Subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable, the Contractor shall at his own expense and cost promptly remedy and restore such property to a condition equal to or better than that existing before such damage was done. The Contractor shall perform such restoration by under-pinning, repairing, rebuilding, replanting, or otherwise restoring as may be required or directed by the Engineer or Owner; or shall make good such damage in a satisfactory and acceptable manner to the Owner.

1.07 SEQUENCE OF WORK

- A. Include the Milestones and sequences of work specified herein as a part of the progress schedule required under Section 01 32 00, Progress Schedules.
- B. The Contractor shall provide all labor, material and equipment to substantially complete the construction activities as described in Section 01 11 00, Summary of Work and as required by the Drawings, Specifications and Contract Documents.
- C. Substantial Completion and Final Completion shall be as defined in the Contract. Substantial Completion and Final Completion dates shall be as stated in the Contract.
- D. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.
- E. Coordinate proposed Work with the Engineer and facility operations personnel before effecting unit shutdowns. Under no circumstances cease Work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process, in which case, remain onsite until necessary repairs are complete.

1.08 PUBLIC UTILITY INSTALLATIONS AND STRUCTURES:

- A. Public utility installations and structures understood to include all poles, tracks, pipes, wires, conduits, service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto whether owned or controlled by the Owner, other governmental bodies or privately owned by individuals, firms or corporations.
- B. The Contractor shall protect all Owner and utility installations and structures from damage during the Work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the Engineer. The Contractor shall so arrange his operations as to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing installations and public utilities damaged by the contractor which are shown on the Drawings or have been located in the field by the utility shall be repaired by the Contractor, at his expense, as directed by the Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.
- C. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as a part of the general cost of doing the work and shall be included in the prices bid for the various contract items. No separate payment shall be made thereof.
- D. Where public utility installations or structure owned or controlled by the Owner or other governmental bodies are encountered during the course of the work, and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the Engineer, removal, relocations, replacement or rebuilding is necessary to complete the work under this Contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the Engineer, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement.
- E. The Contractor shall, at all times in performance of the Work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of public utility installations and structures; and shall, at all times in the performance of the Work, avoid unnecessary interference with, or interruption of, public utility services, and shall cooperate fully with the owners thereof to that end.

- F. The Owner's and other governmental utility departments and other owners of public utilities which may be affected by the Work will be informed in writing by the Contractor within two weeks after the execution of the Contract or Contracts covering the Work. Such notice will set out, in general, and direct attention to, the responsibilities of the Owner and other governmental utility departments and other owners of public utilities for such installations and structures as may be affected by the Work and will be accompanied by one set of Drawings and Specifications covering the work under such Contract or Contracts.
- G. The maintenance, repair, removal, relocation or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the Engineer.

1.09 DRAWINGS AND SPECIFICATIONS

- A. Drawings:
 - 1. The Drawings referred to in the Contract Documents bear the general project name and number as shown in the Notice to Bidders (Advertisement). When obtaining data and information from the Drawings, figured dimensions shall be used in preference of scaled dimensions, and large-scale Drawings in preference to small scale Drawings. Contractor is to verify dimensions and is notified that copying and reproduction may reduce or skew the scaled Drawings.
 - 2. Electronic copies of Drawings in pdf may also be distributed to bidders. Contractor is to verify dimensions and is notified that electronic file copying, printer settings and reproduction may reduce or skew the scaled Drawings.

1.10 DRAWINGS AND SPECIFICATIONS FURNISHED TO CONTRACTOR FOR CONSTRUCTION

- A. After the Owner has executed the Contract, the Contractor shall be furnished with six half size sets of Drawings, six full size sets of Drawings, and twelve copies of Specifications. Additional copies of the Drawings and Specifications, when requested, may be furnished to the Contractor at the cost of reproduction.
- B. Contractor will be supplied with a computer disk copy of the conformed construction drawings in PDF and AutoCAD and/or MicroStation format. Contractor must sign the Engineer's Electronic Media Release Form attached to this Specification section to receive the electronic documents. The electronic files are to be used by the Contractor for preparation and submittal of record documents.

- C. The Contractor shall furnish each of the subcontractors, manufacturers, and material suppliers such copies of the Contract Documents as may be required for their work.
- D. Supplementary Drawings:
 - 1. When, in the opinion of the Engineer or Owner, it becomes necessary to explain more fully the work to be done, to illustrate the work further or to show any changes that may be required, additional Drawings known as Supplementary Drawings, with Specifications pertaining thereto, will be prepared by the Engineer and paper prints will be given to the Contractor.
 - 2. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of work, credit to the Owner or compensation to the Contractor shall be subject to the terms of the Contract Documents.

1.11 MATERIALS AND EQUIPMENT

- A. Manufacturer:
 - 1. The names of proposed manufacturers, material suppliers, and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be submitted to the Engineer for approval, as early as possible, to afford proper investigation and checking. Such approval must be obtained before Shop Drawings will be checked. No manufacturer will be approved for any materials to be furnished under this Contract unless the manufacturer is of good reputation and has a plant of ample capacity. He shall, upon the request of the Engineer, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.
 - 2. All transactions with the manufacturers or subcontractors shall be through the Contractor. Any two or more pieces of material or equipment of the same kind, type or classification, and being used for identical types of service, shall be made by the same manufacturer.
- B. Delivery: The Contractor shall coordinate the delivery of materials in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Subcontractor.

C. Tools and Accessories:

1. The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind or size of equipment, one complete set of suitably marked high grade special tools and appliances which may be needed to adjust, operate, maintain or repair the equipment. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys. Spare parts shall be furnished as specified.
2. Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight and principal rating data.

D. Installation of Equipment:

1. The Contractor shall have on hand sufficient and proper equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character.
2. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings, unless directed otherwise by the Engineer during installation. All equipment shall be correctly aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.
3. The Contractor shall furnish, install and protect all necessary anchor and attachment bolts and all other appurtenances needed for the installation of the devices included in the equipment specified. Anchor bolts shall be as approved by the Engineer and made of ample size and strength for the purpose intended. Substantial templates and working drawings for installation shall be furnished.

- E. Service of Manufacturer's Engineer: The Contract prices for equipment shall include the cost of furnishing a competent and experienced engineer or superintendent who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test and place in operation the equipment in conformity with the Contract Documents. After the equipment is placed in permanent operation for the Owner, such engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that such equipment is proper and satisfactory operating condition and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

1.12 OWNER FACILITIES

- A. Contractor shall not create a public nuisance including, but not limited to, encroachment on adjacent lands, road closure without the Owner's prior approval, prevention of the Owner from performing normal operations at the landfill, littering along the main Site access road and/or outside of the construction limits.
- B. The Contractor shall be responsible for any encroachments on rights-of-way or property of the public or adjoining property owners and shall hold the Owner and Engineer and Consultant(s) harmless because of any encroachments which may be a result of his lack of proper layout or project execution. In this regard, he shall, without extra cost to the Owner, remove any work or that portion of any work that encroaches on the property of others or that is built beyond legal building or setback limits, and he shall rebuild the affected work or portion of work at the proper location and in full compliance with the Contract Documents.
- C. Operation of Existing Facilities:
 - 1. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
 - 2. Do not proceed with Work affecting a facility's operation and roads without obtaining Owner's advance approval of the need for and duration of such Work.
 - 3. Provide 7 days' advance request for approval to Owner of need to shut down a process or facility or reroute traffic.
- D. Relocation of Existing Facilities:
 - 1. During construction, it is expected that minor relocations of Work will be necessary.
 - 2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
 - 3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
 - 4. Perform relocations to minimize downtime of existing facilities.
 - 5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.13 TEMPORARY STRUCTURES

- A. Temporary Fences and Railing: If, during the course of the work, it is necessary to remove or disturb any fence, railing, or part thereof, the Contractor shall provide a suitable temporary fence at his own expenses, which shall be maintained until the permanent fence is replaced. The Owner shall be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.
- B. Responsibility for Temporary Structures: In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and save harmless the Owner and the Engineer from all claims, lawsuits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.14 PHYSICAL CONDITIONS

- A. Exercise reasonable care to verify locations of existing subsurface structures and underground facilities.
- B. Thoroughly check immediate and adjacent areas subject to excavation by visual examination (and by electronic metal and pipe detection equipment, as necessary) for indications of subsurface structures and Underground Facilities.
- C. Make exploratory excavations where existing underground facilities or structures may potentially conflict with proposed underground facilities or structures.
- D. Conduct exploratory excavations in presence of Resident Project Representative (RPR) and sufficiently ahead of construction to avoid possible delays to Contractor's Work.

1.15 ADJACENT STRUCTURES AND LANDSCAPING

- A. Responsibility: The Contractor shall also be entirely responsible and liable for all damage or injury as a result of his operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the Work. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the Work, whether or not shown on the Drawings, and the reconstruction of such items called for on the Drawings or specified shall be included in the various Contract Items and no separate payments will be made therefor.

1.16 PROTECTION OF WORK AND PUBLIC

- A. Barriers and Lights: During the prosecution of the work, the Contractor shall put up and maintain at all times such barriers and lights as will effectually prevent accidents. The Contractor shall provide suitable barricades, red lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the work causes obstructions to the normal traffic or constitutes in any way a hazard to the public.
- B. Smoke Prevention: The Contractor shall follow strict compliance with ordinances regulating the production and emission of smoke.
- C. Noise: The Contractor shall strictly observe all local regulations and ordinances covering noise control.
- D. Dust Prevention: The Contractor shall prevent dust nuisance from his operations by keeping the roads and the construction areas sprinkled with water at least once per day, or more often as may be required.
- E. Erosion Control:
 - 1. The Contractor shall provide all labor, materials and equipment to protect the Work throughout the construction period from erosion, and repair all erosions, washouts and other repairs at no cost to the Owner.
 - 2. The cost to the Contractor to protect Work from erosion throughout the construction period shall be included in the Lump Sum portion of the Bid and the Owner will make no additional payments.

1.17 CUTTING AND PATCHING

- A. The Contractor shall do all cutting, fitting or patching of his portion of the Work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the Engineer and in accordance with the Drawings and Specifications. The work must be done by competent workmen skilled in the trade required by the restoration.

1.18 CLEANING

- A. During Construction:
 - 1. During construction of the Work, the Contractor shall, at all times, keep the site of the Work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same at the end of every day, from any portion of the site if, in the opinion of the RPR, such material, debris, or rubbish constitutes a nuisance or is objectionable.

2. Contractor shall instruct all his workers not to litter on the grounds of the landfill and shall provide garbage dumpsters at employee areas for disposal of Contractor generated trash.
3. No excavated area will be allowed to stay open at night. Excavated trenches shall be filled in at the end of the day, or properly covered with planking or plating to prevent injury to personnel or damage to work, to the satisfaction of RPR.

B. Final Cleaning:

1. At the conclusion of the Work, all surplus material, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances.
2. The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished and new operating condition.

1.19 HOURS OF WORK

- A. The normal work hours for the RPR, onsite Engineer, and Engineer's QA testing technician are defined as any 10-hour period between 7:00 a.m. and 7:00 p.m., Monday through Friday. Work outside the daily 10-hour period shall be paid for as overtime work by the Contractor and requested in writing, at least 24 hours in advance. Work on weekends, County Holidays, and all other overtime work by the RPR, onsite Engineer, and Engineer's QA testing technician shall be at the rate of \$125/hour each and shall be deducted from payment due the Contractor monthly.

1.20 OTHER WORK

- A. Coordination of Owner's Work by Others: Reference the General Conditions for coordination of Owner's work by others, if any, and coordinate Contractor's Work with Owner or Owner's designated coordinator.
- B. Other work is anticipated to be performed at site by others prior to, during, and in sequence with scheduled performance of Work under these Contract Documents. Specific activities include but are not limited to: Installation of groundwater monitoring wells and landfill gas monitoring probes by Engineer. Removal and relocation of gopher tortoises by Engineer.
- C. Contractor shall be responsible for coordinating the monitoring well installation with the Owner. The monitoring wells must be installed prior to the installation of the overhead power lines.

- D. The Contractor shall be required to afford other contractors and the Owner reasonable opportunity for the introduction, transportation, and storage of their materials and equipment and the execution for their work and shall properly connect and coordinate the Work with such other work. The Contractor shall coordinate his construction work activities with the Owner and other contractors to store his apparatus, materials, supplies, and equipment in such orderly fashion at the site of the Work as will not unduly interfere with the progress of the Work or the work of any other contractors.
- E. If the execution or result of any part of the Work depends upon any work of the Owner or of any separate contractor, the Contractor shall, prior to preceeding with the Work, inspect and promptly report to the Owner in writing any apparent discrepancies or defects in such work of the Owner or of any separate contractor that render it unsuitable for the proper execution or result of any part of the Work.
- F. Failure of the Contractor to so inspect and report shall constitute an acceptance of the Owner's or other contractor's work as fit and proper to receive the Work, except as to defects which may develop in the Owner's or other contractor's work after completion of the Work and which the Contractor could not have discovered by its inspection prior to completion of the work.
- G. Should the Contractor cause damage to the work or property of the Owner or of any other contractors on the Project, or to other work on the Site, or delay or interfere with the Owner's ongoing operations or facilities or adjacent facilities or said separate contractors work, the Contractor shall be liable for the same; and, in the case of another contractor, the Contractor shall attempt to settle said claim with such other contractor prior to such other contractor's institution of litigation or other proceedings against the Contractor.
- H. If such contractor sues the Owner on account of any damage, delay or interference caused or alleged to have been so caused by the Contractor, the Owner shall notify the Contractor, who shall defend the Owner in such proceedings at the Contractor 's expense. If any judgement or award is entered against the Owner, the Contractor shall satisfy the same and shall reimburse the Owner for all damages, expenses, attorney's fees, and other costs which the Owner incurs as a result thereof.
- I. Should another contractor cause damage to the Work or to the property of the Contractor or cause delay or interference with the Contractor's performance of the Work, the Contractor shall present directly to said other contractor any claims it may have as a result of such damage, delay or interface (with an information copy to the Owner) and shall attempt to settle its claim against said other contractor prior to the institution of litigation or other proceedings against said other contractor.

- J. In no event shall the Contractor seek to recover from the Owner or the Engineer, and the Contractor hereby represents to the Owner and the Engineer that it will not seek to recover from them, or either of them, any costs, or any expenses including, but not limited to, attorney's fees or losses of profit incurred by the Contractor or any delay or interference caused or allegedly caused by any other contractors.

1.21 UTILITY NOTIFICATION AND COORDINATION

- A. Coordinate Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.
- B. The Contractor shall notify the electric company and coordinate the installation of electrical service to the site to assure work is performed in accordance with Section 26 05 01, Electrical. The Contractor shall pay all costs associated with the installation of electrical service to the site.
- C. The Contractor shall, at all times in performance of the Work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of public utility installations and structures; and shall, at all times in the performance of the Work, avoid unnecessary interference with, or interruption of, public utility services, and shall cooperate fully with the Owner's thereof to that end.
- D. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his own investigations to inform himself fully of the character, conditions, and extent of all installations and structures as may affect the construction operations.
- E. The Contractor shall protect all Owner and public utility installations and structures from damage during the Work. All required protective devices and construction shall be provided by the Contractor at his expense. All existing installations and public utilities damaged by the Contractor, which are shown on the Drawings or have been located in the field by the utility shall be repaired by the Contractor, at his expense, as directed by the Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.
- F. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Drawings to be removed, relocated, replaced, or rebuilt by the Contractor shall be considered as a part of the general cost of doing the Work and shall be included in the prices bid for the various Contract items. No separate payment shall be made therefore.

- G. Where public utility installations or structure owned or controlled by the Owner or other governmental body are encountered during the course of the Work, and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the Engineer, removal, relocations, replacement, or rebuilding is necessary to complete the Work under this Contract, such Work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the Engineer, for the Contractor to accomplish.
1. The maintenance, repair, removal, relocation, or rebuilding of public utility installations and structures, when accomplished by the Contractor, shall be done by methods approved by the Engineer.
 2. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement, or rebuilding as required.
- H. The Contractor shall give written notice to Owner and other governmental utility departments and other owners of public utilities of the location of proposed construction operations, at least 48 hours in advance of breaking ground in any area or on any unit of the Work. This can be accomplished by making the appropriate contract with the following utility companies:

Duke Energy

Attn: Stephanie Olmo
Utility Services Department
452 E. Crown Point Rd
Winter Garden, FL 34787
407-905-3376

Orange County Utilities

Attn: Victor Gonzalez
Field Services Department
8100 Presidents Dr
Orlando, FL 32809
407-836-6869

**Orlando Utilities
Commission**

P.O. Box 3193
Orlando, FL 32802
407-236-9651

Orange County Utilities

Attn: David Shorette
Utility Development Department
201 S Rosalind Ave.
Orlando, FL 32801
407-254-9764

AT&T Distribution

Attn: Dino Farruggio
Damage Prevention Manager
1120 S Rogers Cir
Boca Raton, FL 33487
954-249-0558
df1979@att.com

1.22 CONSTRUCTION CONDITIONS AND SUBSURFACE INVESTIGATION

- A. The Contractor shall strictly adhere to the specific requirements of the governmental unit(s) or agency(ies) having jurisdiction over the work. Wherever there is a difference in the requirements of a jurisdictional body and these Specifications, the more stringent shall apply.

- B. Prior to submission of a bid, the Contractor shall determine and investigate the nature and location of the work, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the work conditions, the character of equipment and facilities needed during the prosecution of the work, the general and specific conditions, and all other matters which can in any way affect the work under this Contract. The Contractor shall make appropriate plans to deal with these matters and perform the Work described in the Contract Documents effectively and efficiently.

1.23 DAILY REPORTS

- A. The Contractor shall prepare and submit daily reports of construction activities, including nonwork days. The reports shall include as a minimum:
 - 1. Manpower, number of personnel by name and craft.
 - 2. Equipment with Contractor's identification number on the Project.
 - 3. Major deliveries.
 - 4. Activities and Work with reference to the schedule activity numbers.
 - 5. New problems.
 - 6. Other pertinent information.
- B. A similar report shall be prepared by each subcontractor and submitted along with the Contractor's report.
- C. The reports shall be submitted to the Engineer's field office on a weekly basis, at least 2 days before the weekly progress meeting. Each report shall be signed and dated by the Contractor's Superintendent and the Project Manager. Submittal of these daily reports should not be construed to mean that the Owner and Engineer have agreed or disagreed with the content of these reports.

1.24 EMERGENCIES

- A. The Contractor shall, at all times, after regular working hours, including weekend and holidays, maintain a telephone where he or his representative can be reached on an emergency basis. The Contractor or his representative shall be prepared to act to correct conditions on the site deemed to constitute an emergency by either the Owner, his agent, the Engineer, or local authorities, and is obligated to act to prevent threatened damage, injury, or loss without special instructions from the Owner or Engineer. The Contractor shall give the Engineer prompt written notice of all significant changes in the Work or deviations from the Contract Documents caused thereby. If a condition on the site requires attention after working hours, either the Owner, agent, Engineer, or local authority shall call the Contractor or his representative at the emergency telephone number, identify himself and describe the emergency condition. The Contractor is expected to dispatch men and equipment to adequately institute corrective measures within 2 hours of

notification. If for some reason the Contractor or his agent cannot be reached at the emergency number after a reasonable time (1/2 hour), the Owner shall have the right to immediately initiate corrective measures, and the cost shall be borne by the Contractor.

- B. In the event the Contractor fails to maintain safe job conditions and traffic conditions, including, but not limited to, trench settlement and hazardous storage of backfill or construction materials, the Owner, after failure of the Contractor to commence substantial steps at the jobsite to rectify the situation within 2 hours of the time the Contractor has been notified of the unsafe conditions, may hire guards, take such precautions, make such repairs, and take any other steps which the Owner or the Owner's agent in its direction, considers necessary to protect the property, persons, or the Owner. The cost of any of these precautions, guards, or steps shall be deducted from the payments due the Contractor, and the Contractor will be billed for these services, work, and material at prevailing rates.
- C. Emergency phone numbers (fire, medical, police) shall be posted at the Contractor's phone and its location known to all.
- D. Accidents shall be reported immediately to the Owner's Project Manager by messenger or phone.
- E. All accidents shall be documented, and a fully detailed written report submitted to the RPR after each accident.

1.25 CUTTING, FITTING, AND PATCHING

- A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.
- B. Obtain Prior Written Authorization of Engineer Before Commencing Work to Cut or Otherwise Alter:
 - 1. Structural or reinforcing steel, structural columns or beams, elevated slabs, trusses, or any other structural member.
 - 2. Weather- or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Work of others.
- C. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown.
- D. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use best recommended practice of manufacturer or appropriate trade association.

- E. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.
- F. Remove specimens of installed Work for testing when requested by Engineer.

1.26 SUPPLEMENTS

- A. The supplements listed below, following “END OF SECTION,” are part of this Specification.
 - 1. Electronic Media Release.
 - 2. Contractor’s Verification of the Accuracy of Drawings and Specifications.
 - 3. Contract Clarification/Interpretation Request Form.
 - 4. Defective/Rejected Work Notification.
 - 5. Notification of Correction of Defective/Rejected Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTIONS (NOT USED)

END OF SECTION

ELECTRONIC MEDIA RELEASE

CH2M, Inc., Project No. _____: Orange County Landfill _____

This release for electronic media is dated the _____ day of _____, 20____, between _____ (RECIPIENT) and CH2M Inc., for the exchange of electronic media (disks, tape, optical disk, etc.) containing information on the _____ project (hereinafter referred to as the PROJECT) for use by the RECIPIENT.

Therefore, RECIPIENT and CH2M, Inc., agree as follows:

1. The electronic files provided to RECIPIENT by CH2M Inc., for the PROJECT may be used by RECIPIENT without restriction except as described herein. If RECIPIENT chooses to alter the electronic files provided for the PROJECT in any way, in whole or in part, or if RECIPIENT chooses to use the electronic files for any purpose other than for the PROJECT for which they were prepared, RECIPIENT agrees that the unrestricted use shall be without liability or legal exposure to CH2M, Inc.
2. Because information and data provided electronically may be altered, whether inadvertently or otherwise, CH2M, Inc., reserves the right to retain copies of the electronic file(s) and to remove from the electronic files provided to RECIPIENT all identification (such as logo, surveyor’s seal, etc.) reflecting the involvement of CH2M, Inc., in their preparation.
3. The electronic files are provided solely as a convenience to RECIPIENT by CH2M Inc., and shall NOT be considered “Drawings of Record” or as “Construction Documents.” All documents considered “Drawings of Record” or “Construction Documents” shall be accompanied by a professional’s embossed stamp and signature. The stamped and signed hardcopy shall be referred to and shall govern in the event of any inconsistency between the hardcopy and the information provided electronically.
4. RECIPIENT is advised to check all electronic media for viruses before loading the files. RECIPIENT is fully responsible for intercepting and disabling viruses, if any, that may be inadvertently transmitted with the electronic files and hereby agrees to indemnify and hold CH2M Inc., harmless from and against all claims of any type or nature asserted by RECIPIENT or any party as a result of viruses inadvertently transmitted with the electronic files.
5. Files distributed electronically are subject to data erosion, erasure, and/or alteration, and computer systems and software become obsolete in time. By accepting these electronic files, RECIPIENT acknowledges these risks and agrees to waive all claims against CH2M Inc., should data erosion, erasure, and/or alteration of these electronic files occur.

ORANGE COUNTY CELL 11

6. By accepting electronic files, RECIPIENT acknowledges that such files may be incomplete and/or insufficient for use in calculating quantities or bid values or for other purposes relating to the preparation of any bid document. RECIPIENT further acknowledges that it is RECIPIENT's sole responsibility to obtain all additional information required for these purposes.
7. RECIPIENT agrees to defend, indemnify, and hold CH2M Inc., harmless from all claims, injuries, damages, losses, expenses, and costs, including attorneys' fees, arising out of breach of this agreement and/or the modification or reuse of these materials in or for any project other than the PROJECT for which they were originally prepared by CH2M.

ACCEPTED FOR RECIPIENT:

ACCEPTED FOR CH2M Inc.

By _____
Title _____
Date _____

By _____
Title _____
Date _____

**CONTRACTOR'S AFFIDAVIT VERIFYING ACCURACY
OF
DRAWINGS AND SPECIFICATIONS**

(This Affidavit shall be submitted to the Engineer prior to the start of Construction)

STATE OF _____)
COUNTY OF _____)

The undersigned being first duly sworn as provided by law, deposes and certifies that:

- 1. The undersigned is authorized to make this Affidavit on behalf of,

(Name of Corporation, Partnership, Individual, etc.)

A _____, formed under the laws of _____

of which he is _____
(Sole Owner, Partner, President, etc.)

- 2. Prior to the start of work on the site, Affiant has carefully studied, reviewed and compared the Drawings and Specifications and checked and verified all pertinent figures shown thereon and all applicable field measurements;
- 3. Affiant hereby verifies that the, Drawings and Specifications in the Contract Documents for the _____ (Project Name) accurately represent the existing site conditions and do not contain any conflicts, errors, ambiguities, or discrepancies except as specifically noted below.
- 4. Number of exceptions _____ (if none, please indicate zero in the space provided). Each exception is explained in detail on the attached sheets. _____ additional sheets are attached.

Affiant

BY: _____

Sworn and subscribed before me this _____ day of _____, 200_____.

Notary Public

My Commission Expires:

END OF CONTRACTOR VERIFICATION FORM

**CONTRACT CLARIFICATION/
INTERPRETATION REQUEST**

CCIR NO: _____

PROJECT: Orange County Landfill Cell 11

PROJECT NO: _____

CONTRACTOR: _____

Clarification/Interpretation Initiated By: _____

Regarding: Plan Sheet _____ of _____ Spec. Section: _____

Description:

Prepared by

Date

Response Assigned to:

Prepared by

Date

DEFECTIVE/REJECTED WORK NOTIFICATION

TO CONTRACTOR: _____ NOTIFICATION NO: _____

PROJECT: _____ PROJECT NO: _____

OWNER: _____ TIME: _____ AM

ENGINEER: _____ OBSERVER: _____

Pursuant to the GENERAL CONDITIONS of the Contract, you are hereby notified of the following noncompliance violation:

Specification Section: _____ Paragraph: _____

Violation:

Contract Requirement:

Violation Detected by: Test Inspection Observation

Noncompliance Work is: Defective Rejected

Estimated Value of Noncomplying Work: \$ _____

Defective work shall be corrected. Rejected work shall be removed and replaced. All costs shall be borne by the Contractor. Payment will not be made for defective or rejected work. Contractor shall notify Engineer when defective or rejected work is corrected.

Received by:

Engineer: _____ Contractor: _____
Authorized Representative

Date: _____ Title: _____

_____ Date

- Distribution:**
1. Engineer
2. Owner
3. Field File

NOTIFICATION OF CORRECTION OF DEFECTIVE/REJECTED WORK

TO CONTRACTOR: _____ PREVIOUS NOTIFICATION NO: _____ DATE: _____

PROJECT: _____ PROJECT NO: _____

OWNER: _____

ENGINEER: _____

The below listed Defective/Rejected work has been reinspected and the results of the Contractor's corrective actions have placed the work in compliance with the Contract Documents.

Description of Violation: _____

Description of Correction: _____

Engineer: _____
Authorized Representative

Date: _____

- Distribution:**
- 1. Engineer
 - 2. Owner
 - 3. Field File

**SECTION 01 31 19
PROJECT MEETINGS**

PART 1 GENERAL

1.01 GENERAL

- A. The Engineer will schedule and administer a preconstruction meeting, construction progress meetings, monthly pay application/progress schedule meeting and specialty called meetings including to, but not limited to, pre-activity and pre-installation meetings throughout the progress of the work. The Engineer will:
 - 1. Prepare agenda for meetings.
 - 2. Preside at meetings.
 - 3. Prepare and distribute meeting notes to all attendees.
- B. Representatives of Contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. Contractor's Project Manager is required to attend all meetings and prepared to report activities and issues of the Contractor and construction.
- D. The Contractor shall attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules. The Engineer will prepare a meeting summary of the preconstruction meeting and each progress meeting; copies of the meeting summaries will be distributed to the Owner and Contractor prior to the next scheduled meeting.
- E. Written draft meeting summaries will be reviewed by the Contractor and review comments provided to the Engineer to finalize the meeting summaries. Contractor, Engineer and RPR may voice record the meetings for their own records and recollection with prior notification pursuant to Florida Statutes and Regulations. However, the final meeting summaries are the official records of the meetings.
- F. The Engineer will provide notice of meeting schedule, prepare agenda and e-mail to participants at least 3 days prior to each meeting.

1.02 PRECONSTRUCTION CONFERENCE

- A. Contractor shall provide a Preliminary Construction Schedule and a list of Submittals at the Preconstruction Conference.

B. Attendees will include:

1. Owner's representatives.
2. Contractor's office representative.
3. Contractor's superintendent.
4. Contractor's quality control representative.
5. Subcontractors' representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer's representatives.
7. Others as appropriate.

C. Suggested Agenda:

1. Distribution and discussion of:
 - a. List of major subcontractors and suppliers.
 - b. Contractor's projected schedule.
 - c. Contractor's Schedule of Values.
 - d. Contractor's submittal log summary.
 - e. M/WBE participation requirement and reporting.
2. Critical work sequencing; Relationships and coordination with other contracts and/or work.
3. Communication Protocol.
4. Project Coordination: Designation and responsible personnel.
5. Procedures and processing of:
 - a. Field decisions.
 - b. Proposal requests.
 - c. Submittals.
 - d. Change orders.
 - e. Applications for Payment.
6. Submittal of Shop Drawings, project data and samples.
7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining Record Documents.
9. Use of premises:
 - a. Work and storage areas.
 - b. Owner's use of project site and permit requirements.
 - c. Access and traffic control.
 - d. Speed limit, traffic signs and right-of-way.
10. Construction facilities, controls and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Check of required bond and insurance certifications.
14. Completion time for contract and liquidated damages.
15. Request for extension of contract time.
16. Request for a weekly project meeting for all involved.
17. Security procedures.
18. Procedures for making partial payments.
19. Guarantees on completed work.

20. Equipment to be used.
21. Survey requirements/staking of work.
22. Project inspection.
23. Labor requirements.
24. Laboratory testing requirements.
25. Provisions for material stored on site.
26. Housekeeping procedures.
27. Liquidated Damages.
28. Posting of signs.
29. Pay request submittal dates.
30. Equal opportunity requirements.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

- A. As set forth in General Conditions and Section 01 32 00, Progress Schedules.

1.04 PROGRESS MEETINGS

- A. Engineer will schedule regular progress meetings at site, conducted weekly to review Work progress, progress schedule, Shop Drawing and Sample submissions schedule, Application for Payment, contract modifications, and other matters needing discussion and resolution.

- B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor's Project manager and Superintendent.
3. Contractor, Subcontractors, and Suppliers, as appropriate to the agenda.
4. Engineer's representative, as appropriate.
5. Others as appropriate.

- C. Suggested Agenda:

1. Review/comments/approval of meeting summaries of previous meetings.
2. Review of work progress since previous meeting.
3. Field observations, problems, or conflicts.
4. Problems which impede Construction Schedule.
5. Review of off-site fabrication, delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to Construction Schedule.
8. Progress schedule during succeeding work period.
9. Coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Maintenance of quality standards.
12. Pending changes and substitutions.
13. Shop Drawing submittals.

14. Review proposed changes for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other contracts of the Project.
 15. Other business.
 16. Construction progress schedule.
 17. Critical/long lead items.
- D. The Contractor's Project Manager and Superintendent is required to attend all progress meetings and are to review draft meeting summaries and current agenda items e-mailed to them in advance in order to attend the meeting prepared to discuss pertinent topics such project progress, construction activities, mobilizations/demobilization, Shop Drawings and submittals, deliveries of materials and equipment, etc.
- E. The Contractor is required to provide copies of current updated submittal log at each progress meeting.

1.05 QUALITY CONTROL AND COORDINATION MEETINGS

- A. Scheduled by Engineer as necessary to review test and inspection reports, and other matters relating to quality control of Work and work of other contractors.
- B. Attendees will include:
1. Contractor.
 2. Contractor's designated quality control representative.
 3. Subcontractors and Suppliers, as necessary.
 4. Engineer's representatives.

1.06 PREINSTALLATION MEETINGS

- A. When required in individual Specification sections. Convene at site prior to commencing Work of that section.
- B. Require attendance of entities directly affecting, or affected by, Work of that section.
- C. Notify Engineer 4 days in advance of meeting date.
- D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.07 FACILITY STARTUP MEETINGS

- A. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting the Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.
- B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.
- C. Attendees will include:
 - 1. Contractor.
 - 2. Contractor's designated quality control representative.
 - 3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
 - 4. Engineer's representatives.
 - 5. Owner's operations personnel.
 - 6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.08 OTHER MEETINGS

- A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 32 00
PROGRESS SCHEDULES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Submit with Each Progress Schedule Submission:
 - 1. Contractor's certification that progress schedule submission is the actual schedule being utilized for execution of the Work and certification by all Subcontractors with 5 percent or more of Work that they concur with Contractor's progress schedule submission.
 - 2. Four Legible Copies of the Progress Schedule: For each computer-generated schedule submission.
 - 3. Primavera P6 Professional Project Management (P6) .xer file. The Contractor's scheduling software shall be capable of generating P6 files without conversion. Commercially available programs that meet this standard include Primavera P6 Professional Project Management Software, Primavera P6 Enterprise Project Portfolio Management Software, Primavera Contractor Software, and Phoenix Project Manager.
- B. Preliminary Progress Schedule: Submit no later than preconstruction conference.
- C. Progress Schedule: Submit initial Detailed Progress Schedule in accordance with General Conditions, but not later than the date of Mobilization. Submit adjusted schedule or confirm validity of current schedule with each monthly Application for Payment, and at such other times as necessary to reflect:
 - (i) progress of Work to within 5 working days prior to submission;
 - (ii) changes in Work scope and activities modified since submission;
 - (iii) delays in Submittals or resubmittals, deliveries, or Work; (iv) adjusted or modified sequences of Work; (v) other identifiable changes; and (vi) revised projections of progress and completion.
- D. Narrative Progress Report: Submit with each monthly submission of progress schedule.
- E. Precedent to final payment, provide four copies of any Critical Path Method (CPM) type schedule utilized with certification that said schedule represents correctly the way the Work was performed.
- F. Progress quantity chart(s).

1.02 PROGRESS OF THE WORK

- A. The Contractor shall furnish personnel and equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will ensure the completion of the Work within the Contract time as stipulated in these Specifications.
- B. If Contractor fails to complete activity by its latest scheduled completion date and this failure may extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to the acceptable current progress schedule. Actions by Contractor to complete Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- C. Owner may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to: (i) complete a critical scheduled activity by its latest scheduled completion date, or (ii) satisfactorily execute Work as necessary to prevent delay to the overall completion of the Project. Such order will not be justification for adjustment to Contract Price or Contract Time.

1.03 PRELIMINARY PROGRESS SCHEDULE

- A. As a minimum, submit preliminary network analysis diagrams as follows:
 - 1. 90-Day Plan: Show major initial activities including, but not limited to, mobilization, permits, submittals for early product procurement and long lead time items, initial sitework, and other activities anticipated in the first 90-day period of the Contract Time.
 - 2. Project Overview Plan: Show major components of the Work and the sequence relations between major components and subdivisions of major components. The chart shall indicate the relationship and time frames in which the various facilities will be made substantially complete and placed into service in accordance with the Project Milestones. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as:
 - a. Site cleaning.
 - b. Site dewatering.
 - c. Site earthwork.
 - d. Installation of liner system.
 - e. Installation of 2 feet of drainage sand.
 - f. Access road construction and paving.
 - g. Reconfiguration of Young Pine Road and Administration Building Access Road.
 - h. Construction of Stormwater Ponds and Perimeter Roads.
 - i. Major mechanical work.

- j. Major electrical work.
 - k. Instrumentation and control work.
 - l. Other important work within the overall work scope.
- B. Planned durations and start dates shall be indicated for each Work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 11 inches by 17 inches in size. Not more than four sheets shall be employed to represent this overview information.
- C. The preliminary progress schedule, when accepted by the Engineer, will be the initially acceptable schedule.

1.04 PROGRESS SCHEDULE

- A. General:
1. Schedule(s) shall reflect Work logic sequences, restraints, delivery windows, review times, Contract Times, and Milestones set forth in the Agreement and Section 01 31 13, Coordination, and shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
 2. The schedule requirement herein is the minimum required. Contractor may prepare a more sophisticated schedule if such will aid Contractor in execution and timely completion of Work.
 3. Base schedule on standard 5-day work week.
 4. When network analysis schedules are specified, use Primavera Project Planner (P6) latest version or a compatible and approved software.
 5. Adjust or confirm schedules in accordance with the General Conditions on a monthly basis.
 6. Float time is a Project resource available to both parties to meet contract Milestones and Contract Times.
 7. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
 8. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which (i) impacts Project's critical path, (ii) consumes available float or contingency time, and (iii) extends Work beyond contract completion date.
 9. If Contractor provides an accepted schedule with an early completion date, (more than 10 percent Total Float on the Critical Path) Owner reserves the right to reduce Contract Times to match the early completion date by issuing a deductive Change Order at no change in Contract Price.

- B. Format: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) Publication No. 1107.1, "Construction Planning and Scheduling," latest edition. If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.
- C. Contents:
1. Schedule shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
 2. Identify Work calendar basis using days as a unit of measure.
 3. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete Work.
 4. Identify Work of separate stages and other logically grouped activities and clearly identify critical path of activities.
 5. Reflect sequences of Work, restraints, delivery windows, review times, Contract Times, and Project Milestones set forth in the Contract and Section 01 31 13, Coordination.
 6. Include as Applicable, at a Minimum:
 - a. Obtaining permits, submittals for early product procurement, and long lead time items.
 - b. Mobilization and other preliminary activities.
 - c. Specified Work sequences, constraints, and Milestones, including Substantial and Final Completion date(s).
 - d. Major equipment design, fabrication, factory testing, and delivery dates.
 - e. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work, if applicable.
 - f. Initial sitework.
 - g. Site cleaning.
 - h. Site dewatering.
 - i. Site earthwork.
 - j. Installation of liner system.
 - k. Installation of 2 feet of drainage sand.
 - l. Access road renovation and paving.
 - m. Construction of Stormwater Pond
 - n. Construction of Perimeter Roads.
 - o. Major mechanical/piping work:
 - 1) Stormwater Collection
 - 2) Leachate Collection
 - 3) Landfill Gas
 - p. Electrical work.
 - q. Instrumentation and control work.
 - r. Other important work within the overall work scope.
 - s. Interfaces with Owner-furnished equipment, if applicable.
 - t. Other important work for each major facility.

- u. Equipment and system startup and test activities.
 - v. Project closeout and cleanup.
 - w. Demobilization.
7. No activity duration, exclusive of those for Submittal's review and product fabrication/delivery, shall be less than 1 day or more than 15 days, unless otherwise approved.
 8. Activity duration for Submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from Engineer.

D. Network Graphical Display:

1. Plot or print on paper not greater than 30 inches by 42 inches or smaller than 22 inches by 34 inches, unless otherwise approved.
2. Title Block: Show name of Project, Owner, date submitted, revision or update number, and the name of the scheduler. Updated schedules shall indicate data date.
3. Identify horizontally across the top of the schedule the time frame by year, month, and day.
4. Identify each activity with a unique number and brief description of the Work associated with that activity.
5. Indicate the critical path.
6. Show, at a minimum, the controlling relationships between activities.
7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
8. Plot activities on an early start basis unless otherwise requested by Engineer.
9. Provide a legend to describe standard and special symbols used.

E. Schedule Report:

1. On 8-1/2 inch by 11-inch white paper, unless otherwise approved.
2. List information for each activity in tabular format, including, at a minimum:
 - a. Activity Identification Number.
 - b. Activity Description.
 - c. Original Duration.
 - d. Remaining Duration.
 - e. Early Start Date (Actual Start of Updated Progress Schedules).
 - f. Early Finish Date (Actual Finish on Updated Progress Schedules).
 - g. Late Start Date.
 - h. Late Finish Date.
 - i. Total Float.
3. Sort Reports, in Ascending Order, as Listed Below: Activity number sequence with predecessor and successor activity.

1.05 PROGRESS OF THE WORK

- A. Updated Progress Schedule shall reflect:
 - 1. Progress of Work to within 5 working days prior to submission.
 - 2. Approved changes in Work scope and activities modified since submission.
 - 3. Delays in Submittals or resubmittals, deliveries, or Work.
 - 4. Adjusted or modified sequences of Work.
 - 5. Other identifiable changes.
 - 6. Revised projections of progress and completion.
 - 7. Report of changed logic.
- B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns, etc.
- C. If Contractor fails to complete activity by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current progress schedule. Actions by Contractor to complete Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:
 - 1. Complete a Milestone activity by its completion date.
 - 2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 NARRATIVE PROGRESS REPORT

- A. Format:
 - 1. Organize same as Progress Schedule.
 - 2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.
- B. Contents:
 - 1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks, etc.).
 - 2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.

3. Contractor's plan for management of site (e.g., lay down and staging areas, construction traffic, etc.), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract Changes.
5. Documentation of weather conditions over the reporting period and any resulting impacts to the Work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.07 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that the proposed schedule conforms with requirements of Contract including, but not limited to, the following:

1. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
2. Specified Work sequences and constraints are shown as specified.
3. Complete Scope of Work is included.
4. Specified Owner-furnished equipment or material arrival dates, or range of dates, are included.
5. Access restrictions are accurately reflected.
6. Startup and testing times are as specified.
7. Training time is as specified.
8. Level of detail is as specified herein.
9. Submittal submission and review times are as specified.
10. Duration of activities is reasonable.
11. Sequencing is reasonable and does not include preferential logic contrary to the contingency/float sharing clauses of this Specification.
12. Meets all administrative requirements of Contract Documents.
13. Updated schedules reflect actual dates and duration of Work performed.

B. Preliminary Progress Schedule Review Disposition:

1. Reviewed and in conformance with Specifications.
2. Rejected as Noted:
 - a. Make requested corrections; resubmit within 10 days.
 - b. Until acceptable to Engineer as the Baseline Progress Schedule, continue the review and revision process, during which time Contractor shall update the schedule monthly to reflect actual progress and occurrences to date.

- C. Detailed Progress Schedule:
 - 1. Reviewed and in conformance with Specifications.
 - 2. Rejected as Noted:
 - a. Make requested corrections; resubmit within 10 days.
 - b. Until acceptable to Engineer as the Baseline Progress Schedule, continue the review and revision process.
- D. Narrative Report: All changes to activity duration and sequences, including the addition or deletion of activities subsequent to Engineer's acceptance of the Baseline Progress Schedule, shall be delineated in the Narrative Report current with the proposed Updated Progress Schedule.

1.08 CLAIMS FOR ADJUSTMENT OF CONTRACT TIMES

- A. Reference the General Conditions.
- B. Evaluation and reconciliation of adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of the proposed adjustment or claimed delay.
- C. Float:
 - 1. Float time is a Project resource available to both parties to meet Contract Milestones and Contract Times.
 - 2. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
 - 3. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which impacts Project's critical path.
- D. Claims Based on Contract Times:
 - 1. Where Owner has not yet rendered formal decision on Contractor's claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in progress schedule, Contractor shall reflect an interim adjustment in the progress schedule as acceptable to Owner.
 - 2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
 - 3. Contractor shall revise progress schedule prepared thereafter in accordance with Owner's formal decision.

1.09 CHANGE OF CONTRACT TIME

- A. The Contractor Time (or Milestone) may only be changed by a Change Order to the Contract. Any claim for an adjustment of the Contract Time (or Milestone) shall be based on written notice delivered by the party making the claim to the other party and to Owner promptly (but in no event, later than 5 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within 30 days after such occurrence (unless Owner allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. No claim for an adjustment in the Contract Time (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph.
- B. All time limits stated in the Contract Documents are of the essence of the Agreement.
- C. In the event of a claim under Paragraph A, the Contract Time may be extended in an amount equal to time lost due to delays beyond the control of the Contractor. Such delays shall include, but not be limited to, acts or neglect by Owner, acts or neglect by other contractors performing other work on site, acts or neglect by utility owners, fires, floods, labor disputes, epidemics, abnormal weather conditions, or Force Majeure.
- D. Extension of time for "abnormal weather" shall be granted only under the following conditions:
1. All weather delays will be considered on a cumulative calendar month basis.
 2. On-site rainfall measurements will be recorded by the RPR at the end of each workday from a rain gauge installed by the Contractor at the actual Work site.
 3. At the end of each month, the cumulative rainfall for that month will be tabulated by the Engineer, as well as the number of days where the rainfall amount was greater than 0.25 inches.
 4. If the total monthly rainfall recorded on site by the RPR exceeds the normal monthly rainfall according to the National Weather Service (weather.gov) for the Orlando International Airport Station, the Contract Time shall be extended by the number of days calculated as follows:
 - a. The number of days in the month where the rainfall amount is greater than 0.25 inches after the normal rainfall for the month has been exceeded.

- b. If RPR rainfall records for any month are incomplete the monthly rainfall records of the National Weather Service, Orlando International Airport Station may be substituted.
- E. Contractor shall carry on the Work and adhere to the Progress Schedule during resolution of any claims made by Contractor pursuant to General Conditions and the requirements of the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 32 23
SURVEYING**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Surveyor Qualifications:
 - 1. Submit to the Engineer the name, address, telephone number, and qualifications of the surveyor, crew chief, and all other persons who are proposed to perform surveys or survey-related duties 30 days prior to start of any survey work.
 - 2. All control survey and layout shall be performed and signed and sealed by a qualified land surveyor registered in the State of Florida.
- B. Field Notes and/or Data Collector Output: Within 48 hours of completing and reducing the notes, or downloading and computing using a data collector, for a survey or portion of survey, submit reduced data to the Engineer. Upon completing a field survey book, the original field survey book shall be submitted to the Engineer.

1.02 REFERENCE POINTS AND SURVEYS

- A. Profile Elevations on Topographic Base Map: Existing ground profiles shown on Drawings were developed by photogrammetric methods. Elevations of well-identified features shown on the ground profiles have been measured to an estimated vertical position accuracy of plus or minus 1 foot in accordance with Chapter 61G17-6.003(1)(d) 2 of the Florida Administrative Code.
- B. Owner's Responsibilities: Establish horizontal reference points or coordinate system with bench marks and reference points for Contractor's use as necessary to lay out Work.
- C. Location and elevation of bench marks are shown on Drawings.
- D. Engineer may perform checks to verify accuracy of Contractor's layout Work and that completed Work complies with Contract Documents.
- E. Any existing reference points, survey points or other control markers destroyed without proper authorization will be replaced by owner of the reference points, survey points or control markers at the Contractor's expense.
- F. Contractor's Responsibilities:
 - 1. Provide additional survey and layout required.
 - 2. Locate and protect reference points prior to starting site preparation.

3. Notify Engineer at least 5 working days in advance of time when grade and line to be provided by others will be needed.
4. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
5. In event of discrepancy in data or staking provided by Engineer, request clarification before proceeding with Work.
6. Preserve and leave undisturbed control staking until Engineer has completed checks it deems necessary.
7. Retain professional land surveyor or civil engineer registered in state of Project who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
8. Maintain onsite a complete, accurate log of control of survey work as it progresses. All original field notes, computations, and other records for the purpose of layout and quantity surveys shall be recorded in field books.
9. On request of Engineer, submit documentation.
10. Provide Competent Employee(s), Tools, Stakes, and Other Equipment and Materials as Engineer may require to:
 - a. Check layout, survey, and measurement Work performed by others.
 - b. Measure quantities for payment purposes.
11. Cooperate with Engineer so that checking and measuring may be accomplished with least interference to Contractor's operations.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified in individual specification sections, the following minimum standards shall apply:
 1. Control Surveys: Vertical shall close within 0.03 foot. Horizontal control angles shall close to the nearest plus or minus 10 seconds. Measured distances shall be plus or minus 0.01 foot.
 2. Construction Certification Surveys by Contractor: Elevations shall be to the nearest 0.1 foot. Horizontal distances shall be plus or minus 0.1 foot.
 3. Topographic Survey: Contours shall be shown at 1-foot intervals with 5-foot index contours. Accuracy shall be National Mapping Standards for 1-foot contour intervals.

2.02 EQUIPMENT AND MATERIALS

- A. Contractor shall provide all equipment and materials as required to properly perform the surveys. All material shall be of good professional quality and in first-class condition.

- B. All instruments (conventional or electronic) shall be calibrated according to the manufacturer's recommendations and maintained in accurate calibration throughout the execution of the Work.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify with the Engineer locations of site reference and survey control points prior to starting work. Promptly notify the Engineer of any discrepancies discovered. Verify layouts periodically during construction.

3.02 SURVEY REFERENCE POINTS

- A. Protect survey points prior to starting Work and preserve permanent reference points during construction.
- B. Promptly report to the Engineer the loss, damage, or destruction of any reference point or relocation required because of changes in grades or other reasons. Replace dislocated survey control points based on original survey control.

3.03 SURVEY REQUIREMENTS

- A. Reference survey monuments or establish new survey monuments referenced to the project horizontal coordinate grid system as shown on the Drawings and the National Geodetic Vertical Datum.
- B. Reference survey and site reference points to the provided control monuments and record locations of survey control points, using horizontal project coordinate grid system and National Geodetic Vertical Datum, on Record Drawings.
- C. Establish lines, levels, and locate and lay out site features to be constructed including necessary stakes for cut, fill, placement, and grading operations and stakes for utility locations, slopes, and invert elevations. When it is necessary to remove a grade marker for construction operations, appropriate offset staking shall be used.
- D. All marks given shall be carefully preserved and, if destroyed or removed by the Contractor without the Engineer's approval, they shall be reset, if necessary, at no additional cost to this Contract.
- E. All work not done with the methods and equipment as submitted by the Contractor and approved by the Engineer shall be removed and replaced using approved methods and equipment.

- F. Construction Certification Survey of the liner disposal area includes the following:
 - 1. Survey of prepared subbase prior to placement of the GCL.
 - 2. Survey of the top of the uppermost layer of drainage net prior to placement of the drainage sand.
 - 3. Survey of the top of 24-inch drainage sand.
- G. At the completion of all earthwork, including embankments, ditches, roads, ponds, etc., a topographic survey shall be conducted. The survey results shall be submitted to the Engineer within two weeks after the completion of the survey.
- H. Contractor's Record Drawings shall include as-built coordinates and elevation for all data points defined on the Design Drawings and all additional data points required to accurately define the completed Work. Contractor shall also provide other relevant data and information, included, but not limited to, curve data, radii, building and structural dimensions, necessary to accurately define the completed Work.
- I. In addition to the items listed above, the Contractor's Record Drawings shall include as-built coordinates and elevations of all underground site utilities including, but not limited to, water pipes, wastewater pipes, leachate pipes, landfill gas pipes, condensate pipes, electrical conduits and lines, fiber optic conduits and lines, and telephone conduits and lines.
- J. Contractor shall clearly delineate the edge of the liner by installing permanent survey markers around the entire perimeter of the liner system. The markers shall be 3-1/2-inch aluminum survey disks installed at intervals not to exceed 500 feet. To the extent practicable, the disks shall be installed on stormwater control structures. Where installation on stormwater control structures is not practicable, the disks shall be installed in 4-inch concrete survey markers at locations approved by the Engineer. Distance to the edge of the liner shall be clearly indicated on each survey disk.
- K. It shall be the duty of the Contractor to keep the Engineer informed of the times and places at which he intends to work in order that the Engineer may have an ample opportunity to furnish and/or to check the lines and elevations with a minimum of inconvenience to the Engineer or delay to the Contractor.

3.04 RECORDS

- A. Maintain a complete, up-to-date accurate log of all control and survey work as it progresses. Review as-built drawings with RPR and Engineer as part of Monthly Pay Application.

- B. Submit seven sets of signed and sealed Record Drawings in accordance with Section 01 77 00, Contract Closeout. Record Drawings shall be submitted with bubbles designating changes on the Conformed Drawings. Changes shall include properly designated invert elevations, locations and x-y-z coordinates.
- C. All surveying data to be submitted to the Engineer shall be provided in AutoCAD 2013, 3D View format. In addition, topographic survey and Construction Certification Surveys shall be submitted as Digital Terrain Models (DTM) suitable for use in Intergraph's Inroad computer program.

END OF SECTION

**SECTION 01 33 00
SUBMITTALS**

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies requirements for handling submittals and procedures for processing.
- B. The Owner, Engineer, and Contractor may agree at the pre-construction meeting to develop procedures for electronic submittal for this Project. The required review times for submittals included in this section applies equally to either paper or electronic submittal.

1.02 GENERAL

- A. Inquiries: Direct to Engineer regarding procedure, purpose, or extent of Submittal.
- B. Timeliness: Schedule and make submissions in accordance with requirements of individual Specification sections and in such sequence as to cause no delay in Work or in work of other contractors. Allow at least 2 weeks for initial review and 2 weeks for each subsequent review of each submittal. Allow more time if processing must be delayed for coordination with other submittals, manufacturer, or other trades. The Engineer will advise the Contractor when a submittal review must be delayed for coordination.
- C. Coordinate submittal preparation with performance of construction activities, purchasing, fabrication, delivery, other submittals, and related activities. Transmit in advance of performance of related activities.
- D. Coordinate transmittal of different submittals for related elements so processing will not be delayed by the need to review concurrently for coordination. The Owner reserves the right to withhold action on a submittal requiring coordination until related submittals are received.
- E. Contractor is required to review the submittals from manufacturers and sign the affidavit stating that the submittal meets the technical specifications. The Contractor's "Shop Drawing Stamp" attached to this section shall be included with all shop drawing submittals and signed by the Contractor's project Manager.

1.03 SUBMITTAL SCHEDULE

- A. Progress Schedule(s): Meet the requirements of Section 01 32 00, Progress Schedules.
- B. Schedule of Values: Meet requirements of Section 01 29 00, Measurement and Payment.
- C. The Contractor is required to develop a summary list of all submittals required for this project and log in the date each submittal is anticipated to be submitted to the Engineer. The Contractor's initial submittal schedule shall be submitted to the Engineer at the first construction progress meeting after the pre-construction conference.
- D. The submittal schedule log shall be updated for each progress meeting and copies submitted into the records at the weekly progress meetings.
- E. Prepare the Submittal Schedule in chronological order; include anticipated date of submittals required during the construction. Provide the following information for each item:
 - 1. Scheduled date for the submittal to Owner and Engineer.
 - 2. Related Section number.
 - 3. Name and Type of submittal.
 - 4. Description of the construction element covered.
 - 5. Scheduled date for the Engineer's final release or approval.
- F. Schedule of Submittal Submissions:
 - 1. Prepare and submit, preliminary list of submissions grouped by Specification Section number, with identification, numbering and tracking system as specified under Numbering and Packaging Submittals and as approved by Engineer.
 - 2. Include only the following required submissions:
 - a. Shop Drawings and Samples.
 - b. Training plans.
 - c. Test procedures.
 - d. Operation and maintenance manuals.
 - e. Record documents.
 - f. Specifically required certificates, warranties, and service agreements.
 - 3. Coordinate with progress schedule and prepare submissions to show for each Submittal, at a minimum, the following:
 - a. Estimated submission date to Engineer.
 - b. Specifically requested and clearly identified Engineer review time if shorter than that set forth herein, with justification for such request and critical dates Submittals will be needed from Engineer.

- c. For first 6-month period from the date the Contract Times commence or following any update or adjustment of the submissions, the estimated submission date shall be week, month, and year; for submissions beyond 6-month time period, show closest month and year.
- 4. Submit to Engineer monthly (i) updated list if changes have occurred, otherwise submit a written communication confirming existing list, and (ii) adjusted submissions reflecting submission activity planned for forthcoming 6-month time period and beyond. Coordinate with progress schedule updates.

G. Numbering and Packaging Submittals

- 1. Number and package Submittals appropriately for transmittal and handling. Number Submittals beginning with the specification section number, then sequentially starting with "001" for each Specification section (e.g., Submittal 01 33 00-001, Submittal 31 23 16-001, Submittal 33 05 01.05-002, etc.). Resubmission of a Submittal will have the original number with sequential alphabetic suffix (e.g., Submittal 01 33 00-001A would be the first resubmission of Submittal 01 33 00-001).

1.04 DISTRIBUTION OF SCHEDULES

- A. Distribute copies of the approved Construction and Submittal Schedules to the Owner, Subcontractors, and other parties required to comply with schedule dates. Post copies in the field office. When revisions are made, distribute to the same parties and post in the same locations.
- B. Revise each Schedule after each meeting or activity, where revisions have been made. Provide the updated Submittal Schedule at weekly progress meeting. Provide the updated Construction Schedule with the monthly pay application.

1.05 DAILY CONSTRUCTION LOG

- A. Prepare a daily construction log of information concerning events, construction equipment, personnel onsite and construction activities at the site and submit to the Owner and Engineer on a weekly basis. Maintain a 3-ring binder with all daily construction reports onsite for periodic review of the Owner and Engineer.
- B. Provide a copy of the daily construction logs to the RPR on a weekly basis.

1.06 SHOP DRAWINGS AND SAMPLES

- A. Submit new information, drawn to an accurate scale. Indicate deviations from Contract Documents.
 - 1. Dimensions.
 - 2. Identification of products and materials included.
 - 3. Notation of coordination requirements.
 - 4. Notation of dimensions established by field measurement.
- B. Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 inches by 11 inches but no larger than 24 inches by 36 inches.
- C. Product Data:
 - 1. Collect Product Data into a single submittal for each element or system. Mark each copy to show applicable choices and options.
 - 2. Where Product Data includes information on several products, and some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with recognized trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.

1.07 INFORMATIONAL SUBMITTALS

- A. Description: Submittals that are not Shop Drawings or Samples, or that do not reflect quality of product or method of construction. May include, but not limited to those Submittals identified below.
- B. Applications for Payment (and Cash Allowance Data and Values): Meet requirements of Section 01 29 00, Measurement and Payment.
- C. Construction Photographs: In accordance with Section 01 31 13, Coordination, and as may otherwise be required in the Contract Documents.
- D. Statement of Qualification (SOQ) for Land Surveyor, Site Safety Officer, Site Supervisor, Contractor's Project Manager, Specialty Subcontractor Site Supervisors, and other SOQ required by the Specifications.
- E. Health and Safety Plan: Contractor shall submit a copy of its Section 01 35 00, Health and Safety Requirements.

- F. Hurricane Preparedness Plan: Within 15 days of the date of Notice to Proceed, the Contractor shall submit to the Engineer a Hurricane Preparedness Plan. The plan shall outline the necessary preparedness and protective measures in accordance with local and state requirements. Implementation of the plan, in the event of hurricane warning that encompasses the project site, is included in the Contractor's Lump Sum Bid Amount.
- G. Contractor shall prepare a Maintenance of Traffic (MOT) plan in accordance with the requirements of Section 01 50 00, Construction Facilities and Temporary Controls and Section 32 12 16, Asphalt Concrete Pavement, and shall coordinate with Owner and landfill operation staff prior to any paving activities or other activities that might adversely affect the normal flow of traffic.
- H. Progress Reports and Quantity Charts: As may be required in Section 01 32 00, Progress Schedules.

1.08 DISTRIBUTION

- A. Submittals that were submitted electronically will be processed and returned to the Contractor electronically. An email will be sent to the Contractor with a link to the Engineer's ProjectWise system where the processed Submittals can be downloaded.
- B. Hard copies of submittal shall be provided as required by Paragraph 1.09.
- C. Furnish copies of final submittal to installers and others required for performance of construction activities. Show distribution on transmittal forms. Do not proceed with installation until an applicable copy of Product Data is in the installer's possession.
- D. Do not permit use of unmarked copies of Product Data in connection with construction.
- E. Maintain in separate folders and files, a complete extra set of all approved Submittals onsite for inspection by Engineer, Owner or Regulatory Agencies. Submit the extra set of Submittals to the Engineer/Owner boxed with contents listed on the box(es) at Final Completion.
- F. Prepare additional sets for subcontractors, manufacturers, fabricators, installers, and others as required for performance. Show distribution on transmittal forms.

1.09 DISPOSITION

- A. Shop Drawing and Samples: Engineer will review, mark, and stamp as appropriate and distribute marked-up copies as noted:
1. Accepted as Submitted (For Incorporation in Work):
 - a. One copy furnished Owner.
 - b. Two copies furnished Resident Project Representative.
 - c. One copy retained in Engineer's file.
 - d. Remaining copies returned to Contractor appropriately annotated.
 - e. Contractor may begin to implement activities to incorporate specific product(s) or Work covered by Submittal.
 2. Accepted as Noted (For Incorporation in Work):
 - a. One copy furnished Owner.
 - b. Two copies furnished Resident Project Representative.
 - c. One copy retained in Engineer's file.
 - d. Remaining copies returned to Contractor appropriately annotated.
 - e. Contractor may begin to implement activities to incorporate product(s) or Work covered by Submittal, in accordance with Engineer's notations.
 3. Incomplete:
 - a. Four copies distributed as appropriate and retained in Engineer's file.
 - b. Remaining copies returned to Contractor appropriately annotated.
 - c. Contractor shall complete and resubmit or submit missing portions.
 - d. Submittal is not fully accepted for implementation or incorporation into the Work. Contractor may begin to implement activities to incorporate product(s) or Work marked as accepted for the Submittal. Contractor must submit missing and unacceptable information as necessary to obtain full acceptance of the submittal.
 4. Revise and Resubmit:
 - a. Four copies distributed as appropriate and retained in Engineer's file.
 - b. Remaining copies returned to Contractor appropriately annotated.
 - c. Contractor shall make corrections or develop replacement and resubmit (in same manner and quantity as specified for original submission).
 - d. Submittal is not approved accepted for implementation or incorporation into the Work.

- B. Informational Submittals: Engineer will review, stamp, and indicate requirements for resubmission or acceptance on Submittal as follows:
1. Meets Project Criteria:
 - a. Contractor may proceed to perform Submittal related Work.
 - b. One copy furnished Owner.
 - c. Two copies furnished Resident Project Representative.
 - d. One copy retained in Engineer's file.
 - e. Remaining copies returned to Contractor appropriately annotated.
 2. Meets Project Criteria as Noted:
 - a. Contractor may proceed to perform Submittal related Work in accordance with the comments provide with the Engineer's response.
 - b. One copy furnished Owner.
 - c. Two copies furnished Resident Project Representative.
 - d. One copy retained in Engineer's file.
 - e. Remaining copies returned to Contractor appropriately annotated.
 3. Does not Meet Project Criteria; Resubmit:
 - a. One copy retained in Engineer's file.
 - b. Remaining copies returned to Contractor appropriately annotated.
 - c. Contractor shall revise/correct or develop replacement and resubmit.
- C. Submittals Required by Laws, Regulations, and Governing Agencies:
1. Submit promptly notifications, reports, certifications, payrolls, and others as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

1.10 CONTRACT CLOSEOUT SUBMITTALS

- A. Copies: Submit five. Contractor should increase the number of copies submitted accordingly if more than one copy needs to be returned.
- B. General: In accordance with Section 01 77 00, Contract Closeout.
- C. Disposition: Engineer will review, stamp, and indicate requirements for resubmission or acceptance on Submittal as follows:
1. Accepted:
 - a. Acceptance will indicate that Submittal conforms to intent of Contract Documents as to form and substance.
 - b. Contractor may proceed to perform Submittal related Work.
 - c. One copy furnished Owner.

- d. Two copies furnished Resident Project Representative.
 - e. One copy retained in Engineer's file.
 - f. Remaining copies returned to Contractor appropriately annotated.
2. Rejected as Noted:
- a. One copy retained in Engineer's file.
 - b. Remaining copies returned to Contractor appropriately annotated.
 - c. Contractor shall revise/correct or develop replacement and resubmit.

1.11 SUPPLEMENTS

- A. The supplements listed below, following “END OF SECTION,” are part of this Specification.
- 1. Supplement 1, Transmittal of Contractor's Submittal.
 - 2. Supplement 2, Contractor’s Shop Drawing Certification Stamp.
 - 3. Supplement 3, Submittal Review Comments.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL
(ATTACH TO EACH SUBMITTAL)

DATE: _____

TO: _____

Submittal No.: _____
 New Submittal Resubmittal
 Previous Submittal No.: _____
 Project: _____
 Project No.: _____
 Specification Section No.: _____

FROM: _____
 Contractor

(Cover only one section with each transmittal)
 Schedule Date of Submittal: _____

- SUBMITTAL TYPE:** Shop Drawing Administrative Sample
 Quality Control Contract Closeout "Or-Equal"/Substitute

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (AUTHORIZED SIGNATURE)

CONTRACTOR'S SHOP DRAWING STAMP

PROJECT NAME:	Orange County
SHOP DRAWING NO.:	_____
SPECIFICATION SECTION:	_____
<p>WITH RESPECT TO THIS SHOP DRAWING OR SAMPLE, I HAVE REVIEWED THIS PACKAGE AND I HAVE DETERMINED AND VERIFIED ALL QUANTITIES, DIMENSIONS, SPECIFIED PERFORMANCE CRITERIA, INSTALLATION REQUIREMENTS, MATERIALS, CATALOG NUMBERS, AND SIMILAR DATA WITH RESPECT THERETO AND REVIEWED OR COORDINATED THIS SHOP DRAWING OR SAMPLE WITH OTHER SHOP DRAWINGS AND SAMPLES AND WITH THE REQUIREMENTS OF THE WORK AND THE CONTRACT DOCUMENTS. I CERTIFY THAT THIS SHOP DRAWING MEETS OR EXCEED THE REQUIREMENTS OF THIS PROJECT.</p>	
<p>No Variation From Contract Documents. _____</p>	
<p>Variation From Contract Documents As Noted Below: _____</p>	
_____ (Name)	_____ (Title)
_____ (Date Reviewed and Verified)	

SUBMITTAL REVIEW COMMENTS

DATE: _____		PROJECT: <u>Orange County</u>	
SUBMITTAL NO.: _____		PROJECT NUMBER: <u>TA-051 (164622.2J.A2)</u>	
ORANGE CO. CONTRACT NO.: _____		PAGE: <u>Page 1 of 1</u>	
SUBMITTAL TYPE:	SHOP DRAWINGS & SAMPLES	ADMINISTRATIVE, QUALITY CONTROL & CLOSE-OUT	
<input type="checkbox"/>	1. ACCEPTED AS SUBMITTED	<input type="checkbox"/>	5. ACCEPTED
<input type="checkbox"/>	2. ACCEPTED AS NOTED	<input type="checkbox"/>	6. REJECTED AS NOTED
<input type="checkbox"/>	3. INCOMPLETE	<input type="checkbox"/>	
<input type="checkbox"/>	4. NOT ACCEPTED		
NO.	COMMENT	RELATED SPEC PARA./ DRAWING	REVIEWER'S INITIALS

**SECTION 01 35 00
HEALTH AND SAFETY REQUIREMENTS**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section outlines the health and safety requirements for the construction of the Project. These health and safety requirements shall be followed by the Contractor during the entire performance of the Work specified in this Contract Document. These requirements do not supersede, but are in addition to any federal, OSHA, state, or local requirements. If a conflict occurs between these requirements and current regulations, the more stringent shall apply.

1.02 SUBMITTALS

- A. The submittals for this section shall include the following:
 - 1. Site Specific Health and Safety Plan: A plan meeting the requirements specified in Paragraph 3.01.
 - 2. Personnel Certification: A certificate showing all Contractor personnel have received the minimum safety training as required by federal, OSHA, state, or local requirements and in conformance with the Site Specific Health and Safety Plan.
 - 3. Munitions training certification as require by Paragraph 3.03.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall furnish all labor, materials, equipment, and appurtenances to perform the Work specified in this section.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor is solely responsible for the health, safety, and protection of all onsite personnel during the performance of the work. The Contractor shall perform the work specified in these Contract Documents in accordance with the health and safety requirements specified herein, including the current edition of the standard operating safety guide: NIOSH guidance manual, and all federal, OSHA, state, and local health and safety regulations, including OSHA regulations for hazardous waste site work. It shall be the responsibility of the Contractor to be familiar with the required health and safety regulations in the performance of this work.

- B. Contractor shall prepare a project specific Health and Safety Plan for this Work. The plan shall include provisions for dealing with Munitions and Explosives of Concern (MEC). If materials suspected to being MEC are discovered by the Contractor, the finding shall be immediately report to the County and Engineer.
- C. The Contractor shall provide a Health and Safety Officer to implement, monitor, and enforce the Health and Safety Plan. The Health and Safety Officer shall not be the Superintendent, Project Manager or a Foreman assigned to this Project. The Health and Safety Officer shall have a sound working knowledge of federal and state occupational safety and health regulations and formal training in occupational safety and health adequate to comply with current OSHA requirements.
- D. The Health and Safety Officer may implement requirements in addition to those specified herein.
- E. Should any unforeseen or site specific safety concern, hazard or condition become evident during the performance of the work, the Contractor shall take immediate and prudent action to establish and maintain safe working conditions and to safeguard site personnel, the public, and the environment. The Contractor shall also immediately inform the Owner and Engineer of such condition.
- F. Payment for complying with the additional safety requirements for construction on this Project shall be included in the Contract lump sum price, and no separate payment will be made therefor.

3.02 HAZARD COMMUNICATIONS

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with law and regulations.
- B. Contractor shall inform their employees working onsite that the work site is a former World War II training facility that was used for small arms firing, air tactics evaluations, and training demonstrations of strafing, practice bombing, air-to-ground rocket firing and high explosive bombing; and that unexploded ordnance may still be present at the site.

3.03 MUNITIONS REQUIREMENTS

- A. The U. S. Army Corps of Engineers (USACOE) has informed Orange County, Florida (Owner) that portions of the Southern Expansion Site (SES) were included in the Pinecastle Jeep Range, a former World War II arms practice range and training facility. USACOE Fact Sheet titled “Formerly Used

Defense Site Program, Pinecastle Jeep Range,” dated July 2007, identifies two target areas on the Southern Expansion Site (SES) east of State Road 417, one centered on the proposed Cell 11 area and one near the proposed Western Borrow Area (WBA).

- B. The Owner had munitions Remedial Investigations (RIs) performed on three different occasions in 2008, 2009, and in 2013. More than 5,000 subsurface anomalies were investigated during these RIs of which approximately 99 percent were culture debris (nails, railroad spikes, metal scrap). A fused 40-millimeter (mm) MK2 high-explosive (HE) found in the 2008 RI, and a 37-mm anti-aircraft projectile found in the 2013 RI present a minimal hazard in the overall analysis of recovered items. The probability of encountering a hazardous munition is 0.0004 percent.
- C. Digital geophysical mapping (DGM) and intrusive investigation activities were performed in Cells 10-12, the associated stormwater pond areas, a landfill gas pipeline corridor, and two future borrow areas (the Southern Borrow Area [SBA] and WBA) during the three RIs conducted between 2008 and 2013. During the intrusive portion of these RIs, anomalies identified by DGM were reacquired, characterized, and their sources removed. Detectable and locatable anomalies within 1 meter of the identified anomalies have been removed to the limits of detection except in a small portion of the site near the northeast corner of Cell 11. The ability to detect and locate potential munitions is limited by the geophysical equipment used, the size of the objects present and the physical characteristics of the soils at the site. The Owner and the Engineer neither warrant nor imply that all potential munitions and explosives of concern (MEC) and materials potentially presenting an explosive hazard (MPPEH) have been located and removed from the construction site.
- D. The current risk level overall for the SES is “low risk” based on the hazard severity and an incident “probability of occurrence,” making the site suited for future planned activities. Prudent procedures working within the site should include 3R (recognize, retreat, and report) training, and a standard operating procedure for reporting future potential MEC and MPPEH to the appropriate authorities. An area referred to as the “disturbed area” (See attached figure) in the eastern portion of Bays 17, 18 and 19 was partially investigated and is considered as a “moderate risk.” It shall be considered as potentially containing hazardous munitions, which will require “construction support” during this project.
- E. Contractor shall provide onsite employees and Subcontractors employees 3R (recognize, retreat and report) training similar in nature to Version 1.0 Air Force Unexploded Ordnance Safety Training available from the U. S. Air Force Safety Center. Contractor shall maintain on site at all times Certificates indicating that onsite employees and Subcontractors employees have completed the required 3R Training.

- F. Contractor shall provide one (1) UXO Technician II to be on site at all times when earthmoving activities are underway within the “moderate risk” area indicated in Paragraph 3.03.D. UXO Technician II shall be qualified in accordance with Department of Defense Explosive Safety Board (DDESB) Technical Paper 18, Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel, December 20, 2004. Firms that supply such personnel may be found on the National Association of Ordnance Contractors web site at NAOC.org, Member List. The UXO technician shall have:
1. Schonstedt metal detector.
 2. Training and medical surveillance that conform to 29CFR 19 10.120 (e) and (f).
 3. American Red Cross (or equivalent training) certified in CPR, First Aid and AEDA.
 4. Vehicle driver license from the home state of record.
- G. UXO Technician shall present a graduation certificate from the Naval School of Explosive Ordnance Disposal and a resume to the County Project Manager or his designee. The UXO Technician shall be able and competent to perform procedures defined in US Army Corps of Engineers, Engineer Pamphlet (EP) 75-1-2, Munitions and Explosives of Concern (MEC) Support during Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities, August 01, 2004.”
- H. Contractor shall provide “on call” services of a UXO Contractor qualified to identify potential MEC and MPPEH encountered during construction and demilitarize the materials, if warranted.

3.04 INITIAL ONSITE SAFETY BRIEFING

- A. The Contractor shall provide an appropriate site-specific safety briefing to all onsite employees and subcontractors. This safety briefing shall include all items listed below:
1. Identify the Site Safety Office and distribute his/her contact information.
 2. Physical health hazards identified at the site.
 3. Personal hygiene.
 4. Safety equipment and procedures required for personal protection.
 5. Prohibitions in Working Areas: no eating, smoking, and chewing at the work area.
 6. Working when ill.
 7. Working under the influence of alcohol or drugs.
 8. Emergency response and procedures.
- B. The Contractor shall inform all onsite employees and subcontractors that smoking, alcoholic beverages, and illicit drugs are prohibited onsite.

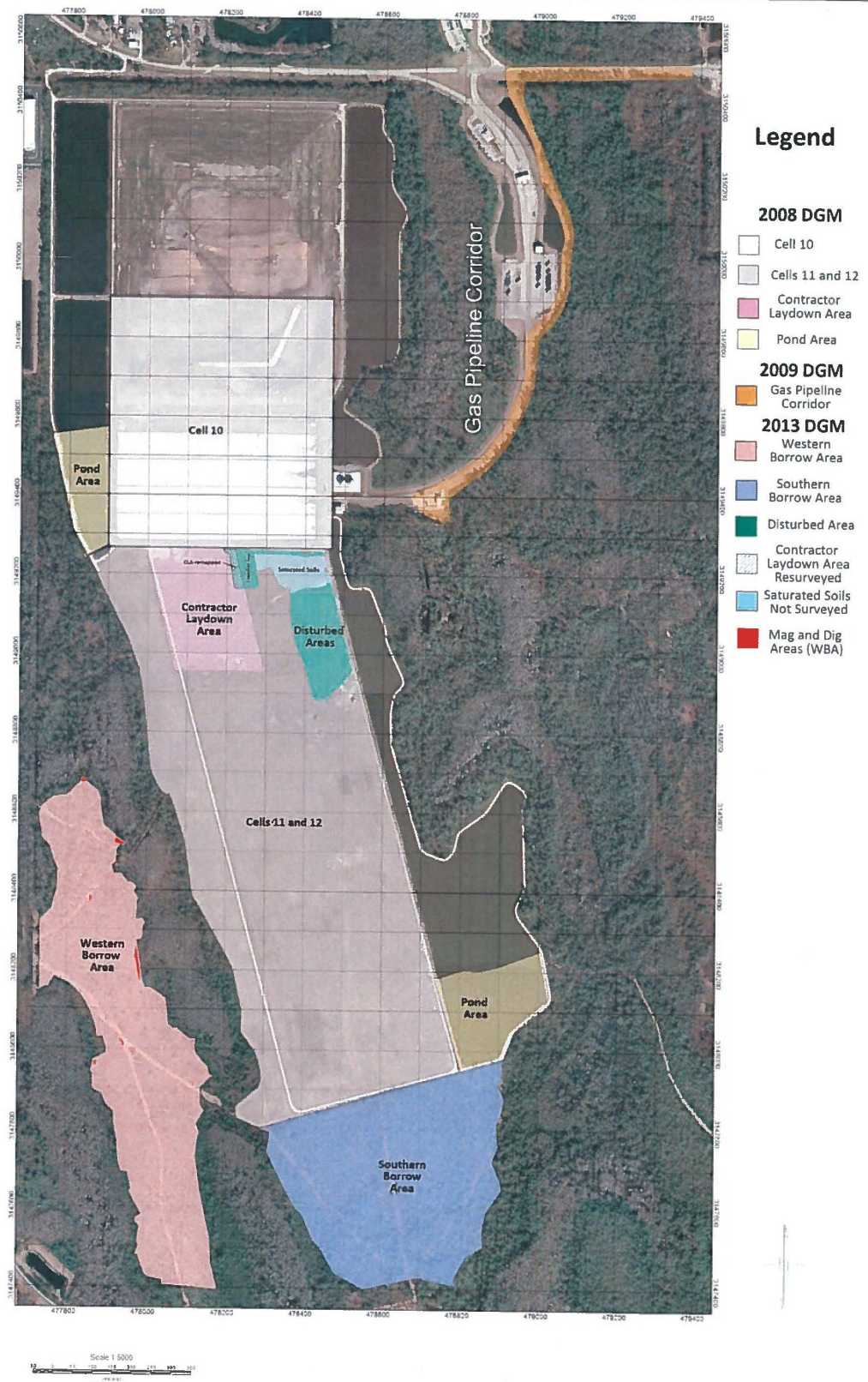
3.05 EMERGENCY AND FIRST AID REQUIREMENTS

- A. In the event of any emergency associated with or resulting from Work at this site, the Contractor shall without delay: cease work activity on the site; contact and notify proper local authorities as deemed appropriate based on the severity of the emergency; take cautious and diligent action to remove or otherwise minimize the cause of the emergency; render full assistance to local authorities; alert the Owner and Engineer; and institute whatever measures might be necessary to prevent any repetition of the conditions or actions leading to or resulting in the emergency.
- B. The Contractor shall have at least one trained first aid technician onsite at all times. This person may perform other duties, but must be immediately available to render first aid when needed.
- C. At least one “industrial” first aid kit shall be provided and be maintained fully stocked at a manned location. First aid kit locations shall be specially marked and provided with adequate water and other supplies necessary to cleanse and decontaminate burns, wounds, or lesions.

3.06 SUPPLEMENTS

- A. The supplements listed below, following “END OF SECTION,” are part of this Specification.
 - 1. Investigation Area, Legend.

END OF SECTION



E50204141015500NV

2008-2013 Investigation Area
 Southern Expansion Site, Orange County, Florida
CH2MHILL.

**SECTION 01 41 26
PERMITS AND FEES**

PART 1 GENERAL

1.01 CONSTRUCTION PERMITS

- A. Construction of this Project is required to be permitted by Federal, State and local permitting agencies.
- B. Contractor shall obtain and pay for all permits, licenses, notifications, and authorizations related to his work as provided for in the Conditions of the Contract, except as otherwise provided herein.
- C. The County has obtained the following Permits for this Project:
 - 1. *Solid Waste Management Facility Permit for Construction of Cell 11-12 Class I Landfill Expansion on the Southern Expansion Site*, Permit No. 0128169-049-SC-01, issued by the Florida Department of Environmental Protection, August 27, 2019. Copy included in Exhibit C of these Specifications.
 - 2. *Construction Environmental Resource Permit for Cell 11-12 Class I Landfill Expansion*, Permit No. 0177603-013-EI, issued by the Florida Department of Environmental Protection, December 27, 2018. Copy included in Exhibit C of these Specifications.
 - 3. *Formal Determination of the Landward Extent of Wetlands at the Orange County Landfill – Southern Expansion Site*, File No. FD-48-0166218-002, Notice of Agency Action by Florida Department of Environmental Protection, July 25, 2001. Renewal issued December 21, 2007.
 - 4. Orange County Solid Waste Management Facility – Southern Expansion Site, Conceptual Federal Dredge and Fill Permit Application, Permit Application No. 199905437 (IP-TB), issued by the U. S. Army Corps of Engineers, February 4, 2003.
 - 5. *Gopher Tortoise Relocation Permit Application* - If needed based on a survey prior to excavation activities, Permit Application will be prepared by Engineer for submittal to the Florida Fish & Wildlife Conservation Commission for removal and relocation of Gopher Tortoise from the construction site.

- D. Construction activities cannot begin until all permits have been issued. Copies of the applications and permits obtained by the County are on file with the permitting agencies for Contractor's review. Copies of the permits not provided herein may be provided to the Contractor at the pre-construction meeting with prior request of the selected Contractor.
- E. Contractor, prior to bidding for this Project, shall make himself familiar with the requirements of the all permits for this project and shall include all costs associated with compliance in his bid.
- F. Contractor shall be fully bound to comply with the general and specific conditions of the Owner obtained permits as part of this Contract at no additional cost to the Owner.
- G. Contractor shall be responsible for all corrective actions and fines due to any environmental impacts caused by the Contractor or any of his subcontractors and shall bear the full cost of all fines, penalties, engineering, legal fees and/or additional mitigation which may be imposed by any regulatory agency due to the failure to adhere to all permit requirements and conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 42 13
ABBREVIATIONS**

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards and specifications of technical societies, and reporting and resolving discrepancies associated therewith shall be as required herein and in the individual Specification sections.
- B. Work specified by reference to the published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet the requirements or surpass the minimum standards of quality for materials and workmanship established by the designated standard or specification.
- C. Where so specified, products or workmanship shall also meet or exceed the additional prescriptive or performance requirements included within the Contract Documents to establish a higher or more stringent standard of quality than that required by the referenced standard.
- D. Where two or more standards are specified to establish quality, the product and workmanship shall meet or exceed the requirements of the most stringent.
- E. Where both a standard and a brand name are specified for a product in the Contract Documents, the proprietary product named shall meet or exceed the requirements of the specified reference standard.
- F. Copies of standards and specifications of technical societies:
 - 1. Copies of applicable referenced standards have not been bound in these Contract Documents.
 - 2. Where copies of standards are needed by the Contractor, obtain a copy or copies directly from the publication source and maintain in an orderly manner at the site as Work site records, available to the Contractor's personnel, Subcontractors, Owner, and Engineer.

1.02 ABBREVIATIONS

- A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.
 - 1. AA Aluminum Association.
 - 2. AABC Associated Air Balance Council.

3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	ARI	Air-Conditioning and Refrigeration Institute
21.	ASAE	American Society of Agricultural Engineers
22.	ASCE	American Society of Civil Engineers
23.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
24.	ASME	American Society of Mechanical Engineers
25.	ASNT	American Society for Nondestructive Testing
26.	ASTM	ASTM International
27.	AWI	Architectural Woodwork Institute
28.	AWPA	American Wood Preservers' Association
29.	AWPI	American Wood Preservers' Institute
30.	AWS	American Welding Society
31.	AWWA	American Water Works Association
32.	BHMA	Builders Hardware Manufacturers' Association
33.	CBM	Certified Ballast Manufacturer
34.	CDA	Copper Development Association
35.	CGA	Compressed Gas Association
36.	CISPI	Cast Iron Soil Pipe Institute
37.	CMAA	Crane Manufacturers' Association of America
38.	CRSI	Concrete Reinforcing Steel Institute
39.	CS	Commercial Standard
40.	CSA	Canadian Standards Association
41.	CSI	Construction Specifications Institute
42.	DIN	Deutsches Institut für Normung e.V.
43.	DIPRA	Ductile Iron Pipe Research Association
44.	EIA	Electronic Industries Alliance
45.	EJCDC	Engineers Joint Contract Documents' Committee
46.	ETL	Electrical Test Laboratories

47.	FAA	Federal Aviation Administration
48.	FCC	Federal Communications Commission
49.	FDA	Food and Drug Administration
50.	FEMA	Federal Emergency Management Agency
51.	FIPS	Federal Information Processing Standards
52.	FM	Factory Mutual
53.	Fed. Spec.	Federal Specifications (FAA Specifications)
54.	FS	Federal Specifications and Standards (Technical Specifications)
55.	GA	Gypsum Association
56.	GANA	Glass Association of North America
57.	HI	Hydraulic Institute
58.	HMI	Hoist Manufacturers' Institute
59.	IBC	International Building Code
60.	ICBO	International Conference of Building Officials
61.	ICC	International Code Council
62.	ICEA	Insulated Cable Engineers' Association
63.	IFC	International Fire Code
64.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
65.	IESNA	Illuminating Engineering Society of North America
66.	IFI	Industrial Fasteners Institute
67.	IGMA	Insulating Glass Manufacturer's Alliance
68.	IMC	International Mechanical Code
69.	INDA	Association of the Nonwoven Fabrics Industry
70.	IPC	International Plumbing Code
71.	ISA	Instrumentation, Systems, and Automation Society
72.	ISO	International Organization for Standardization
73.	ITL	Independent Testing Laboratory
74.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
75.	MIA	Marble Institute of America
76.	MIL	Military Specifications
77.	MMA	Monorail Manufacturers' Association
78.	NAAMM	National Association of Architectural Metal Manufacturers
79.	NACE	NACE International
80.	NEBB	National Environmental Balancing Bureau
81.	NEC	National Electrical Code
82.	NECA	National Electrical Contractor's Association
83.	NEMA	National Electrical Manufacturers' Association
84.	NESC	National Electrical Safety Code
85.	NETA	InterNational Electrical Testing Association
86.	NFPA	National Fire Protection Association
87.	NHLA	National Hardwood Lumber Association
88.	NICET	National Institute for Certification in Engineering Technologies
89.	NIST	National Institute of Standards and Technology
90.	NRCA	National Roofing Contractors Association

- 91. NRTL Nationally Recognized Testing Laboratories
- 92. NSF NSF International
- 93. NSPE National Society of Professional Engineers
- 94. NTMA National Terrazzo and Mosaic Association
- 95. NWWDA National Wood Window and Door Association
- 96. OSHA Occupational Safety and Health Act (both Federal and State)

- 97. PCI Precast/Prestressed Concrete Institute
- 98. PEI Porcelain Enamel Institute
- 99. PPI Plastic Pipe Institute
- 100. PS Product Standards Section-U.S. Department of Commerce
- 101. RMA Rubber Manufacturers' Association
- 102. RUS Rural Utilities Service
- 103. Society of Automotive Engineers
- 104. SDI Steel Deck Institute
- 105. SDI Steel Door Institute
- 106. SJI Steel Joist Institute
- 107. SMACNA Sheet Metal and Air Conditioning Contractors National Association

- 108. SPI Society of the Plastics Industry
- 109. SSPC The Society for Protective Coatings
- 110. SWI Steel Window Institute
- 111. TEMA Tubular Exchanger Manufacturers' Association
- 112. TCA Tile Council of North America
- 113. TIA Telecommunications Industry Association
- 114. UBC Uniform Building Code
- 115. UFC Uniform Fire Code
- 116. UL Underwriters Laboratories Inc.
- 117. UMC Uniform Mechanical Code
- 118. USBR U.S. Bureau of Reclamation
- 119. WCLIB West Coast Lumber Inspection Bureau
- 120. WWPA Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 43 33
MANUFACTURERS' SERVICES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Person-Day: One person for 10 hours within regular Contractor working hours.

1.02 SUBMITTALS

- A. Training Schedule: Submit not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
- B. Lesson Plan: Submit proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.
- C. Maintenance Service Agreements: Submit preliminary Maintenance Service Agreements and a letter from the proposed Surety with Shop Drawings of the equipment covered by the Agreement.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified elsewhere.
- B. Representative subject to acceptance by Owner and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services when required by an individual Specification Section, to meet the requirements of this Section.
- B. Where the time required for the actual manufacturers' services is in excess of that stated in the Specifications, or when a minimum time is not specified, the time required to perform the cost of specified services shall be considered to be part of the Lump Sum Contract Amount.

- C. Schedule manufacturer's services to avoid conflict with other onsite testing or other manufacturers' onsite services.
- D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum services.
- F. When Specified in Individual Specification Sections, Manufacturer's Onsite Services shall Include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation included at the end of this Section.
 - 3. Providing, on a daily basis, copies of all manufacturers' representatives field notes and data to Engineer.
 - 4. Revisiting the site as required to correct problems and until installation and operation are acceptable to Engineer.
 - 5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing, and facility startup and evaluation.
 - 7. Training of Owner's personnel in the operation and maintenance of respective product as required.
 - 8. Additional requirements may be specified elsewhere.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. When specified in individual Specification section, submit prior to shipment of product or material.
- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Signed by product manufacturer certifying that product or material specified conforms to or exceeds specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this Section, shall be completed and signed by the equipment manufacturer's representative.
- B. Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

3.04 TRAINING

- A. General:
 - 1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
 - 2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
 - 3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
 - 4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.
 - 5. All training sessions shall be video taped by the manufacturer's representative and a copy of the tape shall be provided to the Owner.
- B. Training Schedule:
 - 1. List Specified Equipment and Systems that Require Training Services and Show:
 - a. Respective manufacturer.
 - b. Estimated dates for installation completion.
 - c. Estimated training dates.
 - 2. Allow for multiple sessions when several shifts are involved.
 - 3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
 - 4. Coordinate with Section 01 32 00, Progress Schedules and Section 01 91 14, Equipment Testing and Facility Startup.

- C. Lesson Plan: When specified, prepare for each required course, containing the following minimum information:
 - 1. Title and objectives.
 - 2. Recommended types of attendees (e.g., managers, engineers, operators, and maintenance personnel).
 - 3. Course description and outline of course content.
 - 4. Format (e.g., lecture, self-study, demonstration, and hands-on).
 - 5. Instruction materials and equipment requirements.
 - 6. Resumes of instructors providing the training.

- D. Prestartup Training:
 - 1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
 - 2. Complete at least 14 calendar days prior to beginning of facility startup.

- E. Post-Startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

3.05 SUPPLEMENTS

- A. The supplement listed below, following "END OF SECTION," is part of this Specification.
 - 1. Supplement, Manufacturer's Certificate of Proper Installation Form.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO: _____
EQPT TAG NO: _____ EQPT/SYSTEM: _____
PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- Functional tests.
- System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

**SECTION 01 45 16.13
QUALITY CONTROL, QUALITY ASSURANCE AND
TESTING LABORATORY SERVICES**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Inspection and testing of materials unless otherwise noted or specified shall be the responsibility of the Contractor. For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Five copies of the reports shall be submitted, and authoritative certification thereof must be furnished to the Engineer as a prerequisite for the acceptance of any material or equipment.

- B. If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract, the Contractor will be notified thereof and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the County.

- C. The Owner may, at any time during the progress of the work, request additional testing beyond that which is specified in the Contract. This testing will be at the Owner's expense. The Contractor shall assist the testing laboratory personnel in all ways so as to facilitate access to the location of the material or equipment to be tested.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.03 DEFINITIONS

- A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.04 SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

1.05 CONTRACTOR'S RESPONSIBILITIES

- A. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- B. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes, which require control by the testing laboratory.
- C. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The Engineer may require the Contractor to provide statements of certification from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.
- D. Furnish Incidental Labor and Facilities:
1. To provide access to work to be tested.
 2. To obtain and handle samples at the project site or at the source of the product to be tested.
 3. To facilitate inspections and tests.
 4. For storage and curing the test samples.
- E. Notify laboratory, sufficiently in advance of operations, to allow for laboratory assignment of personnel and scheduling of tests.
1. When tests or inspections cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to the Contractor's negligence.

- F. If the test results indicate the material or equipment complies with the Contract Documents, the Owner will pay for the cost of the testing laboratory. If the tests, and any subsequent retests, indicate the material and equipment fail to meet the requirements of the Contract Documents, the Contractor shall pay the laboratory costs incurred in such tests. Contractor shall also pay for standby time and/or results caused by Contractor's delay.

1.06 OWNER'S QUALITY ASSURANCE

- A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.
- B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:
 - 1. Relieve Contractor of responsibility for providing adequate quality control measures;
 - 2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
 - 3. Constitute or imply acceptance; or
 - 4. Affect the continuing rights of Owner after acceptance of the completed Work.
- C. The Owner will employ and pay for services of an independent Quality Assurance Testing Laboratory to perform testing specifically indicated in the Contract Documents, unless otherwise specified.
 - 1. Contractor shall complete a "Test Request and Test Result Summary" form included with this section for each test required by the Owner's independent testing laboratory. The form shall be completed and submitted to the Owner's RPR by 11:00 a.m. on the day prior to the test requirement.
 - 2. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
 - 3. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the work of the Contract.
- D. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.
- E. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.

- F. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

1.07 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is Not Authorized to:
 - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.
- B. Maintain complete inspection records and make them available at all times to Owner and Engineer.
- C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

- A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.
- B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.
- C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

A. CQC Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC Manager may perform other duties on the Project.
3. CQC Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
4. CQC Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. Obtain Engineer's acceptance before replacing the CQC Manager. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.04 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
 - a. Organization: Description of the quality control organization, including a chart showing lines of.
 - b. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

- c. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
 - d. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
 - e. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.
- C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.05 CONTRACTOR QUALITY CONTROL REPORT

- A. As a minimum, prepare a CQC report for every 30 calendar days. Reports shall be signed and dated by CQC Manager. Include copies of Contractor's and subcontractor's daily logs and test reports.
- B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items.
 - 1. These records shall cover both conforming and deficient features, and shall include a statement that equipment and materials incorporated in final work and workmanship comply with the Contract.

3.06 SUBMITTAL QUALITY CONTROL

- A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures.

3.07 TESTING QUALITY CONTROL

- A. Testing Procedure:
 - 1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory as required to meet requirements of the Contract Documents.

- B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.08 COMPLETION INSPECTION

- A. CQC Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.
- B. Deficiency List:
 - 1. CQC Manager shall develop a Deficiency List of items which do not conform to the Contract requirements.
 - 2. CQC Manager shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
 - 3. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

3.09 SUPPLEMENTS

- A. The supplement listed below, following “END OF SECTION,” is part of this Specification.
 - 1. Test Request and Testing Result Summary.

END OF SECTION

**TEST REQUEST AND TESTING RESULT SUMMARY
ORANGE COUNTY LANDFILL CELL 11**

TEST REQUEST NO.: _____ **DATE & TIME OF REQUEST:** _____

TYPE OF TEST REQUESTED:		
DATE & TIME OF PROPOSED TESTS	Date:	Time:
LOCATION(S) READY FOR TESTS	_____ _____	
CONTRACTOR'S SIGNATURE:	Name:	Signature:
TEST PERFORMED BY:	Name:	Organization:
RESULTS REVIEWED BY	Name;	Date:

SUMMARY OF TEST RESULTS & COMMENTS (Attach Copy of QA Consultants Field Report)

Results & Comments

TEST REQUEST DISTRIBUTION		TEST RESULTS DISTRIBUTION		REMARKS
Owner's RPR Attn.:		Owner's Project Manager & RPR Attn.:		
Engineer's Field Office: Attn:		Engineer's Field Office: Attn:		
QA Consultant Field Rep: Attn:		QA Consultant Field Rep: Attn:		
Contractor's Field Office: Attn:		Contractor's Field Office: Attn:		
Geotechnical Lab: Attn:		Other: Attn:		
Other: Attn:		Other: Attn:		

RPR'S Actions:	DATE RESULTS ACCEPTED BY RPR:
F	Failed, (Tech Test No. _____) see retest on Test Request No.: _____
R	RETEST for failed test on Test Request No.: _____
NR	No Review required - For information Purposes Only.

**SECTION 01 50 00
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish, install, and maintain two separate temporary field offices, one for the Contractor, and one for the Engineer and Owner's Resident Project Representative during the entire construction period. The temporary offices shall be adequately furnished and maintained in a clean and orderly condition by the Contractor until Final Completion.
- B. Temporary field offices shall be installed and operational prior to the start of construction.
- C. Upon final completion of work, remove the field offices from the Project Site and restore the area to original or better condition.
- D. Prior to installation of offices, consult with the Engineer and Owner on location, access, and related facilities.
- E. The Contractor or their authorized representative shall be present in the field office at all times while Work is in progress. Instructions received there from the Engineer or Owner will be considered as delivered to the Contractor.
- F. Maintain temporary utilities and temporary control as specified herein during the entire construction period.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Association of Nurserymen: American Standards for Nursery Stock.
 - 2. U.S. Weather Bureau, "Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years."
 - 3. U.S. Department of Agriculture, "Urban Hydrology for Small Watersheds."
 - 4. Federal Emergency Management Agency.
 - 5. NFPA, National Fire Prevention Standard for Safeguarding Building Construction Operations.

1.03 SUBMITTALS

- A. Administrative Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
- B. Shop Drawings:
 - 1. Temporary Construction Submittals:
 - a. Access Roads: Routes, cross-sections, and drainage facilities.
 - b. Contractor's field office, storage yard, and storage building plans including gravel surfaced area.
 - c. Fencing and protective barrier locations and details.
 - d. Engineer's and Owner's field office plans.
 - e. Staging area location plan.
 - f. Traffic Control and Routing Plans: As specified herein, and proposed revisions thereto.
 - g. Plan for maintenance of existing plant operations.

1.04 MOBILIZATION

- A. Mobilization shall Include, but Not be Limited to, these Principal Items:
 - 1. Obtaining required permits.
 - 2. Moving Contractor's, and Engineer's and Owner's field offices, and equipment required for first month's operations onto site.
 - 3. Installing temporary construction power, wiring, and lighting facilities.
 - 4. Providing onsite communication facilities, including telephones and internet service.
 - 5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 - 6. Arranging for and erection of Contractor's work and storage yard.
 - 7. Posting OSHA required notices and establishing safety programs and procedures.
 - 8. Having the Contractor's superintendent at the site full time.
- B. Use area designated for Contractor's temporary facilities as shown on Drawings.

1.05 PERMITS

- A. Permits, Licenses, or Approvals: Obtain in accordance with the General Conditions and as otherwise may be provided in Section 01 41 26, Permits and Fees and the Supplemental Conditions and retain onsite.

1.06 PROTECTION OF WORK AND PROPERTY

- A. Comply with Owner's safety rules while on Owner's property.
- B. Keep Owner informed of all accidents whether OSHA reportable or not on the site and related claims.
- C. Contractor shall maintain a log of all Contractor's employees, Subcontractors' employee, suppliers' and manufacturers' representatives, and all other onsite visitors for which the Contractor has responsibility using the "Visitor's Sign-In Log" included with this Section. The log shall be maintained in the Contractor's field offices and copies of the log shall be provided to the Engineer on a weekly basis.
- D. Use of Explosives: No blasting or use of explosives will be allowed on the site.
- E. During the performance of the Work, Contractor is responsible for adapting its means, methods, techniques, sequences and procedures of construction to be consistent with applicable permit requirements, and Laws and Regulations. In performing such Work and in cooperating with the Owner to maintain operations, it may be necessary for the Contractor to plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items which shall be included in the Contract Price.

1.07 VEHICULAR TRAFFIC

- A. Maintenance of Traffic (MOT) Plan:
 - 1. The Contractor shall be responsible for ensuring the normal traffic to the landfill is not interrupted due to their activities, and responsible for the maintenance of vehicular traffic on Young Pine Road and the Cells 9-12 Access Road. The Contractor shall submit a MOT Plan for review by the Engineer. Plan shall conform to *Uniform Manual of Traffic Control Procedures* as well as FDOT Standard Drawings. Engineer's review of the Contractor's MOT Plan does not constitute the Owner's or the Engineer's approval of such plan.
 - 2. Contractor shall be fully responsible for a complete safety and control of traffic in accordance with the established rules and regulations.
 - 3. The Contractor shall perform the Work in a manner that will allow at least one travel lane of Young Pine Road and the Cells 9-12 Access Road to be open between the hours of 10:00 a.m. and 4:00 p.m. Additionally, the Contractor shall perform the Work in a manner that will allow two travel lanes to be open between 6:00 a.m. and 10:00 a.m., and 4:00 p.m. and 6:00 p.m.

4. The Contractor shall be responsible for all traffic controls, signs, flagmen, and shall perform such work in accordance with State of Florida DOT and Orange County Standards. Compensation to the Contractor for all traffic control and maintenance shall be included in the lump sum portion of the Contract and no additional compensation shall be made.
 5. Contractor's vehicles and drivers are required to obey the posted speed limits on all onsite roads and allow the Owner's vehicles and normal traffic to the landfill to have the rights-of-way.
 6. Contractor shall inform all employees and all his on-site subcontractors to allow rights-of-way to the Owner's vehicles, equipment and normal traffic to the landfill.
 7. Adhere to traffic control plan reviewed and accepted by the Engineer. Changes to this plan shall be made only by written acceptance by the Engineer. Secure acceptance of necessary changes so as not to delay progress of the Work.
- B. Coordinate with Engineer detours and other operations affecting traffic and access. Provide at least 72 hours' notice to Engineer of operations that will alter access to the site.

1.08 DUST CONTROL

- A. Strictly adhere to applicable environmental regulations for dust prevention.
- B. Control measures will be implemented to minimize windblown dust from the project, prevent visible emissions from leaving the landfill property and avoid visibility impairment along the landfill entrance road. If construction occurs during a period of drought or water restrictions, priority will be placed on non-water-based methods to minimize dust. Dust control measures will include:
1. Application of a dust-preventive treatment or periodic water of unpaved streets, roads, detours, or haul roads used in the construction area to prevent dust.
 2. Performance of operations such as excavation, grading, loading, dumping, or carrying earthfill or other material in a manner that produces a minimum of dust.
 3. Rocked construction entrances/exits to reduce track out of mud/dirt from the site
 4. Maintaining streets and roadways adjacent to construction entrances/exits by sweeping accumulated soil tracked onto the street manually or mechanically as needed to prevent dust created from passing vehicles.

- 5. Designated stabilized construction access roads onsite to prevent vehicles and equipment from impacting vegetation unnecessarily in areas that do not need to be impacted by construction.
- C. If the above-referenced measures are not sufficient to control dust from the project, application of water or dust control chemicals, to the excavation area, construction access roads, and/or stockpiles, or use of portable misting systems may be used to control dust to prevent visible emissions from leaving landfill property.

PART 2 PRODUCTS

2.01 ENGINEER'S AND OWNER'S FIELD OFFICE

- A. Furnish equipment specified under the article for the exclusive use of Engineer and its representatives.
- B. Ownership of equipment furnished under this article will remain, unless otherwise specified, that of the Contractor.
- C. Equipment furnished shall be new or like new in appearance and function.
- D. Minimum Features:
 - 1. 110-volt lighting and wall plugs.
 - 2. Ceiling lights.
 - 3. Electric heating and self-contained air conditioning unit, properly sized for Project locale and conditions. Provide ample electric power to operate installed systems.
 - 4. Railed stairways and landings at entrances.
 - 5. Two Signs at Entrance Door: One reading, Orange County Utilities Solid Waste Division, Project Field Office, and one reading, Jacob's Field Office. Letter height on both signs shall be 4 inches minimum.
 - 6. Exterior Door(s):
 - a. Number: Two.
 - b. Type: Solid core.
 - c. Lock(s): Cylindrical.
 - 7. Number of Windows: Twelve.
 - 8. Minimum Interior Height: 8 feet.
- E. Floor Space: Minimum 1,000 square feet.
- F. Rooms: Five, with four private offices having minimum floor space of 100 square feet each and the remainder configured for open meeting space.
- G. A 3-foot by 5-foot plan table for open meeting area, four double desks with two drawers, five lockable steel file cabinets; and overhead shelf.

H. Office Equipment:

1. Swivel Chair: Four each.
2. Folding Table: Five each, 36 inches by 72 inches.
3. Steel Folding Chairs: Ten each.
4. Bookcase: Five each, 36 inches wide by 48 inches high.
5. Wastepaper Basket: Six each.
6. Clothes Rack: Two each.
7. First-Aid Kit: One each; standard recommended size for an office with 10 residents.
8. Carbon Dioxide (10-Pound) Fire Extinguisher: One each.
9. Telephone: Five each, with one intercom line and four incoming/outgoing lines, Touch-Tone, with conference speaker, and 12-foot coiled handset cord.
10. Fastest available in the market DSL line or equivalent for computers in each of the four offices with wireless Internet connectivity.
11. Arrange for voice mail (answering) service through local phone company or other approved carrier.
12. An office size photocopy/printer/scanner/fax machine with wireless network capability that copies and prints letter, legal, and ledger size paper with maintenance and service throughout construction period, HP Laserjet Enterprise M775f A3 Colour Multifunction Laser Printer or approved equal.

2.02 PROJECT SIGN

- A. Provide and maintain two 8-foot wide by 4-foot high signs constructed of 3/4-inch exterior high density overlaid plywood. Signs shall bear the name of Project, Owner, Contractor, Engineer, and other participating agencies. Lettering shall be blue applied on a white background by an experienced sign painter. Paint shall be exterior type enamel. The information to be included will be provided by the Owner.
- B. One sign shall be installed near the entrance to the Project and one shall be installed near the temporary field offices. Location of the signs shall be approved by the Owner.

PART 3 EXECUTION

3.01 ENGINEER'S AND OWNER'S FIELD OFFICE

- A. Make available with all the services for Engineer's and Owner's use at least 14 calendar days prior to the start of Work at the site. Field office shall remain on the site for a minimum of 30 days after following Substantial Completion and shall be removed prior to Final Acceptance of the Work.

- B. Locate where directed by Engineer; level, block, tie down, skirt, provide stairways, and relocate when necessary and approved. Construct on proper foundations, provide proper surface drainage and connections for utility services.
- C. Provide minimum 100 square feet of gravel, crushed rock base or recovered asphaltic pavement, minimum depth of 4 inches, at each entrance. Maintain parking area and access to trailers, clear of weeds, mud, re-grade as necessary and as many times as necessary throughout the construction of the project.
- D. Raise grade under field office, as necessary, to an elevation adequate to avoid flooding.
- E. Provide sanitary facilities in compliance with state and local health authorities.
- F. Exterior Door Keys: Furnish four set(s) of keys for Engineer's and Owner's Field Office.
- G. Telephone:
 - 1. Provide number of incoming lines equal to that specified for the telephone type.
 - 2. Provide appropriate jacks; locate as directed by the Engineer.
 - 3. Provide all wiring necessary for a completed telephone system.
 - 4. Provide separate DSL or wireless connectivity for the Engineer's and Owner's Field Office.
- H. Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of hand soap, toilet paper, and first-aid kit supplies.
- I. Provide letter, legal and tabloid size paper for Engineer's and Owner's Field Office printer/copier.

3.02 TEMPORARY UTILITIES

- A. Power:
 - 1. Electric power is available along Young Pine Road, along the Cells 9-12 Access Road, and west and north of Cell 9. Determine the type and amount available and make arrangements and installation for obtaining temporary electric power service, metering equipment, and pay all costs for the electric power used during the contract period, except for portions of the Work designated in writing by the Engineer as substantially complete.
 - 2. Cost of electric power used in performance and acceptance testing will be borne by the Owner.

- B. Lighting: Provide temporary lighting at least to meet all applicable safety and security requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the Work.
- C. Water:
 - 1. Construction water is available in the onsite stormwater ponds and potable water is available along the Cell 9 access road, at the Leachate Storage Tanks and at the General Maintenance Facility. Make arrangements for and bear costs of providing water required for construction purposes and for drinking by construction personnel during construction.
 - 2. Provide temporary (potable or non-potable) water supply well for restrooms at Engineer's and Owner's Field Office.
 - 3. If non-potable water is provided for the restrooms, provide bottled drinking water for the Engineer's and Owner's Field Office.
- D. Sanitary and Personnel Facilities: Provide and maintain facilities for Engineer's and Owner's Field Office, Contractor's employees, Subcontractors, and any other onsite employees affiliated with the Contractor. Service, clean and maintain facilities and enclosures.
- E. Telephone Service: Arrange and provide onsite telephone service for Contractor's, Engineer's, and Owner's use during construction. Pay all costs of installation and monthly bills including long distance, DSL and Internet access charges.
- F. Fire Protection: Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

3.03 PROTECTION OF WORK AND PROPERTY

- A. General:
 - 1. Maintain in continuous service all existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along the line of work, unless other arrangements satisfactory to Owner's of said utilities have been made.
 - 2. Where completion of Work requires temporary or permanent removal and/or relocation of an existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.

3. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
4. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
5. In areas where the Contractor's operations are adjacent to or near a utility such as gas, telephone, television, electric power, water, sewer, or irrigation system and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection thereof have been made by the Contractor.
6. Notify property owners and utility offices which may be affected by the construction operation at least 2 days in advance.
 - a. Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to the Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
7. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures. Maintain original site drainage wherever possible.

B. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside the limits of the Work and within the limits of the Work which are designated on the Drawings to remain undisturbed.
 - a. Where practical, tunnel beneath trees when on or near the line of trench.
 - b. Employ hand excavation as necessary to prevent tree injury.
 - c. Do not stockpile materials or permit traffic within drip lines of trees.
 - d. Provide and maintain temporary barricades around trees.
 - e. Water vegetation as necessary to maintain health.
 - f. Cover temporarily exposed roots with wet burlap, and keep the burlap moist until soil is replaced around the roots.
 - g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of the Engineer.
2. In the event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
3. Replace each plant that dies as a result of construction activities.

- C. Existing Structures:
 - 1. If construction of the work requires relocation of existing structures, the Contractor shall be responsible for relocation of any above ground or underground structures within the construction limit lines, including but not limited to signs, guard rails, fences, conduits, piping, trees, rubbish, and drains that interfere with the positioning of the work as set out in the Drawings. The cost of such relocations and replacements shall be incurred by the Contractor.
 - 2. Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of property owner and Engineer. Replace those removed in a condition equal to or better than original.
- D. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.
- E. Protection of Wetland Areas: The Contractor shall properly dispose of all surplus material, including spoil, in accordance with local, state, and federal regulations. Under no circumstances shall surplus material be disposed of in wetland areas as defined by the Florida Department of Environmental Regulation.
- F. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain the foundations and parts of the Work free from water.
- G. Endangered Species:
 - 1. Take precautions necessary and prudent to protect native endangered flora and fauna.
 - 2. Notify Engineer of construction activities that might threaten endangered species or their habitats.
 - 3. Engineer will mark areas known as habitats of endangered species prior to commencement of onsite activities.
 - 4. Additional areas will be marked by Engineer, as other habitats of endangered species become known during construction.
- H. Protection of Monitoring Wells and Other Monitoring Devices: Contractor shall protect existing monitor wells, staff gauges, water level recorders, or any other monitoring devices within the limits of construction.

- I. Installation of New Monitoring Wells: New monitoring wells will be “by others.” Construction of the approach areas for monitoring wells in Pond 8 shall be coordinated with the Engineer and Owner, and scheduled to allow adequate time for monitoring well installation prior to the installation of overhead power lines.

3.04 TEMPORARY CONTROLS

A. Air Pollution Control:

- 1. Minimize air pollution from construction operations.
- 2. Burning: Burning of land to clear debris from the project site is acceptable provided that the Contractor secures all necessary permits and regulatory burning approvals. Other waste materials, rubbish, or debris will not be permitted on or adjacent to the site.

B. Water Pollution Control:

- 1. Do not cause or permit action to occur which would cause an overflow to an existing waterway.
- 2. Prior to commencing excavation and construction, obtain Engineer's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and stormwater flow, including dewatering pump discharges.
- 3. Comply with procedures outlined in U.S. Environmental Protection Agency manuals entitled, “Guidelines for Erosion and Sedimentation Control Planning” and “Implementation, Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity,” and “Erosion and Sediment Control-Surface Mining in Eastern United States.”
- 4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

C. Erosion, Sediment, and Flood Control:

- 1. Provide erosion and sediment in accordance with Section 01 57 13, Temporary Erosion and Sedimentation Control, and as specified in the following paragraphs.
- 2. Provide, maintain, and operate temporary facilities to control erosion and sediment releases, and to protect Work and existing facilities from flooding during construction period.

3. Design erosion and sediment controls to handle peak runoff resulting from 25-year, 24-hour storm event based on U.S. Weather Bureau, "Rainfall-Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," Technical Paper No. 40, 1981.
4. Sufficient precautions shall be taken during construction to prevent the run-off of polluting substances such as silt, clay, fuels, oils, bitumens, or other polluting materials harmful to humans, fish, or other life, into the supplies and surface waters of the site. Control measures shall be adequate to ensure that turbidity in the receiving water will not be increased more than 29 nephelometric turbidity units (NTU) above background, unless otherwise permitted. Erosion evident within the limits of construction or other areas affected by the Contractor shall be the responsibility of the Contractor during the full term of the contract and for the full 1-year guarantee period. Areas subject to erosion during this time shall be fully restored to original or design conditions within 10 days of notice to the Contractor.
5. The Contractor shall be responsible for complying with all applicable permit conditions. Contractor shall prepare the site and facilitate regulatory agency site visits.
6. Size temporary stormwater conveyances based on procedures presented in U.S. Department of Agriculture, "Urban Hydrology for Small Watersheds," Soil Conservation Service Engineering Technical Release No. 55, 1986.
7. Design temporary flood control facilities for design flood with minimum of 3 feet of freeboard. The design flood shall be as published by FEMA for 100-year recurrence interval.

D. Inclement Weather:

1. Protect the Work from inclement weather. Work or materials, which has been damaged or injured by reason of failure on the part of the Contractor or subcontractors to protect the Work, shall be removed and replaced at the expense of the Contractor.
2. During inclement weather, Work which might be damaged or rendered inferior by such weather conditions should be suspended. During suspension of the work, the Work shall be suitably covered and protected so as to preserve it from damage by the weather.
3. If work is suspended due to threat of hurricane or inclement weather, Contract Time will be adjusted for the actual days work was suspended in accordance with Section 01 32 00, Progress Schedules.
4. Damage Due to High Speed Wind and Water:
 - a. Contractor shall be responsible for damage done to Work by rainstorm, run-off, windstorm, hurricanes, tornados or floods and Contractor shall take all reasonable precautions to provide against damages in a permittable manner.

- b. Contractor shall protect the in-place geomembrane liner from any damage and shall replace and repair all damages at no additional cost to the Owner.
 - c. Contractor shall protect and maintain the protective cover against windstorms and rainstorms by sequencing the work and covering with sod and placement of erosion control measures such that large unprotected areas are not exposed to rainstorm runoff, erosion and washouts.
 - d. Contractor shall repair eroded areas immediately without any additional cost to the Owner.
- E. Use of Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with manufacturer's instructions. Contractor shall maintain a Safety Data Sheet Notebook onsite.

3.05 STORAGE YARDS AND BUILDINGS

- A. Coordinate requirements with Section 01 60 00, Material and Equipment.
- B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.
- C. Temporary Storage Buildings:
 - 1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
 - 2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
 - 3. Store combustible materials (paints, solvents, fuels, etc.) in a well-ventilated, remote building meeting safety standards.

3.06 ACCESS ROADS

- A. Construct access roads as shown and within easements, rights-of-way, or Project limits. Utilize existing roads where shown.
- B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.
- C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

- D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.
- E. Upon completion of construction, restore ground surface disturbed by access road construction to original grade. Replace damaged or broken culverts with new culvert pipe of same diameter and material.

3.07 PARKING AREAS

- A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.
- B. Provide parking facilities for personnel working on the Project. No employee or equipment parking will be permitted on Owner's existing paved areas.

3.08 MAINTENANCE AND CLEANING DURING CONSTRUCTION

- A. In accordance with the General Conditions, as may be specified in Specification sections, and as required herein.
- B. Furnish, replace, and replenish light bulbs, fluorescent tubes, printer cartridge, copier ink cartridge, facsimile paper, photocopier/printer paper, toilet paper, paper towels, soap, bottled water, first-aid and other things required to maintain the office in a clean working condition.
- C. Provide a weekly cleaning service to sweep and mop the office trailer floors, dust furnishings, and clean water closets and inside.
- D. Maintain the parking area in front of the field office by removing weed and regrading the site on a regular basis.
- E. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least at weekly intervals, dispose of such waste materials, debris, and rubbish offsite.
- F. At least weekly, brush sweep the entry drive and roadways, and all other streets and walkways affected by Work and where adjacent to Work.

3.09 SUPPLEMENTS

- A. The supplement listed below, following "END OF SECTION," is part of this Specification.
 - 1. Supplement, Visitor's Sign-In Log.

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. The Work specified in this Section consists of designing, providing, maintaining, and removing temporary erosion and sedimentation controls as necessary. As a minimum, the Contractor is responsible to install silt curtains around the boundaries of the existing wetlands on the east and west side of the project site to protect these wetlands from any damage during construction. Any damage to wetlands beyond the limits of construction shown on the Drawings shall be corrected by the Contractor at no charge to the Owner. The Contractor shall also be responsible to install turbidity barriers in the waterways downstream from the construction site in accordance with local and state laws.
2. Temporary erosion controls include, but are not limited to, grassing, mulching, netting, watering, and reseeding onsite surfaces and soil and borrow area surfaces, and providing interceptor ditches at end of berms and at those locations, which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the regulatory agencies having jurisdiction.
3. Temporary sedimentation controls include, but are not limited to, silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces, which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the regulatory agencies having jurisdiction.
4. Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective.
5. All activities shall comply with applicable Environmental Resource Permits and the Florida Department of Environmental Protection's Erosion and Sediment Control Inspector's Manual. Copies of applicable Environmental Resource Permits will be provided to the Contractor by request.

1.02 SUBMITTALS

- A. Contractor shall submit a copy of their Erosion and Sedimentation Control Plan to the Engineer prior to the start of Work.

PART 2 PRODUCTS

2.01 EROSION AND SEDIMENTATION CONTROL

- A. Bales: Clean, seed-free cereal hay type.
- B. Netting: Fabricated of material acceptable to the Owner.
- C. Filter Stone: Crushed stone conforming to Florida Department of Transportation Specifications.
- D. Concrete Block: Hollow, nonload bearing type.
- E. Concrete: Exterior grade not less than 1-inch thick.

PART 3 EXECUTION

3.01 PERFORMANCE

- A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results which comply with the requirements of the regulatory agency having jurisdiction, the Owner, Engineer, or Contractor shall immediately take whatever steps are necessary to correct the deficiency at Contractor's expense.

END OF SECTION

**SECTION 01 60 00
MATERIAL AND EQUIPMENT**

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock.
2. Existing materials or components required for reuse.
3. Includes references by the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change the meaning of such other terms used in the Contract Documents as those terms are self-explanatory and have well recognized meanings in the construction industry.
4. Items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A. All materials and manufactured articles for incorporation into the Work shall be new and unused standard products of recognized reputable manufacturers.
- B. Provide systems, equipment, and components, including supports and anchorages, in accordance with the provisions of the latest edition of Standard Building Code (SBCCI).
1. Wind: 100 mph, with exposure C condition and an importance factor of 1.15.
 2. Seismic: Zone 1, importance factor of 1, unless specified otherwise.

1.03 SUBMITTALS

A. Administrative Submittals:

1. List of all proposed substitute or "or-equal" items/methods.
2. Schedule of factory tests required by Contract Documents. Identify tests for which Engineer's presence has been specified.

B. Quality Control Submittals:

1. Factory Tests: As specified in the individual Specifications.
 - a. Procedures: Preliminary outlines.
 - 1) Final Accepted Procedures: Prior to start of factory testing.
 - b. Test Documentation: Results of successful testing, including certification of procedures and results.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 100 feet above sea level.
- B. Provide equipment and devices installed outdoors or in unheated and uncooled enclosures capable of continuous operation within an ambient temperature range of 15 degrees F to 110 degrees F. If heating and/or cooling is required for continuous operation at the ambient temperatures specified, such heating and cooling shall be provided by the Contractor at no additional cost to the Owner.

1.05 PREPARATION FOR SHIPMENT

- A. When practical, factory assemble products. Matchmark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with a strippable protective coating.
- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
- C. Spare Parts, Special Tools, Test Equipment, Expendables, and Maintenance Materials:
 1. Furnish as required by the Specifications prior to (i) starting functional testing, or (ii) operation of the equipment by the Owner, or (iii) 75 percent Project completion, whichever occurs first.
 2. Properly package to avoid damage, in original cartons insofar as possible. Replace parts damaged or otherwise inoperable.
 3. Firmly fix to, and prominently display on, each package.
 - a. Minimum 3-inch by 6-inch manila shipping tag with the following information printed clearly:
 - 1) Manufacturer's part description and number.
 - 2) Applicable equipment description.

- 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
 - 5) Applicable Specification Section.
 - 6) Name of Contractor.
 - 7) Project name.
4. Notify the Owner's Resident Project Representative upon arrival.
- D. Protect equipment from exposure to the elements and keep thoroughly dry and dustfree at all times. Protect painted surfaces against impact, abrasion, discoloration, or other damage. Grease or oil all bearings and similar items.
 - E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification Sections.

1.06 DELIVERY AND INSPECTION

- A. Deliver products in accordance with the accepted current progress schedule and coordinate to avoid conflict with Work and conditions at the site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label date of manufacture and shelf life, where applicable. Include UL labels on products so specified.
- C. Unload products in accordance with manufacturer's instructions for unloading, or as specified. Record the receipt of products at the site. Inspect for completeness and evidence of damage during shipment.
- D. Remove damaged products from the site and expedite delivery of identical new undamaged products and remedy incomplete or lost products to provide that specified, so as not to delay the progress of the Work.

1.07 HANDLING, STORAGE, AND PROTECTION

- A. Handle products in accordance with the manufacturer's written instructions, and in a manner to prevent damage. Store products, upon delivery, in accordance with manufacturer's instructions, with labels intact and legible, in approved storage yards or sheds provided in accordance with Section 01 50 00, Construction Facilities and Temporary Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

- B. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered but not installed in the Work.
- C. Store electrical, instrumentation, and control products, and equipment with bearings in weathertight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage. Connect and operate continuously all space heaters furnished in electrical equipment.
- D. Store fabricated products aboveground, on blocking or skids, and prevent soiling or staining. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- E. Store finished products that are ready for installation in dry and well ventilated areas. Do not subject to extreme changes in temperature or humidity.
- F. Hazardous Materials: Prevent contamination of personnel, the storage building, and the site. Meet the requirements of the product specifications, codes, and manufacturer's instructions.

1.08 SUBSTITUTE AND “OR-EQUAL” PRODUCTS

- A. When a particular product is specified or called for, it is intended and shall be understood that the proposal tendered by the Contractor included those products in the bid submitted. Should the Contractor desire equal to those specified, the Contractor shall furnish information as described herein and in the Standard General Conditions. The alternate product or products shall meet the requirements of the Specifications and shall, in all respects, be equal to or better than the products specified by name herein. The Engineer shall be the sole person deciding the proposed product substitution meets the specifications.
- B. Listing of Proposed Substitute or “Or-equal” Items or Methods:
 - 1. With consideration of the additional evaluation time necessary for Engineer's review of such items, indicate for each item the review status (either substitute or “or-equal”) and estimated submission date.
 - 2. Contractor, in indicating the review status of the proposed item, acknowledges that the time shown for Engineer's review on the current accepted schedule is sufficient only to allow Engineer to accomplish review for the status indicated and not sufficient to perform both a review for “or-equal” status and a subsequent review for substitute status on the same product.

3. Engineer may return unreviewed those submissions (i) not shown on the current accepted schedule, (ii) for which the review status differs from that indicated on the accepted list unless previously approved in writing by Engineer, (iii) not in accordance with the General Conditions and as specified herein, (iv) which are incomplete, or (v) which are uncertified, in which case Contractor shall provide the specified product.
- C. Submit seven copies unless otherwise specified in Section 01 33 00, Submittals of proposed substitute or “or-equal” item/method, to include all supporting data to allow Engineer's review. Complete, sign, and transmit with each proposed substitute or “or-equal” item/method submission.
 - D. Contractor shall provide a point by point list demonstrating the equality of the proposed substitution.
 - E. Substitutions involving building code related products or materials must be approved by the Orange County Building Department.
 - F. Disposition of “Or-Equal” Item: In accordance with Article Shop Drawings and Samples in Section 01 33 00, Submittals, or in accordance with following paragraph.
 - G. Disposition of Substitute Item/Method:
 1. Accepted: Engineer will evidence such acceptance in writing to the Contractor. If the substitution involves a change in Contract Amount Engineer will recommend a Change Order for Contractor and Owner execution. Such Change Order will accompany Engineer's evaluation and acceptance of Contractor's proposed substitute.
 2. Rejected:
 - a. One copy retained by Engineer.
 - b. One copy returned to Contractor with a commentary by Engineer.
 - c. Remaining copies will be destroyed.
 - d. Contractor shall provide item specified in Contract Documents.
 - H. The Contractor shall be responsible for all costs associated with product substitutions that require major design changes to related or adjacent work made necessary by the substitutions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions unless otherwise specified in the individual Specifications.

- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance Specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, and manufacturer's services and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- E. Equipment, Components, Systems, Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.
- F. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- G. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.
- H. Provide materials and equipment listed by UL wherever standards have been established by that agency.
- I. Equipment Finish: Provide manufacturer's standard finish and color, except where specific color is indicated.
- J. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- K. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible. Oil drains with bronze or stainless steel valves and fill plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

- A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.
- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying that instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage which necessitates procurement of new products will be considered delays within Contractor's control.

3.02 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install Work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Repaint painted surfaces that are damaged prior to equipment acceptance.
- E. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions and as may be specified. Retain a copy of manufacturers' instruction at site, available for review at all times.
- F. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.03 ADJUSTMENT AND CLEANING

- A. Perform required adjustments, tests, operation checks, and other startup activities.

3.04 LUBRICANTS

- A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

END OF SECTION

**SECTION 01 77 00
CONTRACT CLOSEOUT**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Quality Control Submittals: Written procedures for maintaining and markup of record documents.
- B. Contract Closeout Submittals: Submit prior to application for final payment.
 - 1. Record Documents: As required in the General Conditions.
 - 2. Special Bonds, Special Warranties, and Service Agreements.
 - 3. Consent of Surety to Final Payment: As required in the General Conditions.
 - 4. Releases or Waivers of Liens and Claims: As required in the General Conditions.
 - 5. Releases from Agreements.
 - 6. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 75, Applications for Payments.
 - 7. Spare Parts and Special Tools: As required by individual Specification sections.
 - 8. Asbestos free letter as per General Conditions.

1.02 SUBSTANTIAL COMPLETION

- A. Contractor shall provide the following liner system related materials and certifications prior to requesting a substantial completion inspection:
 - 1. Geomembrane Installer's Certification of Subgrade Acceptability.
 - 2. Geomembrane Manufacturer's Certification of Proper Installation.
 - 3. Geomembrane Record Documents Including:
 - a. Panel and sheet numbers.
 - b. Panel layout drawing.
 - c. Seaming equipment and operator identification.
 - d. Temperature and speed setting of seaming equipment.
 - e. Identity and location of each repair, cap strip, penetration, boot, and sample taken from installed geomembrane for testing.
 - 4. All material and seam test results.
 - 5. Geomembrane Manufacturer's Special Guarantee.
 - 6. Geomembrane Installer's Special Guarantee.
 - 7. All quality assurance and quality control data and certifications required by Section 33 46 23.19, Composite Drainage Net (CDN); Section 33 47 13.07, Geosynthetic Clay Liner; and Section 40 27 00.14, High Density Polyethylene (HDPE) Geomembrane.

8. All soil test data required by Section 31 23 23, Fill and Backfill for furnishing and placement of drainage sand.
 9. All Manufacturer's Certificate of Proper Installation as required by individual Specification sections.
 10. All Functional and Performance Test Reports.
 11. All Facility Performance Evaluation Forms.
 12. All pipe testing and inspection reports.
- B. When the Contractor considers the Work is Substantially Complete, he shall submit to the Engineer:
1. A written notice that the Work or designated portion thereof, is substantially complete.
 2. A list of items to be completed or corrected for completion.
- C. Within a reasonable time after receipt of such notice, the Engineer will make an inspection to confirm the status of completion.
- D. Should the Engineer determine that the Work is Not Substantially Complete:
1. The Engineer will promptly notify the Contractor, in writing, giving the reasons therefor.
 2. The Contractor shall remedy the deficiencies in the Work and send a second written notice of Substantial Completion to the Engineer.
 3. The Engineer will re-inspect the Work.
- E. When the Engineer finds that the Work is Substantially Complete, He will:
1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion with a tentative punch list of items to be completed or corrected before final payment.
 2. After consideration of any objections made by the Owner as provided in Conditions of the Contract, and when the Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor the Certificate of Substantial Completion with a revised punch list of items to be completed or corrected.

1.03 FINAL INSPECTION

- A. When the Contractor considers the Work to be complete, he shall submit written certifications that the Contract Documents have been reviewed and that:
1. The Work has been inspected for compliance with Contract Documents.
 2. The Work has been completed in accordance with Contract Documents.
 3. Equipment and systems have been tested in the presence of the Owner's Representative and are operational.

4. All punch list items have been addressed.
 5. The Work is completed and ready for final inspection.
- B. The Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should the Engineer Consider that the Work is Incomplete or Defective:
1. The Engineer will promptly notify the Contractor, in writing, listing the incomplete or defective work.
 2. The Contractor shall take immediate steps to remedy the stated deficiencies, and send second written certifications to the Engineer.
 3. The Engineer will re-inspect the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.04 REINSPECTION FEES

- A. Should the Engineer perform re-inspection due to failure of the Work to comply with the claims of status of completion made by the Contractor:
1. The Owner will compensate the Engineer for such additional services.
 2. The Owner will deduct the amount of such compensation from the final payment to the Contract.

1.05 RECORD DOCUMENTS

- A. Quality Assurance:
1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
 2. Accuracy of Records:
 - a. Coordinate changes within record documents, making legible and accurate entries on each page of Specifications and each sheet of Drawings and other documents where such entry is required to show change.
 - b. Purpose of Project record documents is to document factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement, investigation, and examination.
 3. Make entries within 24 hours after receipt of information that a change in Work has occurred.

4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a referral by Engineer to recommend that the Contractor's Application for Payment, either partial or final be withheld in whole or in part.

1.06 RELEASES FROM AGREEMENTS

- A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.
- B. In the event Contractor is unable to secure Written Releases, inform the Owner of the reasons:
 1. Owner or its representatives will examine the site, and Owner will direct Contractor to complete Work that may be necessary to satisfy terms of the easement.
 2. Should Contractor refuse to perform this Work, Owner reserves the right to have it done by separate Contract and deduct the cost of same from the Contract Price, or require the Contractor to furnish a satisfactory Bond in a sum to cover legal claims for damages.
 3. When Owner is satisfied that Work has been completed in agreement with the Contract Documents and terms of easements, the right is reserved to waive the requirement for written release if: (i) Contractor's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that Contractor has failed to fulfill the terms of the easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting the grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

- A. General:
 1. Promptly following commencement of Contract Times, secure from Engineer at no cost to Contractor, one complete set of Contract Documents. Drawings will be full size. One extra set of civil site plans will be provided to the Contractor for documenting the location of underground utilities in accordance with Section 01 32 23, Surveying.
 2. Delete Engineer title block and seal from all documents.

3. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
4. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - 1) Green when showing information deleted from Drawings.
 - 2) Red when showing information added to Drawings.
 - 3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly Mark to Record Actual Changes Made During Construction, Including, but Not Limited to:
 - a. Information and data required by Section 01 32 23, Surveying
 - b. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - c. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
 - d. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - e. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - f. Changes made by Addenda, Work Change Directive, Change Order, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

5. Dimensions on Schematic Layouts: Show on record Drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item by accurate note such as “cast iron drain,” “HDPE Pipe,” and the like.
 - b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
 - c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

- A. At completion of Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire site or parts thereof, as applicable.
 1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Engineer.
 2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
 3. Leave water courses, gutters, and ditches open and clean.
- B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

3.03 FINAL GUARANTEE

- A. All work shall be guaranteed by the Contractor for a period of 1 year from the date of final acceptance of the work by the Owner unless otherwise required by other sections of these Contract Documents.
- B. If mitigation/restoration of wetlands occurs due to Contractor violations of permit conditions and impact caused by Contractor activities aside from approved permitted activities, work shall be guaranteed by the Contractor for a minimum period of 3 years or as long as required by the regulatory agencies.
- C. If, within the guarantee period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Engineer, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall, promptly upon receipt of notice from the Owner and without expense to the Owner, do the following:
 1. Place in satisfactory condition in every particular all of such guaranteed work and correct all defects therein.

2. Make good all damage to the site, or contents thereof, which, in the opinion of the Engineer, is the result of the use of materials or workmanship which are inferior, defective, or not in accordance with the terms of the contract.
 3. Make good any work or material and contents of structure or site disturbed in fulfilling any such guarantee.
- D. If the Contractor, after notice, fails within 10 days to proceed to comply with the terms of this guarantee, the Owner may have the effects corrected, and the Contractor and his surety shall be liable for all expense incurred, provided, however, that in case of an emergency where, in the opinion of the Owner, delay would cause loss or damage, repairs may be started without notice being given to the Contractor and the Contractor shall pay the cost thereof.
- E. All special guarantees or warranties applicable to specific parts of the work as may be stipulated in the Contract Specifications or other papers forming a part of this Contract shall be subject to the terms of this paragraph during the first year of life of such guarantee. All special guarantees and manufacturer's warranties shall be assembled by the Contractor and delivered to the Engineer, along with a summary list thereof, before the acceptance of the Work.

3.04 SUPPLEMENTS

- A. The supplements listed below, following "END OF SECTION," are part of this Specification.
1. Supplement 1, Punch List.
 2. Supplement 2, Certificate of Substantial Completion.

END OF SECTION

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT: _____ PROJECT NO: _____

OWNER: _____

CONTRACTOR: _____

ENGINEER: _____

DATE OF ISSUANCE: _____

Designated Area Shall Include:

The Work performed under this contract has been inspected by authorized representatives of the Owner, Contractor, and Engineer, and the Project (or designated area of the project, as indicated above) is hereby declared substantially completed. The Substantial Completion Date for the designated area _____ which is also the date of commencement of all warranties and guarantees required by the Contract Document, unless otherwise specified.

The Contractor has complied with all the requirements of Substantial Completion, as stated in the GENERAL CONDITIONS of the Contract for this project, or designated portion thereof.

Engineer Date

The Contractor acknowledges receipt of this Certificate of Substantial Completion and agrees to complete or correct the Work on the list of items appended hereto within the Contract completion period.

Contractor Title Date

The Owner accepts the Project, or designated portion thereof, as substantially complete and will assume full possession thereof at _____ o'clock, (AM, PM) on _____, 20 _____

Owner Title Date

The responsibility of the Owner and the Contractor for security, operation, safety, maintenance, heat, and utilities shall be set forth on the attachments. (NOTE: Owner's and Contractor's legal and insurance counsel should determine and review insurance requirements and coverage.)

Attachments (Describe): _____

**SECTION 01 78 23
OPERATION AND MAINTENANCE MANUALS AND DATA**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Maintenance Operation: As used in the Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.02 QUALITY ASSURANCE

- A. Manuals for equipment and systems shall be prepared by equipment manufacturer or system supplier.

1.03 SEQUENCING AND SCHEDULING

- A. Manual Outline: Submit detailed outline of each manual prior to preparation of Preliminary Manuals.
- B. Manuals for Equipment and Systems:
 - 1. Preliminary Manuals: Submit, within 8 weeks following receipt of approved shop drawings and prior to shipment date for equipment, system, subsystem, or component. Include copy of warranties, Bonds, and service agreements if specified.
 - 2. Final Manuals: Submit not less than 6 weeks prior to equipment or system field testing or startup.
- C. Manuals for Materials and Finishes:
 - 1. Preliminary Manuals: Submit at least 15 days prior to request for final inspection.
 - 2. Final Manuals: Submit within 10 days after final inspection.

1.04 GENERAL

- A. Furnish for each item of equipment or system as specified in the individual Specification sections.
- B. Prepare data for use by Owner's personnel in the form of an instructional manual.

C. Manual Format:

1. Size: 8-1/2 inches by 11 inches.
2. Paper: 20-pound minimum, white for typed pages.
3. Text: Manufacturer's printed data, or neatly typewritten.
4. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
5. Provide fly-leaf for each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment and provide with heavy section dividers with numbered plastic index tabs.
6. Provide each manual with title page, and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.
7. Cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE MANUAL, VOLUME NO. _ OF _," if applicable, and list:
 - a. Project title.
 - b. Designate the system or equipment for which it is intended.
 - c. Identity of separate structure as applicable.
 - d. Identity of general subject matter covered in manual. Identity of equipment number and Specification section.
8. Assemble and bind material in same order as specified, as much as possible.
9. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.
10. Binders:
 - a. Preliminary Manuals: Heavy paper covers.
 - b. Final Manuals: Commercial quality, substantial, permanent, three-ring or three-post binders with durable, cleanable, plastic binders.
11. Table of Contents Neatly Typewritten, Arranged in a Systematic Order:
 - a. Contractor, name of responsible principal, address, and telephone number.
 - b. List of each product required to be included, indexed to content of each volume.
 - c. List with Each Product: Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
 - 1) Identify area of responsibility of each.
 - 2) Provide local source of supply for parts and replacement.
 - d. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

12. Product Data:
 - a. Include only those sheets that are pertinent to specific product.
 - b. Clearly Annotate Each Sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
13. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - c. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
 - d. Do not use Project record documents as maintenance manual drawings.
 - e. Provide reinforced punched binder tab, bind in with text.
 - f. Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
 - g. Where reduction is impractical, fold and place in 8-1/2 inch by 11-inch envelopes bound in text.
 - h. Identify Specification section and product on Drawings and envelopes.
14. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Handling, storage, maintenance during storage, assembly, erection, installation, adjusting, testing, operating, shutdown in emergency, troubleshooting, maintenance, interface, and as may otherwise be required.
 - b. Organize in a consistent format under separate heading for each different procedure.
 - c. Provide a logical sequence of instructions for each procedure.
 - d. Provide Information Sheet for Owner's Personnel, Including:
 - 1) Proper procedures in the event of failure.
 - 2) Instances that might affect the validity of warranties or Bonds.
15. Warranties, Bonds, Certifications, and Service Agreements: In accordance with Section 01 43 33, Manufacturer's Services, Section 01 77 00, Contract Closeout and other applicable sections.

1.05 SUBMITTAL PROCEDURE

A. Preliminary Manuals:

1. Submit five copies for Engineer's review.
2. Disposition: In accordance with Section 01 33 00, Submittals.

3. If Accepted:
 - a. One copy will be returned to Contractor.
 - b. One copy will be forwarded to Owner's Project Manager.
 - c. One copy will be retained in Engineer's file.
 - d. Submit five copies of Final Manual.
4. If Rejected:
 - a. Two copies will be returned to Contractor with Engineer's comments for revision.
 - b. One copy will be retained in Engineer's file.
 - c. Resubmit three revised Preliminary copies for Engineer's review.

B. Final Manuals:

1. If Final Manuals are acceptable, Contractor will be so notified.
2. If Rejected, and at Engineer's Option:
 - a. All copies will be returned to Contractor for revision.
 - b. All copies will be retained by Engineer and the necessary revision data will be requested from Contractor.

1.06 MANUALS FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Description of Unit and Component Parts, Including Controls, Accessories, and Appurtenances:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
2. Operating Procedures:
 - a. Startup, break-in, routine, and normal operating instructions.
 - b. Test procedures and results of factory tests where required.
 - c. Regulation, control, stopping, and emergency instructions.
 - d. Description of operation sequence by control manufacturer.
 - e. Shutdown instructions for both short and extended durations.
 - f. Summer and winter operating instructions, as applicable.
 - g. Safety precautions.
 - h. Special operating instructions.
 - i. Installation instructions.
3. Maintenance and Overhaul Procedures:
 - a. Routine operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, removal, repair, reinstallation, and reassembly.
4. Installation Instructions: Including alignment, adjusting, calibrating, and checking.

5. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
6. Spare parts ordering instructions.
7. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
8. Manufacturer's printed operating and maintenance instructions.
9. As-installed, color-coded piping diagrams.
10. Charts of valve tag numbers, with the location and function of each valve.

B. Maintenance Summary:

1. Compile an individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or subunits.
2. Format:
 - a. Use Maintenance Summary Form bound with this section, or an electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2 inch by 11-inch size paper.
 - d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill-of-Materials/Parts List furnished in O&M Manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.

C. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including all control and lighting systems.

2. Circuit Directories of Panelboards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
3. List of electrical relay settings, and control and alarm contact settings.
4. Electrical interconnection wiring diagram, including control and lighting systems.
5. As-installed control diagrams by control manufacturer.
6. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Safety precautions.
 - d. Special operating instructions.
7. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to troubleshooting.
 - c. Adjustment and checking.
 - d. List of relay settings, control and alarm contact settings.
8. Manufacturer's printed operating and maintenance instructions.
9. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

1.07 MANUALS FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's Data, Giving Full Information on Products:
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods that are detrimental to product.
 - c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
2. Instructions for inspections, maintenance, and repair.

1.08 SUPPLEMENTS

A. The supplements listed below, following “END OF SECTION,” are part of this Specification.

1. Forms: Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a. Name Telephone No. _____

b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Standard Oil	Gulf	Arco	Or Equal
List symbols used in No. 7. above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER’S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

**SECTION 01 78 35
WARRANTIES AND BONDS**

PART 1 GENERAL

1.01 DESCRIPTION

- A. Scope of Work:
 - 1. Compile specified warranties and bonds, as specified in these Specifications.
 - 2. Co-execute submittals when so specified.
 - 3. Review submittals to verify compliance with Contract Documents.
 - 4. Submit to the Engineer for review and transmittal to Owner.
- B. Related Work Described Elsewhere: Conditions of the Contract.

1.02 SUBMITTAL REQUIREMENTS

- A. Assembly warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Provide four original signed copies.
- C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.
 - 1. Product of work item.
 - 2. Firm, with name of principal, address and telephone number.
 - 3. Scope.
 - 4. Date of beginning of warranty, bond or service and maintenance contract.
 - 5. Duration of warranty, bond or service and maintenance contract.
 - 6. Provide information for Owner's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances which might affect the validity or warranty or bond.
 - 7. Contractor, name of responsible principal, address and telephone number.

1.03 FORM OF SUBMITTALS

- A. Prepare in quadruplicate packets in commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of 2 inches.

B. Format:

1. Size: 8-1/2 inches by 11 inches with punched sheets for standard three-post binder with larger sheets folded to fit into binders.
2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS". List: Title of Project, and Name of Contractor.

1.04 WARRANTY SUBMITTALS REQUIREMENTS

- A. For all major equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for 1 year, unless otherwise specified, commencing at the time of final acceptance by the Owner.
- B. The Contractor shall be responsible for obtaining certificates of equipment warranty for all major equipment items specified. The Contractor shall still warrant equipment not considered to be "major" in the Contractor's one-year warranty period even though certificates of warranty may not be required.
- C. In the event that the equipment manufacturer or supplier is unwilling to provide a one-year warranty commencing at the date of final completion, the Contractor shall obtain from the manufacturer a 2-year warranty commencing at the time of equipment delivery to the jobsite. This 2-year warranty from the manufacturer shall not relieve the Contractor of the 1-year warranty starting at the time of final completion.
- D. The Owner shall incur no labor or equipment cost during the guarantee period, and all cost of labor, equipment and materials for corrective action shall be paid by the Contractor.
- E. Guarantee shall cover all necessary labor, equipment and replacement parts resulting from faulty or inadequate design, improper assembly or erection, defective workmanship and materials, leakage, breakage or other failure of all equipment and components furnished by the manufacturer.

1.05 SUPPLEMENTS

- A. The supplement listed below, following "END OF SECTION," is part of this Specification.
 1. Warranty for Item.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

WARRANTY FOR ITEM

LOCATION OF PROJECT: _____

OWNER: _____

PROJECT NO: _____

ITEM: _____

SECTION NO. AND ITEM NO.: _____

SUPPLIER: _____

SUPPLIER'S ADDRESS: _____

SUPPLIER'S REFERENCE NO.: _____

The undersigned guarantees that the above item is of good merchantable quality, free from defects in material or workmanship, fully meets the type, quality, design and performance requirements defined in the Contract Specifications of the above Project, and that the equipment will in actual operation satisfactorily perform the functions for which installed.

The undersigned agrees to repair, replace, or otherwise make good, any defect in workmanship or materials in the above described material item which may develop within a period one (1) year (unless otherwise specified) from the date of final acceptance by the Owner of the above name Project.

COMPANY _____

COMPANY ADDRESS _____

BY _____

TITLE _____

SIGNED _____

DATE _____

**SECTION 01 88 15
ANCHORAGE AND BRACING**

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the Florida Building Code Sixth Edition (2017), for wind, gravity, soil, and operational loads.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
 - 2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 - 3. International Code Council (ICC): International Building Code (IBC).
 - 4. Florida Building Code Sixth Edition (2017).

1.03 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

- A. General:
 - 1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in State of Florida.
 - 2. Design anchorage into concrete including embedment in accordance with ACI 318-14; Chapter 17 and Project Specifications.
 - a. Unless otherwise noted, design for cracked concrete condition.
 - 3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.

4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, wind, and operational loading.
5. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
6. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
7. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for wind-exposed mechanical and electrical equipment.
3. Operational:
 - a. For loading supplied by equipment manufacturer for FBC required load cases.
 - b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents other load-inducing conditions.
 - c. Locate braces to minimize vibration to or movement of structure.
 - d. For vibrating loads, use anchors meeting requirements of Section 05 05 19, Post-Installed Anchors, for anchors with designated capacities for vibratory loading per manufacturer's ICC-ES report.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
 - b. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

- B. Informational Submittals:
 - 1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include FBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by an engineer registered in State of Florida.
 - 2. Manufacturer's hardware installation requirements.
- C. Deferred Submittals: Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

PART 2 PRODUCTS

2.01 GENERAL

- A. Design and construct attachments and supports transferring loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.
- B. Provide anchor bolts for anchorage of equipment to concrete. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

PART 3 EXECUTION

3.01 GENERAL

- A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.
- B. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.
- C. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.

3.02 INSTALLATION

- A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. In accordance with Section 05 05 19, Post-Installed Anchors.

END OF SECTION

**SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Facility: Entire Project, or an agreed-upon acceptable portion, including all of its unit processes.
- B. Field Quality Control: Term, as used in individual Specification Sections, which refers to specified on-site functional and performance testing of equipment.
- C. Functional Test: Test or tests in presence of Engineer to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.
- D. Performance Test: A test performed in presence of Engineer and after any required functional test, to demonstrate and confirm that individual equipment meets the performance requirements specified in individual Specification sections.
- E. Source Quality Control: Term, as used in individual Specification sections, which refers to specified testing performed on specified equipment at manufacturer's facility prior to shipment.

1.02 SUBMITTALS

- A. Administrative Submittals:
 - 1. Functional and performance test schedules, test plan, procedures, and log format. Submit at least 14 days prior to start of related testing.
 - 2. Facility Startup and Performance Evaluation Plan: Submit at least 21 days prior to commencement of startup.
- B. Quality Control Submittals:
 - 1. Completed Manufacturer's Certificate of Proper Installation as required by individual Specification sections. Submit prior to beginning Facility Startup procedures.
 - 2. Test Reports: Functional and performance testing, in format acceptable to Engineer.
 - 3. Written documentation, signed by Engineer, of functional and performance test for each piece of equipment tested.

4. Certification of calibration for testing equipment, when so specified.
5. Documentation of HVAC systems balancing results, when so specified.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACTOR'S TESTING AND STARTUP REPRESENTATIVE

- A. Designate and furnish one or more Contractor's personnel to coordinate and expedite testing and facility startup.
- B. Such person or persons shall be present during equipment testing and facility startup meetings specified in Section 01 31 19, Project Meetings, and shall be available at all times during the testing and the facility startup and performance evaluation period.

3.02 EQUIPMENT TESTING

- A. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage that may occur to equipment prior to the time when the County formally takes over the operation thereof.
- B. Test of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.
- C. Preparation:
 1. General:
 - a. Complete installation of each unit and related processes before testing, including all related manufacturer's representative services.
 - b. Furnish qualified manufacturer's representatives, when required by individual Specification sections, to assist in testing.
 - c. Obtain from equipment manufacturer's representative the Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Services, when required by individual Specification sections.
 - d. Schedule equipment testing and facility startup meetings to discuss test schedule, plan of test, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.

- e. Provide temporary valves, gauges, piping, test equipment, and other materials and equipment required to conduct testing.
 - f. Provide written documentation, on Contractor's form, of functional and performance test results for each piece of equipment tested. Provide space on form for Engineer's signature that testing is complete.
2. Cleaning and Checking: Prior to beginning functional testing:
- a. Calibrate testing equipment in accordance with manufacturer's instructions.
 - b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
 - c. Lubricate equipment in accordance with manufacturer's instructions.
 - d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.
 - e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - f. Check power supply to electric-powered equipment for correct voltage.
 - g. Adjust clearances and torque.
 - h. Test piping for leaks.
 - i. Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses.
3. Ready-to-Test Determination Will be by Engineer Based at Least on the Following:
- a. Notification by Contractor of equipment readiness for testing.
 - b. Acceptable testing plan.
 - c. Acceptable Operation and Maintenance Manuals.
 - d. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
 - e. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
 - f. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
 - g. Satisfactory fulfillment of other specified manufacturers' responsibilities.
 - h. Equipment and electrical tagging complete.
 - i. Delivery of all spare parts and special tools.

D. Functional Testing:

- 1. Conduct as specified in individual Specification sections.
- 2. Notify Owner, Engineer, and manufacturer's representative in writing at least 10 days prior to scheduled date of testing.

3. If, in Engineer's opinion, equipment meets the functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by the individual Specification sections.

E. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer at least 14 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been approved by Engineer as having satisfied functional test requirements specified.
4. Follow approved testing plan and detailed procedures specified.
5. Source and type of fluid, gas, or solid for testing shall be as specified.
6. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.
7. Prepare performance test report summarizing test method and results.
8. If, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming with Contract requirements.

3.03 FACILITY STARTUP AND PERFORMANCE EVALUATION

A. General:

1. Support Owner's operations personnel throughout Facility Startup and Performance Evaluation Period.
2. Equipment shall be accepted by Engineer as having met requirements of specified functional testing prior to facility startup.
3. Sequence each unit process to the point that the complete facility is operational for evaluation of unit process and facility performance.
4. Demonstrate proper operation of required interfaces within and between individual unit processes.
5. Include equipment furnished by Owner.
6. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays.
7. Schedule ongoing Work so as not to interfere with or delay the completion of facility startup.
8. After the facility is operating, complete performance testing of those items of equipment not previously tested.

B. Facility Startup and Performance Evaluation Plan:

1. Develop a plan in conjunction with Owner's operations personnel detailing step-by-step instructions for startup of each unit process and the complete facility.
2. Include a method of evaluation and overall performance report for each unit process.
3. When Computer Subsystem applications software is furnished by Owner, coordinate with furnishing Supplier for specific startup instructions.
4. Plan shall consist of bound copies of Startup and Performance Evaluation Forms. Use one form for each unit process; use example form attached, or one designed by Contractor.
5. Startup and Performance Evaluation Form will Minimally Include the Following:
 - a. Description of unit process being started.
 - b. All equipment and devices included in the unit process.
 - c. Unit process startup procedures (i.e., valves to be open/closed, order of equipment startup, etc.).
 - d. Requirements for water, power, chemicals, etc. needed for startup.
 - e. Contractor Certification that each unit process is capable of performing its intended function(s), including fully automatic operation.
 - f. Space for evaluation comments.

C. Owner Responsibilities:

1. Provide water, power, chemicals, and other items as required for testing and facility startup, unless otherwise indicated.
2. Operate process units and devices, with support of Contractor.
3. Provide labor and materials as required for sampling and laboratory analyses.

D. Facility Startup Period:

1. Startup sequencing of unit processes shall be proposed by Contractor, subject to approval by Engineer.
2. Make adjustments, repairs, and corrections necessary to complete facility startup.
3. Startup of entire facility or any portion thereof shall be considered complete when, in opinion of Engineer, facility or designated portion has operated in manner intended for 5 continuous days without significant interruption. This period is in addition to training, functional, or performance test periods specified elsewhere.

4. Significant Interruption: May include any of the following events:
 - a. Failure of Contractor to provide and maintain qualified onsite startup personnel as scheduled.
 - b. Failure to meet specified performance for more than 2 consecutive hours.
 - c. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after failure.
 - d. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after failure.
 - e. As may be determined by Engineer.
5. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.

E. Facility Performance Evaluation:

1. During the Facility Startup Period, conduct a performance evaluation for purpose of evaluating full capabilities of facility.
2. Certify, on the Facility Performance Evaluation Form, that each unit process is capable of performing its intended function(s), including fully automatic operation.

3.04 SUPPLEMENTS

- A. Supplement listed below, following “END OF SECTION,” is a part of this Specification:
1. Startup and Performance Evaluation Form.
 2. Manufacturer’s Certificate of Compliance.

END OF SECTION

STARTUP AND PERFORMANCE EVALUATION FORM

OWNER: _____	PROJECT: _____
Unit Process Description: (Include description and equipment number of all equipment and devices):	
Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):	
Startup Requirements (Water, power, chemicals, etc.): _____	
Evaluation Comments: _____	
CONTRACTOR Certification that Unit Process is capable of performing its intended function(s), including fully automatic operation:	
Firm Name: _____	
Startup Representative: _____ (Authorized Signature)	Date: _____, <u>20</u> _____

**MANUFACTURER’S CERTIFICATE OF COMPLIANCE –
FUNCTIONAL/PERFORMANCE TEST**

Owner: _____

Contractor: _____

Equipment Name: _____

Equipment Tag Number(s): _____

Specification Section: _____

Manufacturer/Phone No.: _____

Service Rep./Phone No.: _____

Date: _____ Hours on Site: _____

Purpose: To verify equipment operates properly prior to placing in operation and verify warranty is valid.

List Items Checked: See Specification Section 01810, Equipment Testing and Facility Startup, Detailed Specification Section and Specifications for related equipment _____

Equipment is functioning properly and meets the specified requirements: ___ Yes ___ No

Comments: _____

Signatures (Do Not Initial):

Contractor: _____

Manufacturer: _____

(Attach additional pages if necessary)

SECTION 03 26 20
FABRIC FORMED CONCRETE REVETMENT SYSTEM (FFCRS)

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform all operations in connection with the installation of the proposed fabric formed concrete lining in accordance with the lines, grades, design and dimensions shown on the Contract Drawings and as specified herein.
- B. The Work shall consist of installing a non-reinforced concrete mat lining, by positioning a specially woven double-layer synthetic fabric form on the surface to be protected and filling it up with a pumpable fine aggregate concrete (structural grout) in such a manner as to form a stable mat of required thickness, weight and configuration.

1.02 REFERENCED DOCUMENTS

- A. American Society for Testing and Materials (ASTM):
 - 1. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. C33, Standard Specification for Concrete Aggregates.
 - 3. C94, Standard Specification for Ready-Mixed Concrete.
 - 4. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or [50-mm] Cube Specimens).
 - 5. C150, Standard Specification for Portland Cement.
 - 6. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - 7. C494, Standard Specification for Chemical Admixtures for Concrete.
 - 8. C618, Standard Specification for Coal Fly Ash and Calcined Natural Pozzolan for Use in Concrete.
 - 9. C685, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
 - 10. C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 - 11. C1603, Standard Test Method for Measurement of Solids in Water
 - ASTM D2061, Standard Test method of Strength of Zippers.
 - 12. D4354, Practice for Sampling of Geotextiles for Testing.
 - 13. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

14. D4533, Standard Test Method for Trapezoidal Tearing Strength of Geotextiles.
15. D4595, Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method ASTM D4632 Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).
16. D4751, Test Method for Determining Apparent Opening Size for a Geotextile.
17. D4759, Practice for Determining the Specification Conformance of Geotextiles.
18. D4873, Standard Guide for Identification, Storage, and Handling of Geotextiles.
19. D4884, Test Method for Seam Strength of Sewn Geotextiles.
20. D5199, Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
21. D5261, Test Method for Measuring Mass per Unit Area of Geotextiles.
22. D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 2-inch [50-mm] Probe.
23. D6449, Standard Method for Flow of Fine Aggregate Concrete for Fabric Formed Concrete.

1.03 RELATED SECTIONS

A. Related sections include but are not necessarily limited to:

1. Division 1, General Requirements.
2. Section 31 23 23, Fill and Backfill.
3. Section 31 32 19.16, Geotextiles.

1.04 SUBMITTALS

A. The following information shall be submitted:

1. The Contractor shall furnish the fine aggregate concrete manufacturer's certificates of compliance, mix design, fine aggregate gradation and fineness modulus for the fine aggregate concrete.
2. The Contractor shall furnish the fabric form manufacturer's certificates of compliance for the fabric forms. The Contractor shall also furnish the manufacturer's specifications, literature, Shop Drawings for the layout of the concrete lining panels, and any recommendations, if applicable, that are specifically related to the Project.

PART 2 PRODUCTS

2.01 FINE AGGREGATE CONCRETE

- A. Fine aggregate concrete shall consist of a mixture of Portland cement, fine aggregate (sand), and water so proportioned and mixed as to provide a pumpable concrete. Pozzolan and grout fluidifier conforming to these Specifications may be used at the option of the Contractor. The mix shall exhibit a compressive strength of 2,500 psi at 28 days when made and tested in accordance with ASTM C31 and C39.
- B. Portland cement shall conform to ASTM C150, Type I or Type II. Average compressive strength of FFCRS test cylinders shall be 20 percent higher at 7 days than the compressive strength required by ASTM C31, and not less than 2,500 psi at 28 days.
- C. Fine aggregate shall conform to ASTM C33, except as to grading. Aggregate grading shall be reasonably consistent and shall be well graded from the maximum.
- D. Water for mixing shall be clean and free from injurious amounts of oil, acid, salt, alkali, organic matter or other deleterious substances.
- E. Pozzolan, if used, shall conform to ASTM C350.
- F. Premixed Fine Aggregate Concrete:
 - 1. The water/cement ratio of the fine aggregate concrete shall be determined by the ready-mix manufacturer, but generally should be on the order of 0.65 to 0.70. The pumping of fine aggregate concrete into the fabric.
 - 2. The sand/cement ratio should be determined by the ready-mix manufacturer and should be on the order of 2.4:1.
 - 3. The consistency of the fine aggregate concrete delivered to the concrete pump should be proportioned and mixed as to have a flow time of 9-15 seconds when passed through the 3/4-inch [19 mm] orifice of the standard flow cone that is described in ASTM C6449-99.
 - 4. Typical Pre-mix characteristics are provided in Table 03 26 20-1:

Table 03 26 20-1 Fine Aggregate Cement-Typical Range of Mix Proportions		
Material	Mix Proportions (lb/CY)	After Placement Mix Proportions (lb/CY)
Cement	750-850	805-915
Sand	2120-2030	2290-2190

Table 03 26 20-1		
Fine Aggregate Cement-Typical Range of Mix Proportions		
Material	Mix Proportions (lb/CY)	After Placement Mix Proportions (lb/CY)
Water	540-555	460-470
Air	As Required	As Required

2.02 COMPONENTS

- A. Portland Cement: Portland cement should conform to ASTM C150/150M, Type I, II or V. Pozzolan grade fly ash may be substituted for up to 35 percent of the cement as an aid to pumpability. Pozzolan, if used, should conform to ASTM C618, Class C, F or N.
- B. Fine Aggregate (Sand): Fine aggregate should consist of suitable clean, hard, strong and durable natural or manufactured sand. It should not contain dust, lumps, soft or flaky materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack any embedded steel, neoprene, rubber, plastic, etc. Motorized sand washing machines should be used to remove impurities from the fine aggregate. Fine aggregate having positive alkali-silica reaction should not be used. All fine aggregates should conform to ASTM C33/C33M-13. The fine aggregate should not have more than 45 percent passing any sieve and retained on the next consecutive sieve of those shown in Table 3.0. The fineness modulus of fine aggregate should neither be less than 2.3 nor greater than 3.1.

Table 03 26 20-2	
Grading Requirement for Fine Aggregate	
Sieve	Percent by Weight Passing the Sieve (100)
9.5-mm (3/8-in.)	
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600-µm (No. 30)	25 to 60
300-µm (No. 50)	5 to 30
150-µm (No. 100)	0 to 10
75-µm (No. 200)	0 to 3

- C. Water:
 - 1. Water used for mixing and curing should be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete.

2. Potable water is permitted to be used as mixing water in fine aggregate concrete without testing for conformance with the requirements of ASTM C1602/C1602M-12.

D. Plasticizing and Air Entraining Admixtures:

1. Grout fluidifier water reducing or set time controlling agents may be used as recommended by their manufacturers to improve the pumpability and set time of the fine aggregate concrete.
2. Any air entraining agent or any other admixture may be used, as approved, by the Engineer-in-charge to increase workability, to make concrete impervious and more durable. Air entraining admixture should conform to ASTM C494/C494M and ASTM C260/C260M, respectively.

2.03 READY-MIXED CONCRETE

- A. The basis of standard specifications for ready-mixed concrete should be ASTM C94/C94M-13a.

- B. The Contractor should require the manufacturer to assume full responsibility for the selection of the proportions for the concrete mixture, the contractor should also specify the following:

1. Requirements for compressive strength as determined on samples taken from the transportation unit at the point of discharge. Unless otherwise specified the age at test should be 28 days.
2. That the manufacturer, prior to the actual delivery of the fine aggregate concrete, furnish a statement to the contractor, giving the dry mass of cement and saturated surface-dry-mass of fine aggregate and quantities, type, and name of admixtures (if any) and the water per cubic yard of fine aggregate concrete that will be used in the manufacture. The manufacturer should also furnish evidence satisfactory to the contractor that the materials to be used and proportions selected will produce fine aggregate concrete of the quality specified.

C. Mixing and Delivery:

1. Ready-mixed fine aggregate concrete should be mixed and delivered to the point of discharge by means of one of the following combinations of operations:
 - a. Central-Mixed Concrete is mixed completely in a stationary mixer and transported to the point of delivery in a truck agitator, or a truck mixer operating at agitating speed, or in non-agitating equipment meeting the requirements of Section 13 of ASTM C94/C94M-13a. The acceptable mixing time for mixers having capacity of 1 yard or less in 1 minute. For mixers of greater capacity, this minimum should be increased 15 seconds for each cubic yard of fraction thereof of additional capacity.

- b. Shrink-Mixed Concrete: Concrete that is first partially mixed in a stationary mixer, and then completely in a truck mixer, should conform to the following: The time for the partial mixing should be the minimum required to intermingle the ingredients. After transfer to a truck mixer the amount of mixing at the designated mixing speed will be that necessary to meet the requirements for uniformity of concrete.
- c. Truck-Mixed Concrete: Concrete that is completely mixed in a truck mixer, 70 to 100 revolutions at the mixing speed designated by the manufacturer to produce the uniformity of concrete.
- d. No water from the truck water system should or elsewhere should be added after the initial introduction of mixing water for the batch except when on arrival to the project site the flow rate of the fine aggregate concrete is less than 9 seconds. If the flow rate is less than 9 seconds obtain the desired flow rate within 9 to 15 seconds with a one-time addition of water. A one-time addition of water is not prohibited from being several distinct additions of water provided that no fine aggregate concrete has been discharged except for flow testing. All water additions should be completed within 15 minutes from the start of the first water addition. Such addition should be injected into the mixer under such pressure and direction of flow to allow for proper distribution within the mixer. The drum should be turned an additional 30 revolutions, or more if necessary, at mixing speed to ensure that a homogenous mixture is attained. Water should not be added to the batch at any later time.
- e. Fine aggregate concrete delivered in cold weather should have the minimum temperature indicated in Table 03 26 20-3. The maximum temperature of fine aggregate concrete produced with heated aggregate, heated water, or both, should at no time during its production or transportation exceed 90 degrees F.

Table 03 26 20-3	
Minimum Fine Aggregate Temperature as Placed	
Section Size, inch	Temperature, min, °F
< 12	55
12—36	50

D. Batch Ticket Information:

- 1. The manufacturer of the concrete should furnish to the contractor with each batch of fine aggregate concrete before unloading at the site, a delivery ticket with the following information:
 - a. Name of ready-mix company and batch plant, or batch plant number.

- b. Serial number of ticket.
- c. Date.
- d. Truck number.
- e. Specific designation of job (name and location).
- f. Specific call or designation of the concrete in conformance with that employed in Project Specifications.
- g. Amount of fine aggregate concrete in cubic yards.
- h. Time loaded or of first mixing of cement and fine aggregate, and
- i. Amount of water added to the fine aggregate concrete by the contractor, at site, or the contractor’s designated representative and their initials.

2.04 FABRIC FORMED CONCRETE LINING

- A. The fabric form shall be 10-inch Filter Point Mat resulting in a 6-inch finished thickness as manufactured by Synthetex Inc., Construction Techniques, or approved equal. Each layer of fabric shall meet or exceed the statistical mean (average) results as shown in Table 03 26 20-4 below.
- B. Fabric formed concrete lining shall be Filter Point (FP600) type and have a finished average thickness of 6.0 inches, a nominal mass per unit area of 68-70 lb/ SF, and a deeply cobbled appearance with cross shaped filter points on approximately 10-inch spacing when measured on the diagonal.
- C. The shear resistance of the concrete lining shall be a minimum of 30 lb/ft, as demonstrated by full scale flume testing.
- D. The fabric forms shall be composed of synthetic yarns formed into a woven fabric. Yarns used in the manufacture of the fabric shall be composed of polyester. Forms shall be woven with a minimum of 50 percent textured yarns (by weight). Partially-oriented (POY), draw-textured, and/or staple yarns shall not be used in the manufacture of the fabric. Each layer of fabric shall conform to the physical, mechanical and hydraulic requirements Mean Average Roll Values listed in Table 03 26 20-4. The fabric forms shall be free of defects or flaws which significantly affect their physical, mechanical, or hydraulic properties.

Table 03 26 20-4 Property Requirements – Geotextile Fabric^{1,2}			
	Test Method	Units	MARV
Physical Properties			
Composition of Yarns	-	-	Polyester
Mass Per Unit Area (double-layer)	ASTM D5261	oz/yd ²	13
Thickness (single-layer)	ASTM D5199	mils	15
Mill Width (Woven)		inch	84

Table 03 26 20-4 Property Requirements – Geotextile Fabric^{1,2}			
	Test Method	Units	MARV
Mechanical Properties			
Wide-Width Strip Tensile Strength - MD	ASTM D4595	lbs/inch	300 350
Elongation at Break - MD TD - Max.			
Grab Tensile Strength - MD TD	ASTM D4595	lbs	300 300
Elongation at Break - MD TD - Max.			
Trapezoidal Tear Strength - MD TD	ASTM D4533	lbs	100 150
CBR Puncture Strength	ASTM D6241	lbs	1250
Mullen Burst Strength	ASTM D3786	psi	500
Hydraulic Properties			
Apparent Opening Size (AOS)	ASTM D4751	U.S. Standard	30 - 40
Flow Rate	ASTM D4491	gal/min/ft ²	30 - 55
Notes:			
1. Conformance of fabric to specification property requirements shall be based on ASTM D4759.			
2. All numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Lots shall be sampled according to ASTM D4354.2.			

- E. Fabric forms shall consist of double-layer woven fabric joined together by spaced, interwoven filter points to form a concrete lining with a deeply cobbled surface appearance. Filter points shall be formed by interweaving the double-layer fabric to form water permeable drains and attachment points for the control of the concrete lining thickness. The interweaving of the fabric layers shall form an area of double density, high strength, single layer fabric. All filter points shall be cross shaped and shall have twill weave centers designed to function as drains to relieve hydrostatic uplift pressure.
- F. Mill widths of fabric shall be a minimum of 84 inches. Each selvage edge of the top and bottom layers of fabric shall be reinforced for a width of not less than 1.35 inches by adding a minimum of 6 warp yarns to each selvage construction. Mill width rolls shall be cut to the length required, and the double-layer fabric separately joined, bottom layer to bottom layer and top layer to top layer, by means of sewing thread, to form multiple mill width panels with sewn seams.
- G. Fabric form panels shall be factory-sewn, by jointing together the layers of fabric, top layer to top layer and bottom layer to bottom layer, into predetermined custom sized panels. Sewn seams shall be downward facing as shown on the Contract Drawings. All sewn seams and zipper attachments

shall be made using a double line of U.S. Federal Standard Type 401 stitch. All seams sewn shall be not less than 100 lbf/inch when tested in accordance with ASTM D4884. Both lines of stitches shall be sewn simultaneously and be parallel to each other, spaced between 0.25 inches to 0.75 inches apart. Each row of stitching shall consist of 4 to 7 stitches per inch. Thread used for seaming shall be polyester.

- H. Baffles shall be installed at predetermined mill width intervals to regulate the distance of lateral flow of fine aggregate concrete. The baffles shall be designed to maintain a full concrete lining thickness along the full length of the baffle. The baffle material shall be nonwoven filter fabric. The grab tensile strength of the filter fabric shall be not less than 180 lbf/inch when tested in accordance with ASTM D4632.
- I. The fabric forms shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D4873.
- J. The Contractor shall submit a manufacturer's certificate that the supplied fabric forms meet the criteria of these Specifications, as measured in full accordance with the test methods and standards referenced herein. The certificates shall include the following information about each fabric form delivered:
 - 1. Manufacturer's name and address.
 - 2. Full product name.
 - 3. Style and product code number.
 - 4. Form number(s).
 - 5. Composition of yarns and;
 - 6. Manufacturer's certification statement.

PART 3 EXECUTION

3.01 SITE PREPARATION

- A. Areas on which fabric forms are to be placed shall be constructed to the lines and grades shown on the Contract Drawings. Where such areas are below the allowable grades they shall be brought to grade by placing compacted layers of granular fill material. Suitable material shall be placed in 6-inch lifts compacted to 95 percent of maximum modified proctor as determined by ASTM D1557, or as specified by Engineer. All obstructions such as roots and projecting stones shall be removed.

- B. Excavation and preparation of aprons as well as anchor, terminal or toe trenches shall be done in accordance with the lines, grades, contours, and dimensions shown on the Contract Drawings and the manufacturer's recommendations.
- C. Immediately prior to placing the fabric forms, the prepared area shall be inspected by the Engineer and tested for compaction. No forms shall be placed thereon, until the area has been tested.
- D. Fabric forms shall be placed over a layer of geotextile filter fabric. See Section 31 32 19.16, Geotextile for geotextile material specification. The geotextile filter fabric shall be placed directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles. The geotextile filter fabric shall be placed so that the upstream roll of fabric overlaps the downstream roll. The longitudinal and transverse joints will be overlapped at least 2 feet. The geotextile will extend at least 1 foot beyond the top and bottom concrete lining termination points, or as required by the Engineer.

3.02 FABRIC FORM PLACEMENT

- A. Following the placement of the fabric forms over the geotextile filter fabric, fine aggregate concrete shall be pumped between the top and bottom layers of the fabric form through small slits to be cut in the top layer of the fabric form or manufacturer supplied valves. The slits shall be of the minimum length to allow proper insertion of a filling pipe inserted at the end of a 2-inch I.D. concrete pump hose. Fine aggregate concrete shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration.
- B. Holes in the fabric forms left by the removal of the filling pipe shall be temporarily closed by inserting a piece of fabric. The fabric shall be removed when the concrete is no longer fluid and the concrete surface at the hole shall be cleaned and smoothed by hand.
- C. Lap joints and expansion joints shall be provided at intervals recommended by the manufacturer. Folding over of panels is unacceptable.
- D. Immediately prior to injection of fine aggregate concrete, the assembled fabric form panels shall be inspected by the Engineer/RPR and no fine aggregate concrete shall be pumped therein until the fabric seams and panel connections have been approved. At no time shall the unfilled fabric forms be exposed to ultraviolet light (including direct sunlight) for a period exceeding 5 days.

3.03 FINE AGGREGATE CONCRETE PLACEMENT

- A. Fine aggregate concrete shall be pumped in such a manner that excessive pressure on the fabric forms is avoided. Consultation with the fabric form manufacturer with regard to the selection of grout/concrete pumps is recommended.
- B. Cold joints shall be avoided. A cold joint is defined as one in which the pumping of the fine aggregate concrete into a given section of form is discontinued or interrupted for an interval of 45 or more minutes.
- C. The sequence of fine aggregate concrete shall be such as to ensure complete filling of the fabric formed concrete lining to the thickness specified by the Engineer. The flow of the fine aggregate concrete shall first be directed into the lower edge of the fabric form and working back up the slope, followed by redirecting the flow into the anchor trench.
- D. Prior to removing the filling pipe from the current concrete lining section and proceeding to the fine aggregate concrete filling of the adjacent lining section, the thickness of the current lining section shall be measured by inserting a length of stiff wire through the lining at several locations from the crest to the toe of the slope. The average of all thickness measurements shall be not less than the specified average thickness of the concrete lining. Should the measurements not meet the specified average thickness, pumping shall continue until the specified average thickness has been attained.
- E. Excessive fine aggregate concrete that has inadvertently spilled on the concrete lining surface shall be removed. The use of a high-pressure water hose to remove spilled fine aggregate concrete from the surface of the freshly pumped concrete lining shall not be permitted.
- F. Foot traffic will not be permitted on the freshly pumped concrete lining when such traffic will cause permanent indentations in the lining surface. Walk boards shall be used where necessary.
- G. After the fine aggregate concrete has set, all anchor, flank and toe trenches shall be backfilled and compacted flush with the top of the concrete lining. The integrity of the trench backfill must be maintained so as to ensure a surface that is flush with the top surface of the concrete lining for its entire service life.
- H. After backfilling flank and toe trenches, filter points shall be cleaned removing soil, debris and grout.

END OF SECTION

**SECTION 03 30 10
STRUCTURAL CONCRETE**

PART 1 GENERAL

1.01 GENERAL

- A. Work shall conform to requirements of ACI 301, Specifications for Structural Concrete, unless otherwise specified.

1.02 REFERENCES

- A. In accordance with ACI 301 and the following:
 - 1. American Concrete Institute (ACI):
 - a. 301, Specifications for Structural Concrete.
 - b. 305.1, Specification for Hot Weather Concreting.
 - c. 306.1, Specification for Cold Weather Concreting.
 - d. 308.1, Specification for Curing Concrete.
 - e. SP-66, Detailing Manual.
 - 2. ASTM International (ASTM):
 - a. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
 - 3. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
 - b. Placing Reinforcing Bars.
 - c. ANSI/CRSI – RB 4.1, CRSI Standard for Supports for Reinforcement Used in Concrete.
 - 4. National Ready Mixed Concrete Association (NRMCA).

1.03 DEFINITIONS

- A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.
- B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

- C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- D. Hot Weather: As defined in ACI 305.1.
- E. New Concrete: Concrete less than 60 days old.
- F. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
 - b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
 - 1) Bending lists.
 - 2) Placing drawings.
 - 2. Mix Design:
 - a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
 - b. Documentation of average strength for proposed mix design in accordance with ACI 301.
 - c. Test Reports:
 - 1) Cement: Chemical analysis report.
 - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - 3) Aggregates:
 - a) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
 - b) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
 - c) All of the following:
 - (1) Manufacturer's Certificate of Compliance that each admixture does not intentionally add chlorides and/or that the chloride content of each admixture does not exceed trace amounts.
 - (2) Verification that potable water is used in the concrete mix or test data documenting the chloride content of the water.

- (3) Letter from the concrete supplier stating that fine and coarse aggregates are from sources that are not known to be susceptible to chlorides in the aggregates.
 - 4) Alkali Aggregate Reactivity: Where required, in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.
 - d. Product Data:
 - 1) Admixtures: Manufacturer's product data sheets for each admixture used in proposed mix designs.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
 - a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
 - b. Documentation of embeds that must be at a temperature above freezing prior to placement of concrete.
 - c. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - d. Methods for temperature protection during placement.
 - e. Types of covering, insulation, housing, or heating to be provided.
 - f. Curing methods to be used during and following protection period.
 - g. Use of strength accelerating admixtures.
 - h. Methods for verification of in-place strength.
 - i. Procedures for measuring and recording concrete temperatures.
 - j. Procedures for preventing drying during dry, windy conditions.
4. Detailed plan for hot-weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
 - a. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - b. Use of retarding admixture.
 - c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
 - d. Types of shading and wind protection to be provided.
 - e. Curing methods, including use of evaporation retardant.
 - f. Procedures for measuring and recording concrete temperatures.
 - g. Procedures for preventing drying during dry, windy conditions.
5. Concrete repair techniques.

B. Informational Submittals:

1. Preinstallation Conference minutes.
2. Manufacturer's application instructions for bonding agent and bond breaker.
3. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
4. Statement of Qualification:
 - a. Batch Plant: Certification as specified herein.
 - b. Mix designer.
 - c. Installer.
 - d. Testing agency.
5. Concrete Delivery Tickets:
 - a. For each batch of concrete before unloading at Site.
 - b. In accordance with ASTM C94/C94M, including Requirement 14.2.1. through Requirement 14.2.10.
 - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
4. Testing Agency: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - a. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician–Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician–Grade II.

B. Preinstallation Conference:

1. Required Meeting Attendees:
 - a. Contractor, including pumping, placing and finishing, and curing subcontractors.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. Steel Reinforcement Installer
 - f. Engineer or Engineer's designee.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include:
 - a. Admixture types, dosage, performance, and redosing at Site.
 - b. Mix designs, test of mixes, and Submittals.
 - c. Placement methods, techniques, equipment, consolidation, and form pressures.
 - d. Slump and placement time to maintain slump.
 - e. Finish, curing, and water retention.
 - f. Steel reinforcement details.
 - g. Protection procedures for weather conditions.
 - h. Other specified requirements requiring coordination.
4. Conference minutes as specified in Section 01 31 19, Project Meetings.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Materials:

1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.
2. For unexposed areas, use new shiplap or plywood.

B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

2.02 CONCRETE

A. Materials:

1. Cementitious Materials:
 - a. Cement:
 - 1) Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
 - 2) Furnish from one source.

- b. Supplementary Cementitious Materials (SCM):
 - 1) Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
 - a) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
- 2. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
 - a. Aggregates:
 - 1) In accordance with ASTM C33/C33M, except as modified herein.
 - a) Class Designation: 4M unless otherwise specified.
 - b) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - c) Alkali Silica Reactivity: See Article Concrete Mix Design.
 - 2) Fine Aggregates:
 - a) Clean, sharp, natural sand.
 - b) ASTM C33/C33M.
 - c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
 - (1) Limit material finer than 75- μ m (No. 200) sieve to 3 percent mass of total sample.
 - (2) Limit coal and lignite to 0.5 percent.
 - 3) Coarse Aggregate:
 - a) Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
 - b) Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.
- 3. Admixtures:
 - a. Characteristics:
 - 1) Compatible with other constituents in mix.
 - 2) Contain at most, only trace amount chlorides in solution.
 - 3) Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
 - b. Air-Entraining Admixture: ASTM C260/C260M.
 - c. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - d. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - e. Accelerating Admixture: ASTM C 494/C 494M, Type C.

- f. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
 - g. Plasticizing Admixture: ASTM C1017/C1017M, Type I or Type II.
 - h. Do not use calcium chloride as an admixture.
4. Water and Ice: Water shall be potable water.

B. Concrete Mix Design:

- 1. General:
 - a. See Supplement at the end of this section for mix design requirements for class of concrete used on Project.
 - b. Prepare design mixture for strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
 - c. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
 - d. Use water-reducing admixture or high-range, water-reducing admixture, or plasticizing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
 - e. Desired fresh properties of concrete shall be determined by Contractor and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
- 2. Potential Alkali-Aggregate Reactivity of Concrete:
 - a. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
- 3. Proportions:
 - a. Design mix to meet aesthetic, durability, and strength requirements.
 - b. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent and maximum of 25 percent of weight of total cementitious materials.
- 1. Slump:
 - a. Contractor shall select a target slump at the point of delivery of concrete mixtures for each application.
 - b. Selected target slump shall not exceed 9 inches.
 - c. Concrete shall show no signs of visible segregation.
 - d. The target slump value shall be enforced for the duration of Project.
 - e. Determine slump by ASTM C143/C143M.
 - f. Slump tolerances shall meet the requirements of ACI 117.

- g. Design mixes that include a high-range, water-reducing or a plasticizing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
- h. Slump tolerance shall meet requirements of ACI 117.

C. Concrete Mixing:

- 1. General: In accordance with ACI 301, except as modified herein.
- 2. Truck Mixers:
 - a. For every truck, test slump, of samples taken per ASTM C94/C94M, Paragraph 12.5.1.
 - b. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.03 REINFORCING STEEL

- A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60. Welding of reinforcing bars is not permitted.
- B. Fabrication: Follow CRSI Manual of Standard Practice.

2.04 ANCILLARY MATERIALS

- A. Bonding Agent:
 - 1. Unless otherwise specified, in accordance with the following:
 - a. ASTM C881/C881M, Type V.
 - b. Two-component, moisture-insensitive, 100 percent solids epoxy.
- B. Bond Breaker: Nonstaining type, providing positive bond prevention.
- C. Reinforcing Steel Accessories:
 - 1. Precast Concrete Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Cementitious (Precast) Reinforcement Supports.
 - a. Precast concrete bar supports shall have equal or greater strength than the surrounding concrete.
 - b. Precast concrete bar supports shall be four square inches minimum, in plan.
- D. Tie Wire:
 - 1. Black, soft-annealed 16-gauge wire.
 - 2. Nylon-coated, epoxy-coated, or plastic-coated wire.

- E. Premolded Joint Filler:
1. Bituminous Type: ASTM D994/D994M or ASTM D1751.
 2. Sponge Rubber: Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum.
- F. Curing Compound:
1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
 2. Manufacturers and Products:
 - a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - c. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
 - d. Dayton Superior; Safe Cure and Seal 1315 EF.
- G. Evaporation Retardant:
1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
 2. Manufacturers and Products:
 - a. BASF Construction Chemicals, Shakopee, MN; MasterKure ER 50.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.
 - c. Or approved equal.
- H. Nonsrink Grout:
1. Nonmetallic, nongas-liberating.
 2. Prepackaged natural aggregate grout requiring only the addition of water.
 3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
 4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
 5. Pass fluid grout through flow cone with continuous flow 1 hour after mixing.
 6. Minimum Strength of Fluid Grout:
 - a. 3,500 psi at 1 day.
 - b. 4,500 psi at 3 days.
 - c. 7,500 psi at 28 days.

7. Maintain fluid consistency when mixed in 1 yard to 9 yard loads in ready-mix truck.
 8. Manufacturers and Products:
 - a. BASF Building Systems, Inc., Shakopee, MN; MasterFlow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
- I. Repair Material:
1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
 2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
 3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
 4. Repair mortar shall be Site mixed.
 5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
 6. Manufacturers and Products:
 - a. BASF Building Systems Inc., Shakopee, MN; MasterEmaco S Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.
 - c. Or approved equal.

PART 3 EXECUTION

3.01 FORMWORK

- A. Form Construction:
1. Construct forms and provide smooth-form finish.
 2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
 3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
 4. Brace as required to prevent distortion during concrete placement.
- B. Form Removal:
1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - b. Curing and protection operations are maintained.

2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

- A. Unless otherwise specified, in accordance with ACI 301.
- B. Accessories:
 1. Bar Supports in Contact with Ground: Provide precast concrete block supports.
 - a. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.
 2. Bar Supports in Contact with Forms: All plastic or stainless steel bar supports.
 3. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports, and location of reinforcement remains within tolerance throughout work.
- C. Splices and Laps:
 1. Lap Splice Reinforcing: Refer to Structural General Notes on Drawings for additional information.
 2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 CONCRETE PLACEMENT INTO FORMWORK

- A. Inspection: Notify Engineer at least 1 work day in advance before starting to place concrete.
- B. Placement into Formwork:
 1. Reinforcement: Secure in position before placing concrete.
 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs that shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
 4. Use placement devices (such as, chutes, pouring spouts, and pumps) as required to prevent segregation.
 5. Vertical Free Fall Drop to Final Placement: 3 feet maximum.

C. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Wipe clean with device that does not allow mortar to adhere to belt.
4. Cover conveyor belts and chutes.

D. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

E. Retempering: Not permitted for concrete where cement has partially hydrated.

3.04 CONSOLIDATION AND VISUAL OBSERVATION

- A. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.

3.05 COLD WEATHER PLACEMENT

- A. Unless otherwise permitted, shall be in accordance with requirements of ACI 301, ACI 306.1, and as follows:
1. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
 2. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.
 3. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
 4. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
 5. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
 6. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.

- B. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
- C. Cure as specified.

3.06 HOT WEATHER PLACEMENT

- A. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
 - 1. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - 2. Internal concrete temperature in structure shall not exceed 158 degrees F, and maximum temperature differential between center of section and external surfaces of concrete shall not exceed 35 degrees F.
 - 3. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
 - 4. Cure as specified.

3.07 CONCRETE BONDING

- A. Construction Joints at Existing Concrete:
 - 1. Thoroughly clean and roughen existing concrete surfaces to roughness profile of 1/4 inch.
 - 2. Saturate surface with water for 24 hours prior to placing new concrete.

3.08 PREMOLDED JOINT FILLER INSTALLATION

- A. Sufficient in width to completely fill joint space where shown.
- B. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
- C. Secure premolded joint filler in forms before concrete is placed.

3.09 FINISHING FORMED SURFACES

- A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.

- B. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2 inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Engineer prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.

3.10 FINISHING UNFORMED SURFACES

- A. General:
 - 1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
 - 2. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
 - 3. Do not dust surfaces with dry materials nor add water to surfaces.
 - 4. Cure concrete as specified.
- B. Slab Tolerances:
 - 1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
 - 2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
 - 3. Steel gauge block 5/16-inch thick.
 - 4. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

5. Provide light broom finish unless specified otherwise.
6. Finish exposed edges with steel edging tool.

3.11 EXPOSED METAL OBJECTS

- A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
- B. Repair area of chipped-out concrete as specified for defective areas.

3.12 PROTECTION AND CURING

- A. Protect and cure concrete in accordance with requirements of ACI 301, ACI 308.1, and as follows:
 1. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
 2. Cure formed surfaces with curing compound applied in accordance with manufacturer's written instructions as soon as forms are removed and finishing is completed.
 3. Remove and replace concrete damaged by freezing.
 4. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.13 NONSHRINK GROUT

- A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's written instructions.

3.14 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against until concrete has obtained specified 28-day compressive strength.
- B. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.15 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. General:
 1. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.
 2. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours and for additional time as may be required before transporting to test lab.

3. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
4. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
5. Evaluation will be in accordance with ACI 301 and Specifications. Obtain one composite sample for each 50 cubic yards of concrete, minimum one per day if less than 50 cubic yards of concrete.
6. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
7. Frequency of testing may be changed at discretion of Engineer.
8. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M, at placement (discharge) end of line.
9. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
 - a. Six extra test cylinders from last 100 cubic yards of concrete.
 - b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.

4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal.

D. Slab Finish Tolerances and Slope Tolerances:

1. Support 10-foot-long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
2. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.16 SUPPLEMENTS

- A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:
1. Concrete Mix Design, Class 4000F1S0W0C0.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 4000F1S0W0C0

- A. Mix Locations: Where specified in Contract Documents.
- B. Exposure Categories and Classifications: F1S0W0C0.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
 - 2. Minimum concrete compressive strength (f'c) shall be 4,000 psi at 28 days.
 - a. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.	Air Content (%)*
3/8	6.0
1/2	5.5
3/4	5.0
1	4.5
*Tolerance of air content is $\pm 1/2$ percent.	

- 3. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - 3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
- 4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

Refer to PART 1 through PART 3 of this section for additional requirements.

**SECTION 03 63 00
CONCRETE DOWELING**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. ASTM International (ASTM):
 - a. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - b. E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 3. International Code Council (ICC):
 - a. 2015 International Building Code (IBC).
 - b. Evaluation Services Reports.

1.02 DEFINITIONS

- A. ICC Evaluation Services Report: Published by ICC for products provided by concrete adhesive anchor manufacturers.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's catalog information.
- B. Informational Submittals:
 - 1. Manufacturer's instructions for preparation, placement, drilling of holes, installation of anchors and adhesive, and handling of cartridges, nozzles, and equipment.
 - 2. Manufacturer's written letter of certification identifying installer's qualifications to install products.
 - 3. ICC Evaluation Services Report: Specific to proposed doweling system manufacturer.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer: Trained and certified by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Container Markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
- B. Store adhesive components in accordance with manufacturer's written instructions.
- C. Dispose of when:
 - 1. Shelf life has expired.
 - 2. Stored other than per manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Adhesive:
 - 1. Approved by an ICC Evaluation Services Report for conformance to 2015 IBC requirements for doweling of steel reinforcing bars in cracked concrete.
 - 2. Suitable for long-term loads as well as for wind loads.
 - 3. Meet requirements of ASTM C881/C881M.
 - 4. Disposable, Self-Contained Cartridge System:
 - a. Capable of dispensing both components in proper mixing ratio.
 - b. Fit into manually or pneumatically operated caulking gun.
 - 5. Mixed Adhesive: Nonsag, light paste consistency with ability to remain in a 1-inch diameter overhead drilled hole without runoff.
 - 6. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
 - 7. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT-RE 500 V3 (ESR-3814) or HIT HY 200 (ESR 3187) Adhesive Anchors.
 - b. Powers Fasteners, Brewster, NY; Power PURE110+ Epoxy Adhesive Anchor System (ESR-3298).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508).
- B. Mixing Nozzles: Disposable, manufactured in several sizes to accommodate size of reinforcing dowels.
- C. Reinforcing Dowels: As specified in Section 03 30 10, Structural Concrete.

PART 3 EXECUTION

3.01 INSTALLATION

A. Drilling Equipment:

1. Drilling Hammers for Dowel Holes:
 - a. Electric or pneumatic rotary type with medium or light impact.
 - b. Hollow drills with flushing air systems are preferred.
2. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

B. Hole Diameter: Use drill bit diameter meeting ICC Evaluation Services Report requirements and as recommended by manufacturer.

C. Obstructions in Drill Path: When existing steel reinforcement is encountered during drilling, obtain Engineer approval for proposed fix.

D. Doweling:

1. Install per details shown on Drawings and in accordance with adhesive manufacturer's instructions.
2. When using epoxy anchors, dowels may be prebent prior to installation to 15 degrees to align with other bars. Do not heat dowels to bend.
3. Bent Bar Dowels: Where edge distances are critical, and intersection with steel reinforcement or other obstruction is likely, slant drill to address edge distance or to clear obstruction. If drill must be slanted more than indicated in the manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

E. Adhesive:

1. Install in accordance with written manufacturer's instructions.
2. Dispense components through specially designed static mixing nozzle that thoroughly mixes components and places mixed adhesive at base of predrilled hole.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
 2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
 3. American National Standards Institute (ANSI).
 4. ASTM International (ASTM):
 - a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
 - f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
 - h. A563, Specification for Carbon and Alloy Steel Nuts.
 - i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
 - k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
 - l. F436, Specification for Hardened Steel Washers.
 - m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
 - n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.

- o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - p. F594, Specification for Stainless Steel Nuts.
 - q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
 - 6. International Code Council Evaluation Service (ICC-ES):
 - a. Evaluation Reports for Concrete and Masonry Anchors.
 - b. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
 - c. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - d. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
 - 7. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.
- C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.
- D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior below grade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete Anchors:
 - a. Manufacturer’s product description and installation instructions.
 - b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
2. Passivation method for stainless steel members.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.
- B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel:	
Threaded Rods	F1554, Grade 36 or F568M Class 5
Flat and Beveled Washers (Hardened)	F436
Nuts*	A194/A194M, Grade 2H
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

- 1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
- 2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind.
- 3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
- 4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

- 1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; Kwik-Bolt –TZ (KB-TZ) Anchors (ESR-1917).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).

C. Self-Tapping Concrete Screw Anchors:

- 1. Manufacturers and Products:
 - a. DeWalt/Powers Fasteners, Brewster, NY; Wedge-Bolt+ (ESR-2526).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Vertigo+ Rod Hanger Screw Anchor (ESR-2989).
 - c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
 - d. Hilti, Inc., Tulsa, OK; HUS-EZ Screw Anchor (ESR-3027).
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713 and IAPMO UES-493).

D. Adhesive Anchors:

- 1. Threaded Rod:
 - a. Diameter as shown on Drawings.
 - b. Length as required to provide minimum depth of embedment indicated and thread projection required.
 - c. Clean and free of grease, oil, or other deleterious material.

- 2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
 - 3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - b. Store adhesive on pallets or shelving in a covered storage area.
 - c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
 - d. Dispose of When:
 - 1) Shelf life has expired.
 - 2) Stored other than in accordance with manufacturer's instructions.
 - 4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 V3 (ESR-3814).
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors. (ESR-4057).
 - c. DeWalt/Powers Fasteners, Brewster NY; Pure 110+ Epoxy adhesive anchor system (ESR-3298).
- E. Adhesive Threaded Inserts:
- 1. Type 316 stainless steel, internally threaded inserts.
 - 2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.
 - 3. Or approved equal.

PART 3 EXECUTION

3.01 CONCRETE ANCHORS

- A. Begin installation only after concrete to receive anchors has attained design strength.
- B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.
- C. Install in accordance with written manufacturer's instructions.
- D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

- E. Use only drill type and bit type and diameter recommended by anchor manufacturer.
- F. Clean hole of debris and dust per manufacturer’s requirements.
- G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer’s installation instructions to clear obstruction, notify Engineer for direction on how to proceed.
- H. Adhesive Anchors:
 - 1. Unless otherwise approved by Engineer and adhesive manufacturer:
 - a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
 - b. Do not install prior to concrete attaining an age of 21 days.
 - c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
 - d. Do not disturb anchor during recommended curing time.
 - e. Do not exceed maximum torque as specified in manufacturer’s instructions.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 FASTENER SCHEDULE

- A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete		
Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment)	Verify product acceptability and manufacturer’s requirements if anchor installation will occur in an overhead application
Exterior, Wet, and Corrosive Areas	Stainless steel adhesive anchors	Verify product acceptability and manufacturer’s requirements if anchor installation will occur in an overhead application

- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

**SECTION 05 05 23
WELDING****PART 1 GENERAL**

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
 2. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
 3. American Welding Society (AWS):
 - a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. A3.0, Standard Welding Terms and Definitions.
 - c. D1.1/D1.1M, Structural Welding Code - Steel.
 - d. D1.2/D1.2M, Structural Welding Code - Aluminum.
 - e. D1.3/1.3M, Structural Welding Code - Sheet Steel.
 - f. D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
 - g. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
 - h. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

- A. CWI: Certified Welding Inspector.
1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes.
- B. MT: Magnetic Particle Testing.
- C. PQR: Procedure Qualification Record.
- D. VT: Visual Inspection/Testing.
- E. WPQ: Welder/Welding Operator Performance Qualification Record.
- F. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Shop and field WPSs and PQRs.
 - b. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
 - 1) Show on Shop Drawings, or on a weld map, complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.
 - 2) Clearly distinguish between shop and field welds.
 - 3) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
 - 4) Welding and NDE Symbols: In accordance with AWS A2.4.
 - 5) Welding Terms and Definitions: In accordance with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. CWI visual inspection (VT) reports.
4. Welding Documentation: Submit on forms in referenced welding codes.

1.04 QUALIFICATIONS

- A. WPSs: In accordance with AWS D1.1/D1.1M (Annex M Forms) for shop or field welding.
- B. WPQs: In accordance with AWS D1.1/D1.1M (Annex M Forms).
- C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.

1.05 SEQUENCING AND SCHEDULING

- A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Fabricator’s CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - 1. Verifying conformance of specified job material and proper storage.
 - 2. Monitoring conformance with approved WPS.
 - 3. Monitoring conformance of WPQ.
 - 4. Inspecting weld joint fit-up and performing in-process inspection.
 - 5. Providing 100 percent visual inspection of welds.
 - 6. Coordinating with nondestructive testing personnel and reviewing NDE test results.
 - 7. Maintaining records and preparing reports documenting that results of CWI VT comply with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

- A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

- A. Quality Control Inspection:
 - 1. All Welds: 100 percent VT by Contractor’s CWI.
 - 2. Acceptance Criteria:
 - a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 9.25.
 - b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.

3.03 FIELD QUALITY CONTROL

- A. Contractor’s CWI shall be present whenever field welding is performed. CWI shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - 1. Verify conformance of specified job material and proper storage.
 - 2. Monitor conformance with approved WPS.
 - 3. Monitor conformance of WPQ.
 - 4. Inspect weld joint fit-up and perform in-process inspection.

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5. Provide 100 percent visual inspection of all welds in accordance with Subparagraph Quality Control Inspection.
6. Supervise nondestructive testing personnel and evaluating test results.
7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

- A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENTS

- A. The supplement listed below, following “End of Section,” is a part of this specification.
 1. Welding and Nondestructive Testing Table.

END OF SECTION

Welding and Nondestructive Testing						
Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Req'd	Submit Written NDT Procedure Specifications	NDT Requirements
05 12 00 Structural Steel Framing	AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	No	100% VT
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code-Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum or AWS D1.6/D1.6M, Structural Welding Code - Stainless Steel	Yes	Yes	Yes	No	100% VT

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Galvanizers Association (AGA): Quality Assurance Manual.
 2. American Institute of Steel Construction (AISC):
 - a. 201, Certification Program for Structural Steel Fabricators.
 - b. 206, Certification Program for Structural Steel Erectors—Standard for Structural Steel Erectors.
 - c. 303, Code of Standard Practices for Steel Buildings and Bridges.
 - d. 325, Steel Construction Manual.
 - e. 326, Detailing for Steel Construction.
 - f. 360, Specification for Structural Steel Buildings.
 3. American Welding Society (AWS): D1.1/D1.1M, Structural Welding Code—Steel.
 4. ASTM International (ASTM):
 - a. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - b. A36/A36M, Standard Specification for Carbon Structural Steel.
 - c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - d. A123/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - e. A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - g. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
 - h. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
 - i. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - j. A563, Standard Specification for Carbons and Alloy Steel Nuts.
 - k. A572/A572M, Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.

- l. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - m. A992/A992M, Standard Specification for Structural Steel Shapes.
 - n. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - o. A1085/A1085M, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
 - p. ASTM D6386 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
 - q. ASTM D7803 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating.
 - r. F436, Standard Specification for Hardened Steel Washers.
 - s. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 - t. F1136, Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
 - u. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
5. Occupational Safety and Health Administration (OSHA).
 6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide Shop Drawing details showing:
 - a. Erection plans.
 - b. Members, including piece numbers, sizes, grades, dimensions, cambers, and connection details.
 - c. Anchor bolt layouts.
 - d. Hardened washer details.
 - e. Connection material specifications.
 - f. Indicate type, size, and length of bolts.
 - g. Joint details for complete penetration welds.
 - h. Indicate welds by standard AWS symbols, distinguishing between shop and field welds and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
2. Product specifications, including primer and other coatings.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Welding qualifications as specified in Section 05 05 23, Welding.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of AGA's Quality Assurance Manual.

B. Certifications:

1. AISC Quality Certification for Fabricator: A fabricator who participates in the AISC Certification program and is designated an AISC certified plant, Category BU.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load structural members in such a manner that they will be transported and unloaded without damage to coatings and without being excessively stressed, deformed, or otherwise damaged.

B. Storage:

1. Store materials to permit easy access for inspection and identification. Store in a dry area and keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - a. Do not store materials in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials as directed.
2. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - a. Fasteners may be repackaged provided testing and inspecting agency observes repackaging and sealing of containers.
 - b. Clean and lubricate bolts and nuts that become dry or rusty before use.
 - c. Comply with manufacturer's written recommendations for cleaning and lubricating fasteners and for retesting fasteners after lubrication.

C. Handle materials to avoid distortion or damage to members or supporting structures.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural Steel: As specified in Section 05 50 00, Metal Fabrications.
- B. Aluminum: As specified in Section 05 50 00, Metal Fabrications.
- C. Stainless Steel: As specified in Section 05 50 00, Metal Fabrications.
- D. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon, such as plates over 1.5 inches thick for ASTM A36/A36M and ASTM A572/A572M steels, limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

2.02 FASTENERS

- A. Anchor Bolts: As specified in Section 05 50 00, Metal Fabrications.
- B. Post-Installed Anchors: As specified in Section 05 05 19, Post-Installed Anchors.
- C. High-Strength Bolts:
 - 1. ASTM F3125 Grade A325, Type 1, hot-dip galvanized.
 - 2. Bolt Length and Thread Length: As required for connection type shown, with hardened washers as required.
- D. Nuts: ASTM A563, type to match bolt type and finish.
- E. Hardened Steel Flat and Beveled Washers: ASTM F436, type to match bolt finish.

2.03 FABRICATION

- A. General:
 - 1. Fabricate as shown and in accordance with AISC 360 and AISC 303.
 - 2. Columns: Full-length members without splices, unless shown otherwise or approved by Engineer.
 - 3. Mark and match mark materials for field assembly.
 - 4. Complete assembly, including bolting and welding of units, before start of finishing operations.
 - 5. Fabricate to agree with field measurements.
 - 6. Fabricate beams with rolling camber up.

B. Connections:

1. Shop Connections: Weld or bolt as shown on Drawings.
2. Meet requirements of AISC 325 for bolted double-angle shear connections, unless indicated otherwise.
3. Meet OSHA requirements for one independent bolt at beams framing in to column web connections.
4. Provide oversized holes for anchor bolts in column baseplate in accordance with AISC 325, unless indicated otherwise.

C. Welded Construction:

1. As specified in Section 05 05 23, Welding.
2. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

D. Interface with Other Work:

1. Holes:
 - a. As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members shall be approved by Engineer.
 - b. No flame-cut holes are permitted without prior approval of Engineer.
2. Weld threaded nuts to framing members, and other specialty items to receive other Work.

2.04 FINISHES

A. Shop Paint Primer:

1. Surface Preparation and painting as specified in Section 09 90 00, Painting and Coating.
2. Do not shop prime the following surfaces, unless indicated otherwise:
 - a. Within 2 inches of field-welded connections.

- B. Galvanizing: Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of steel.

2.05 SOURCE QUALITY CONTROL

A. Welding:

1. Contractor's Certified Welding Inspector (CWI): Inspect and test fabrication welds as specified in Section 05 05 23, Welding.

2. Visually inspect fabrication welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
3. Repair and retest defective welds as specified in Section 05 05 23, Welding.

PART 3 EXECUTION

3.01 ERECTION

A. General:

1. Meet requirements of AISC 360 and AISC 303, with exceptions as specified.
2. Install Contractor-designed temporary construction bracing to provide necessary support until components are in place and construction is complete.
3. Provide additional field connection material as required by AISC 303.
4. Splice members only where indicated and accepted on Shop Drawings.

B. Field Assembly:

1. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.
2. Set structural frames accurately to lines and elevations shown.
3. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.

C. Setting Baseplates and Bearing Plates:

1. Clean concrete bearing surfaces of bond reducing materials and roughen to improve bond to surfaces.
2. Clean bottom surface of baseplates and bearing plates.
3. Set loose and attached baseplates and bearing plates for structural members on wedges, shims, leveling nuts, or other adjustable devices. Use leveling plates where indicated.
4. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to placing grout. Weld plate washer to baseplate where indicated.
5. Grout Under Baseplate: As specified in Section 03 30 10, Structural Concrete, prior to placing loads on structure.

D. Anchor Bolts:

1. Coordinate installation of anchor bolts and other connectors required for securing structural steel to in-place work.
2. Provide templates and other devices for presetting bolts and other anchors to accurate locations.
3. Projection of anchor bolts beyond face of concrete and threaded length shall be adequate to allow for full engagement of threads of hold-down nuts, adjustment of leveling nuts, washer thicknesses, and construction tolerances, unless indicated otherwise.

3.02 REPAIR AND CLEANING

- A. Clean shop primer from field welds, bolted connections, and abraded areas immediately after erection.
- B. Remove and grind smooth tack welds, fit-up-lugs, and weld runoff tabs.
- C. Remove weld back-up bars and grind smooth where indicated on Drawings.
- D. Apply touchup paint primer by brush or spray of same thickness and material as that used in shop application and as specified in Section 09 90 00, Painting and Coating.
- E. Hot-Dip Galvanized Coating Repair:
 1. Conform to ASTM A780/A780M.
 2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
 3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
 4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspect and test as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
 2. American Galvanizers Association (AGA):
 - a. Inspection of Hot-Dip Galvanized Steel Products.
 - b. Quality Assurance Manual.
 3. American Iron and Steel Institute (AISI): Stainless Steel Types.
 4. American National Standards Institute (ANSI).
 5. American Welding Society (AWS):
 - a. D1.1/D1.1M, Structural Welding Code - Steel.
 - b. D1.2/D1.2M, Structural Welding Code - Aluminum.
 - c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
 6. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - d. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - e. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - g. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - h. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 - i. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - j. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - k. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
 - l. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).

- m. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - n. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - o. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - p. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - q. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - r. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 - s. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
 - t. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
 - u. A992/A992M, Standard Specification for Structural Steel Shapes.
 - v. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
 - w. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - x. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - y. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - z. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
 - aa. F436, Standard Specification for Hardened Steel Washers.
 - bb. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - cc. F594, Standard Specification for Stainless Steel Nuts.
 - dd. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
 - ee. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 - ff. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
7. Specialty Steel Industry of North America (SSINA):
- a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Anchor Bolt: Cast-in-place anchor.
- B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- C. Exterior Area: Location not protected from weather by building or other enclosed structure.
- D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.
- E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Metal fabrications, including welding and fastener information.
- B. Informational Submittals:
 - 1. U-Channel Concrete Inserts:
 - a. Manufacturer’s product description.
 - b. Allowable load tables.
 - 2. Passivation method for stainless steel members.
 - 3. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.
- B. Package stainless steel items to provide protection from carbon impregnation.
- C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.
- D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

- A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.
- B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (Type 316L for welded connections)
Shapes	A276, AISI Type 304 (Type 304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (Type 316L for welded connections)

Item	ASTM Reference
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	F3125, Type 1 bolts, with A563 nuts
Anchor Bolts and Rods	F1554, Grade 55
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436

- C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

- A. Cast-In-Place Anchor Bolts:
 - 1. Headed type, unless otherwise shown on Drawings.
 - 2. Material type and protective coating as shown in Fastener Schedule at end of this section.

2.03 POST-INSTALLED CONCRETE ANCHORS

- A. See Section 05 05 19, Post-Installed Anchors.

2.04 ACCESSORIES

- A. Antiseizing Lubricant for Stainless Steel Threaded Connections:
 - 1. Resists washout.
 - 2. Manufacturers and Products:
 - a. Bostik, Middleton, MA; Neverseez.
 - b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.
 - c. Or approved equal.

2.05 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures—Allowable Stress Design.
4. Stainless Steel Built-up Shapes: Fabricate built-up shapes in accordance with ASTM A1069/A1069M.

C. Welding:

1. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
2. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
3. Aluminum: Meet requirements of AWS D1.2/D1.2M.
4. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
5. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts, unless indicated otherwise.

- E. Galvanizing:
 - 1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
 - 2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
 - 3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
 - 4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
 - 5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
 - 6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
 - 7. Galvanized steel sheets in accordance with ASTM A653/A653M.
 - 8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

- F. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

- G. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.06 SOURCE QUALITY CONTROL

- A. Visually inspect all fabrication welds and correct deficiencies.
 - 1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
 - 2. Aluminum: AWS D1.2/D1.2M.
 - 3. Stainless Steel: AWS D1.6/D1.6M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

- A. General:
 - 1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
 - 2. Install rigid, substantial, and neat in appearance.

3. Install manufactured products in accordance with manufacturer's recommendations.
4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Locate and hold anchor bolts in place with templates at time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 U-CHANNEL CONCRETE INSERTS

- A. Provide as indicated for pipe supports and where otherwise shown on Drawings.
- B. Except for interior dry areas, use plastic clips or similar dielectric material to isolate channel anchors from concrete reinforcing steel.

3.04 PAINTING

- A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.
- B. Repair of Damaged Hot-Dip Galvanized Coating:
 1. Conform to ASTM A780/A780M.
 2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
 3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
 4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control:
 1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.

3.06 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Stainless steel headed anchors for stainless steel members. Galvanized headed anchors for galvanized steel members. Steel headed anchors for steel and miscellaneous steel members.	
Exterior and Interior Wet Areas	Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Stainless steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Connections for Structural Steel Framing		

Service Use and Location	Product	Remarks
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections	Use hot-dipped galvanized high- strength bolted connections for galvanized steel framing members.
5. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment	
6. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

**SECTION 09 90 00
PAINTING AND PROTECTIVE COATINGS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
1. American Water Works Association (AWWA):
 - a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot-Applied.
 - b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 - c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 - d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
 2. Environmental Protection Agency (EPA).
 3. NACE International (NACE): RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
 4. NSF International (NSF): 61 Drinking Water System Components-Health Effects.
 5. Occupational Safety and Health Act (OSHA).
 6. The Society for Protective Coatings (SSPC):
 - a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
 - b. PA 3, Guide to Safety in Paint Applications.
 - c. SP 1, Solvent Cleaning.
 - d. SP 2, Hand Tool Cleaning.
 - e. SP 3, Power Tool Cleaning.
 - f. SP 5, White Metal Blast Cleaning.
 - g. SP 6, Commercial Blast Cleaning.
 - h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
 - i. SP 10, Near-White Blast Cleaning.
 - j. SP 11, Power Tool Cleaning to Bare Metal.
 - k. SP 12, Surface Preparation and Cleaning of Metals Waterjetting Prior to Recoating.
 - l. SP 13, Surface Preparation of Concrete.

1.02 DEFINITIONS

A. Terms Used in this Section:

1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PDS: Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Data Sheets:
 - 1) For each paint system, furnish a Product Data Sheet (PDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.
 - 2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this Section.
 - 3) Technical and performance information that demonstrates compliance with Specification.
 - 4) Submit required information on a system-by-system basis.
 - 5) Furnish copies of paint system submittals to the coating applicator.
 - 6) Indiscriminate submittal of manufacturer's literature only is not acceptable.
 - b. Detailed chemical and gradation analysis for each proposed abrasive material.

B. Samples:

1. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
2. Reference Panel:
 - 1) Surface Preparation:
 - a. Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
 - b. Provide panel representative of the steel used; prevent deterioration of surface quality.
 - c. Panel to be reference source for inspection upon approval by Engineer
 - 2) Paint:
 - a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
 - b) Furnish additional samples as required until colors, finishes, and textures are approved.
 - c) Approved samples to be the quality standard for final finishes.

C. Quality Control Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Services.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for intended use.
5. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.
6. Manufacturer's written instructions and special details for applying each type of paint.

D. Contract Closeout Submittals: Special guarantee.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Applicator: Provide minimum 5 year's documented experience of satisfactory application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform Surface Preparation and Painting in Accordance with Recommendations of the Following:
 - a. Paint manufacturer's instructions.
 - b. SSPC-PA 3, Guide to Safety in Paint Applications.
 - c. Federal, state, and local agencies having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply paint in temperatures outside of manufacturer's recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.
- B. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

1.07 SPECIAL GUARANTEE

- A. Provide coating applicator's and coating manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coatings Manufacturers Code A (Able to supply most heavy-duty industrial coatings and architectural paints):

- 1. Ameron Protective Coatings, Brea, CA.
- 2. Benjamin Moore Paints, New York, NY.
- 3. Carboline Coatings Co., St. Louis, MO.
- 4. DuPont Chemical Co., Wilmington, DE.
- 5. Hempel/Reliance Paints, Houston, TX.
- 6. Keeler and Long, Inc., Watertown, CT.
- 7. Master Builders, Inc., Cleveland, OH.
- 8. Pittsburgh Paints, Pittsburgh, PA.
- 9. Plas-Chem Coatings, St. Louis, MO.
- 10. International Protective Coatings, Houston, TX.
- 11. Sherwin Williams, Cleveland, OH.
- 12. Sigma Coatings, Inc., Harvey, LA.
- 13. Tnemec Coatings, Kansas City, MO.
- 14. ICI Devoe Coatings, Louisville, KY.
- 15. Plasite Protective Coatings, Green Bay, WI.

- B. Paint Manufacturers Code B (Able to supply most architectural and institutional paints):

- 1. Ameritone, Long Beach, CA.
- 2. Detroit Graphite Co., Rockford, IL.
- 3. Pratt and Lambert, Inc., Buffalo, NY.
- 4. Rust-Oleum Corp., Evanston, IL.
- 5. Samuel Cabot, Inc., Boston, MA.
- 6. Textured Coatings of America, Los Angeles, CA.
- 7. Thoro Systems, Miami, FL.

- C. Fusion Bonded Coating Applicators Code E.

- D. Acid-Resistant Coatings Manufacturers Code F.
- E. Moisture-Cure Polyurethane Coatings Manufacturers Code G.

2.02 ABRASIVE MATERIALS

- A. Select abrasive type and size to produce a surface profile that meets coating manufacturer’s recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

- A. General:
 - 1. Material Quality: Manufacturer's highest quality products and suitable for intended service.
 - 2. Materials Including Primer and Finish Coats: Produced by same manufacturer.
 - 3. Thinners, Cleaners, Driers, and Other Additives: As recommended by manufacturer of the particular coating.
- B. Products are listed below according to their approximate order of appearance in the systems. The letter designating the manufacturer code refers to Article Manufacturers.

Product	Definition	Manufacturer Code
Tar Stop	Coating designed to prevent bleeding of black asphaltic varnish through finish paint; Shellac is a suitable alternate; not applicable for white and pastel colors	A
Polyamide Epoxy	Potable grade polyamide epoxy coatings approved for potable water contact and conforming to NSF 61	A
Epoxy Primer	Polyamide, anticorrosive, converted epoxy primer containing rust-inhibitive pigments	A
Coal-Tar Epoxy	Amine or phenolic epoxy type where minimum pH is less than 5.0; amine, phenolic, or polyamide type where minimum pH is greater than 5.0; 70 percent volume solids minimum, suitable for immersion service	A
Organic Zinc Rich Primer	Converted epoxy, epoxy/phenolic or urethane type, minimum 10 pounds metallic zinc content per gallon	A

Product	Definition	Manufacturer Code
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading	A,B
Alkyd Enamel	Optimum quality, gloss finish, medium long oil	A,B
Wash Primer	Vinyl butyral acid	A
Epoxy Nonskid	Polyamide or amine converted epoxies aggregated; aggregate may be packaged separately	A
Inorganic Zinc Primer	Solvent or water based, having 85 percent metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating	A
Silicone/ Silicone Acrylic	Elevated temperature silicone or silicone/acrylic based	A,B
Elastomeric Polyurethane	100 percent solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service	D
Cementitious Acrylic Emulsion	Two-component (liquid and aggregate) filler	A,B
Polyamide High Build Epoxy	Capability of 4 to 8 MDFT per coat	A
Polyamide Epoxy, High Solids	Percent of volume solids 80 percent minimum, suitable for immersion service	A
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish	A
Acrylic Latex (High-Gloss)	Single-component	A,B
Acrylic Latex (Semi-Gloss)	Single component	A,B
Canvas Sealer	Single-package latex or alkyd primer for canvas surfaces; follow manufacturer's recommendations for surface preparation	A,B
Bituminous Paint	Single-component, coal-tar pitch based	A

Product	Definition	Manufacturer Code
Block Filler	Primer-sealer designed for rough masonry surfaces, 100 percent acrylic emulsion	A,B
Alkyd Wood Primer	Flat alkyd	A,B
Alkyd (Semigloss)	Semigloss alkyd	A,B
Acrylic Latex (Semigloss)	Flat latex	A,B
Water Base Epoxy	A two-component, polyamide epoxy emulsion	A
Sanding Sealer	Co-polymer oil, clear, dull luster	A,B
Stain, Wood	Satin luster, linseed oil	A,B
Stain, Concrete	Acrylic, water repellant, penetrating stain	B
Acrylic Sealer	Clear acrylic	B
Varnish	Nonpigmented vehicle based on a variety of resins (alkyd, phenolic, urethane) available in gloss, semigloss, and flat finishes	A,B,C
Fusion Bonded Coating	100 percent solids, thermosetting, fusion bonded, dry powder epoxy or polyurethane resin, suitable for the intended service	E
Fusion Bonded, TFE Lube or Grease Lube	Tetrafluoroethylene, liquid coating, or open gear grease as supplied by McMaster-Carr Co., Elmhurst, IL; RL 736 manufactured by Amrep, Marietta, GA	E

2.04 MIXING

A. Multiple Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

- B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at the Site.

2.05 SHOP FINISHES

- A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.
- B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.
- C. Shop Coating Requirements:
 - 1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
 - 2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Surface Preparation Verifications:
 - 1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.
 - 2. Provide Engineer minimum 7 days' advance notice to start of shop or field surface preparation Work and coating application Work.
 - 3. Perform such Work only in presence of Engineer, unless Engineer grants prior approval to perform such Work in Engineer's absence.
- B. Schedule inspection with Engineer in advance for cleaned surfaces and all coats prior to succeeding coat.
- C. Field Abrasive Blasting:
 - 1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed.

2. Refer to coating systems for degree of abrasive blasting required.
3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

3.02 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering the motors.
- E. Protect all surfaces adjacent to, or downwind of Work area from overspray. Contractor shall be responsible for any damage resulting from overspray.

3.03 SURFACE PREPARATION

- A. Metal Surfaces:
 1. Where indicated, meet requirements of the following SSPC specifications:
 - a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
 - b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
 - c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
 - d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
 - e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor

- discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
- f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
 - g. SP 8, Pickling.
 - h. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - i. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.
 - j. SP 12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating: Surface preparation using high-pressure and ultrahigh-pressure water jetting to achieve specified surface cleanliness condition. Surface cleanliness conditions are defined in SSPC SP 12 and are designated WJ-1 through WJ-4 for visual surface preparation definitions and SC-1 through SC-3 for nonvisual surface preparation definitions.
2. The words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” and “blast cleaning,” or similar words of equal intent in these Specifications or in paint manufacturer's specifications refer to the applicable SSPC Specifications.
 3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
 4. Hand tool clean areas that cannot be cleaned by power tool cleaning.
 5. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 6. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - 1) No undercutting or reverse ridges on weld bead.
 - 2) No weld spatter on or adjacent to weld or any other area to be painted.
 - 3) No sharp peaks or ridges along weld bead.

- b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
 - 7. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.
 - 8. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce a surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
 - 9. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
 - b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.
- B. Plastic Surfaces:
- 1. Hand sand plastic surfaces to be coated with a medium grit sandpaper to provide tooth for the coating system.
 - 2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.
- C. Masonry Surfaces:
- 1. Complete and cure masonry construction for 14 days or more before starting surface preparation Work.

2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.
3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
 - a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.
 - b. Brush-off blasting.
 - c. Water blasting.
4. Do not damage masonry mortar joints or adjacent surfaces.
5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.
6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair the intended finished appearance.
7. Clear Coated Masonry Surfaces: Free of discolorations and uniform in texture after cleaning.

D. Existing Painted Surfaces to be Repainted Surface Preparation:

1. Detergent wash and freshwater rinse.
2. Clean loose, abraded, or damaged coatings to substrate by hand or power tool, SP 2 or SP 3.
3. Feather surrounding intact coating.
4. Apply one spot coat of specified primer to bare areas, overlapping prepared existing coating.
5. Apply one full finish coat of specified primer to entire surface.
6. If an aged, plural-component material is to be topcoated, contact coating manufacturer for additional surface preparation requirements.
7. For ductile iron pipe with asphaltic varnish finish not specified to be abrasive blasted, apply coat of tar stop prior to application of cosmetic finish coat.
8. Application of Cosmetic Coat:
 - a. It is assumed that existing coatings have oxidized sufficiently to prevent lifting or peeling when overcoated with paints specified.
 - b. Check compatibility by application to a small area prior to starting painting.
 - c. If lifting or other problems occur, request disposition from Engineer.
9. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of SSPC.

3.04 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC-SP 7, Brush-off Blast Cleaning.
2. Abrasive: Either wet or dry blasting sand, grit, or nut shell.
3. Select various surface preparation parameters such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will approve acceptable trial blast cleaned area and will use area as a representative sample of surface preparation.
6. Repair or replace surfaces damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: one part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
2. Application:
 - a. Application Rate: Approximately 2 gallons per 100 square feet.
 - b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
 - c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
 - d. After bubbling subsides (10 minutes), hose down the remaining slurry with high pressure clean water.
 - e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
 - f. Thoroughly rinse to remove any residual acid surface condition which can impair adhesion.
3. Ensure surface is completely dry before application of coating.
4. Apply acid etching to obtain a "grit sandpaper" surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
2. Meets requirements of SSPC-SP 1.

3.05 APPLICATION

A. General:

1. The intention of these specifications is for existing and new, concrete, metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Prime coat structural steel surfaces. Exterior concrete surfaces will not be painted unless specifically indicated.
2. Extent of Coating (Immersion): Coatings shall be applied to all internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating for any purpose until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and the paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Sand metal lightly between coats to achieve required finish.
6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
9. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
10. Keep paint materials sealed when not in use.
11. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

B. Shop Primed and Factory Finished Surfaces:

1. Schedule inspection with Engineer before shop priming or topcoating factory finished items delivered to site.
2. Prepare surfaces and spot prime using specified primer.
3. Apply mist coat of primer, 1-mil dry film thickness.
4. After welding, prepare and prime holdback areas as required for paint system. Apply primer in accordance with manufacturer's instructions.

C. Manufacturer Applied Paint Systems:

1. Repair abraded areas on factory finished items as recommended by manufacturer.
2. Carefully blend repaired areas into original finish.
3. Fusion Bonded Coatings: Provide appropriate liquid repair kits for field use.

D. Film Thickness and Coverage:

1. Number of Coats:
 - a. Minimum required without regard to coating thickness.
 - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
 - a. Do not exceed coating manufacturer's recommendations.
 - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - a. Perform with properly calibrated instruments.
 - b. Recoat and repair as necessary for compliance with the Specifications.
 - c. All coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Visually inspect concrete, nonferrous metal, and plastic to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. The hiding shall be so complete that the addition of additional coats would not increase the hiding.

3.06 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide a magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA, Mikrotest.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
 - a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
 - b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE RP0188.
 - c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE RP0188.
 - d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.07 MANUFACTURER'S SERVICES

- A. In Accordance with Section 01 43 33, Manufacturers' Services, Coating Manufacturer's Representative shall be Present at Site as Follows:
1. On the first day of application of any coating.
 2. A minimum of two additional site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
 3. As required to resolve field problems attributable to, or associated with the manufacturers' product.
 4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.08 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.
- B. Upon completion of the Work, remove staging, scaffolding, and containers from the site or destroy in a legal manner.
- C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.09 PROTECTIVE COATINGS SYSTEMS

A. System No. 2 Submerged Metal – Leachate:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	Prime in accordance with manufacturer’s recommendations	
	Coal-Tar Epoxy	2 coats, 16 MDFT

B. System No. 4 Exposed Metal – Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
Near-White Blast Cleaning (SP 10)	Epoxy Primer-Ferrous Metal	1 coat, 2.5 MDFT
	Polyamide High Build Epoxy	1 coat, 4, MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

C. System No. 6 Exposed Metal - Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel	2 coats, 4 MDFT

D. System No. 8 Buried Metal - General:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast or Centrifugal Wheel Blast (SP 10)	Standard Hot Coal-Tar Enamel -OR- Coal-Tar Epoxy -OR- Tape Coat System	AWWA C203 AWWA C210 AWWA C214
	For Acidic Soil, Brackish Water High Bacteria: Hot Coal-Tar, Double Felt	AWWA C203
	For Highly Abrasive Soil, Brackish Water: Hot Coal-Tar, Fibrous Glass -OR- Tape Coat System	AWWA C203 AWWA C214 with Double Outer Wrap

E. System No. 14 High Heat-Resistant - 700 Degrees F Maximum:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Inorganic Zinc Primer	1 coat, 2.5 MDFT
	Silicone	1 coat, 2 MDFT

F. System No. 15 Heat-Resistant - 425 Degrees F Maximum:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Inorganic Zinc Primer	1 coat, 2.5 MDFT
	Silicone Acrylic (limited colors)	2 coats, 2 MDFT

G. System No. 19, Concrete Filler and Coating for Concrete Structures Immersed in Leachate or Wastewater:

Surface Prep.	Paint Material	Min. Coats, Cover
Surface Preparation in accordance with Article Concrete Surface Preparation of this Section	Epoxy Filler/Surfacer	As required to fill voids and level surface
	Polyamide Epoxy, high solids	3 coats, 250 SFPGPC

H. System No. 26 Canvas Jacketed Pipe:

Surface Prep.	Paint Material	Min. Coats, Cover
Remove All Oil and Grease	Canvas Sealer	1 coat, 200 SFPG
	Acrylic Latex	2 coats, 240 SFPGPC

I. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Wash Primer	1 coat, 0.4 MDFT
	Bituminous Paint	1 coat, 10 MDFT

J. System No. 29 Fusion Bonded Coating for Metals Subject to Immersion in Leachate or Wastewater:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) or Acid Pickling (SP 8)	Fusion Bonded 100 percent Solids Epoxy or Polyurethane	1 or 2 coats, 7 MDFT

3.10 ARCHITECTURAL PAINT SYSTEMS

A. System No. 112 Concrete, Flat:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

B. System No. 113 Concrete, Semigloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Acrylic Latex (Semigloss)	2 coats, 240 SFPGPC

3.11 APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting Work in question.

B. System No. 2 Submerged Metal - Other: Use on the following items or areas:

1. Metal surfaces new below a plane 1 foot above maximum liquid surface, metal surfaces above maximum liquid surface which are a part of immersed equipment, and the following specific surfaces: Maximum liquid surface within a containment area in top of containment wall.
2. Buried and exposed pinch valves.

C. System No. 4 Exposed Metal - Highly Corrosive: Use on the following items or areas: Exposed metal surfaces, new located outside of buildings or exposed to weather.

D. System No. 6 Exposed Metal - Atmospheric: Use on the following items or areas:

1. Instrumentation and control systems exposed enclosures for process.
2. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

- E. System No. 8 Buried Metal - General: Use on the following items or areas:
 - 1. Buried, below grade portions of steel items, except buried stainless steel or ductile iron and pinch valves.
- F. System No. 15 Heat-Resistant: 425 degrees F, maximum.
- G. System No. 19 Concrete Filler and Coating for Concrete Structures Immersed in Leachate or Wastewater: Concrete surfaces in concrete valve pits, manholes, and wetwells to fill voids and surface irregularities.
- H. System No. 26 Canvas Jacketed Pipe: Use at exposed areas.
- I. System No. 27 Aluminum and Dissimilar Metal Insulation: Use on aluminum surfaces embedded or in contact with concrete.
- J. System No. 29 Fusion-Bonded Coating for Metals Subject to Immersion in Leachate or Wastewater: Use on stainless steel anchor bolts cast into concrete.
- K. Surfaces Not Requiring Painting: Unless otherwise stated or shown, the following areas or items will not require painting or coating:
 - 1. Concrete surfaces.
 - 2. Reinforcing steel.
 - 3. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, Monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
 - a. Required for electrical insulation between dissimilar metals.
 - b. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
 - c. Color coding of equipment and piping is required.
 - 4. Nonmetallic materials such as glass, wood, and porcelain, except as required for architectural painting or color coding.
 - 5. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches (if prefinished in OSHA yellow).
 - 6. Nonsubmerged electrical conduits attached to unpainted concrete surfaces.
 - 7. Cathodic protection anodes.
 - 8. Insulated piping and insulated piping with jacket will require prime coat only, except as required for architectural painting or color coding.

9. Fiberglass reinforced plastic (FRP) surfaces with an integral ultra-violet resistant colored gel coat do not require painting, provided the color is as selected.

3.12 COLORS

- A. Painted light gray, as approved by Owner.
- B. Equipment Colors:
 1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
 2. Paint equipment and piping one color as selected.
 3. Paint Nonsubmerged Portions of Equipment the Same Color as the Piping it Serves, Except as Itemized Below:
 - a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
 - b. Fire Protection Equipment and Apparatus: OSHA Red.
 - c. Radiation Hazards: OSHA Purple.
 - d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

3.13 SUPPLEMENTS

- A. The supplements listed below, following “END OF SECTION,” are a part of this Specification:
 1. Data Sheet: Example Paint System Data Sheet (PSDS).
 2. Paint Product Data Sheet (PPDS).

END OF SECTION

PAINT SYSTEM DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PSDS for each coating system.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

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Provide manufacturer's recommendations for the following:

Mixing Ratio:

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

PAINT PRODUCT DATA SHEET

Complete and attach manufacturer’s Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer’s recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer’s recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Attach additional sheets detailing manufacturer’s recommended storage requirements and holiday testing procedures.

**SECTION 10 14 00
EQUIPMENT LABELS AND SIGNS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 - 2. ASTM International (ASTM):
 - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - b. D709, Standard Specification for Laminated Thermosetting Materials.
 - 3. National Fire Protection Association (NFPA):
 - a. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
 - b. HAZ-01, Fire Protection Guide to Hazardous Materials.
 - 4. Occupational Safety and Health Act (OSHA).

1.02 WORK INCLUDED

- A. See Section 26 05 01, Electrical for electrical equipment signage and labels requirements.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Drawings showing layouts, actual letter sizes and styles, and mounting details.
 - b. Manufacturer's literature showing letter sizes and styles, sign materials, and standard mounting details.
 - 2. Samples: One full size for each type of nameplate, sign, and label specified.
- B. Informational Submittals: Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 SIGNS

A. Fiberglass Signs:

1. Material: Three-ply laminated fiberglass, minimum 1/8 inch thick, with contrasting color core message layer between two clear weather-resistant surface layers.
2. Manufacturers:
 - a. Best Sign System Inc.
 - b. Brady Signmark.
 - c. Or Approved Equal.

2.02 ANCILLARY ITEMS

- A. Fasteners: Stainless steel screws or bolts of appropriate sizes.
- B. Pipe Posts: 2.5-inch galvanized steel pipe meeting ASTM A53/A53M, Type S, Grade B. Sign to be set with center at 42 inches unless otherwise designated by Engineer.
- C. Chain: Type 304 stainless steel No. 16 single jack chain or No. 2 double loop coil chain to be used where post is unnecessary due to type of sign.

2.03 IDENTIFICATION LABELS

A. Equipment Labels:

1. Applies to equipment with assigned tag numbers, where specified on Drawings and Equipment Label Schedule.
2. Letters: White engraved, 3/4-inch minimum high.
3. Background: Black.
4. Materials: Fiberglass with encased lettering.
5. Furnish 1-inch margin with holes at each end of label, for mounting. On fiberglass labels, furnish grommets at each hole.
6. Size:
 - a. Furnish same size base dimensions for all labels.
 - b. Contractor to coordinate label size with Manufacturer.
7. Message: Equipment names and tag numbers as used in sections where equipment is specified.
8. Manufacturers:
 - a. Brady Signmark.
 - b. Seton Identification Products.
 - c. Or Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION—GENERAL

- A. In accordance with manufacturer’s recommendations.
- B. Location of all signage will be as directed by Engineer.
- C. Mount securely, plumb, and level.

3.02 SIGNS

- A. Anchor in-place for easy removal and reinstallation with ordinary hand tools.
- B. Signs:
 - 1. Locate for high visibility with minimum restriction of working area around walkways and equipment.
 - 2. Removable with ordinary hand tools without leaving scars on structure or equipment.

3.03 IDENTIFICATION LABELS

- A. Equipment Labels: Locate and install on pipe, blind flange or concrete equipment base.

3.04 SUPPLEMENTS

- A. The supplement listed below, following “End of Section,” is a part of this Specification.
 - 1. Identification Label and Sign Schedule: A tabulation of characteristics for each sign on the Project. Provide items as scheduled.

END OF SECTION

IDENTIFICATION LABEL AND SIGN SCHEDULE						
		Lettering				
Type	Color	Style	Color	Message	Faces	Other Requirements
Equipment Label	Black	Helvetica	White	Leachate from Bay 17 Storm Water Sump	1	Bay 17 Quick Connect
Equipment Label	Black	Helvetica	White	Leachate from Bay 18 Storm Water Sump	1	Bay 17 Quick Connect
Equipment Label	Black	Helvetica	White	Leachate from Bay 19 Storm Water Sump	1	Bay 19 Quick Connect
Equipment Label	Black	Helvetica	White	Bay 17 Storm Water Sump to Swale	1	Bay 17 Quick Connect
Equipment Label	Black	Helvetica	White	Bay 18 Storm Water Sump to Swale	1	Bay 18 Quick Connect
Equipment Label	Black	Helvetica	White	Bay 19 Storm Water Sump to Swale	1	Bay 19 Quick Connect
Equipment Label	Black	Helvetica	White	Bay 17 North LE/PRI C.O.	1	Bay 17 North LE/PRI (East Side) Mount om Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 South LE/PRI C.O.	1	Bay 17 North LE/PRI C.O. (East Side) Mount om Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 North LE/PRI Header C.O.	1	Bay 17 North(East Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 South LE/PRI Header C.O	1	Bay 17 South (East Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 North LE/SEC C.O.	1	Bay 17 North (East Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 South LE/SEC C.O.	1	Bay 17 South (East Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 North LE/SEC Header C.O.	1	Bay 17 North (East Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 South LE/SEC Header C.O.	1	Bay 17 South (East Side) Mount on Thread-on Cap

IDENTIFICATION LABEL AND SIGN SCHEDULE						
		Lettering				
Type	Color	Style	Color	Message	Faces	Other Requirements
Equipment Label	Black	Helvetica	White	Bay 17 North LE/SEC C.O.	1	Bay 17 South (West Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 South LE/SEC C.O.	1	Bay 17 South (West Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 North LE/PRI C.O.	1	Bay 17 South (West Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 17 South LE/PRI C.O.	1	Bay 17 South (West Side) Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 18 LE/PRI C.O.	1	Bay 18 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 18 LE/SEC C.O	1	Bay 18 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 19 LE/PRI C.O.	1	Bay 19 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 19 LE/SEC C.O	1	Bay 19 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 20 LE/PRI C.O	1	Bay 20 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 20 LE/SEC C.O	1	Bay 20 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 21 LE/PRI C.O	1	Bay 21 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 21 LE/SEC C.O	1	Bay 21 East Side, Mount on Thread-on Cap

IDENTIFICATION LABEL AND SIGN SCHEDULE						
		Lettering				Other Requirements
Type	Color	Style	Color	Message	Faces	
Equipment Label	Black	Helvetica	White	Bay 22 LE/PRI C.O	1	Bay 22 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 22 LE/SEC C.O	1	Bay 22 East Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 20 Storm Water Sump to Swale	1	Bay 20 East Side, Quick Connect
Equipment Label	Black	Helvetica	White	Bay 21 Storm Water Sump to Swale	1	Bay 21 East Side, Quick Connect
Equipment Label	Black	Helvetica	White	Bay 22 Storm Water Sump to Swale	1	Bay 22 East Side, Quick Connect
Equipment Label	Black	Helvetica	White	Bay 18 LE/PRI C.O.	1	Bay 18 West Side Mount on Thread-on Cap,
Equipment Label	Black	Helvetica	White	Bay 18 LE/SEC C.O	1	Locate at Bay 18 West Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 19 LE/PRI C.O.	1	Locate at Bay 19 West Side, Mount on Thread-on Cap
Equipment Label	Black	Helvetica	White	Bay 19 LE/SEC C.O	1	Locate at Bay 19 West Side, Mount on Thread-on Cap
Fiberglass Sign	White	Helvetica	Black	MH-17 PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH 17 SEC	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-18 PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-18 SEC	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-19 PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-19-SEC	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-20 PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH- 20 SEC	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-21 PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-21 SEC	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-22 PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH-22 SEC	1	Top of MH center

IDENTIFICATION LABEL AND SIGN SCHEDULE						
Type	Color	Lettering				Other Requirements
		Style	Color	Message	Faces	
Fiberglass Sign	White	Helvetica	Black	MH PS-2A LE/PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	MH PS-2B LE/PRI	1	Top of MH center
Fiberglass Sign	White	Helvetica	Black	PS-2A LE/PRI	1	Pole Mounted at PS-2A
Fiberglass Sign	White	Helvetica	Black	PS-2B LE/SEC		Pole Mounted at PS-2A
Fiberglass Sign	White	Helvetica	Black	COND SUMP 11-70-1	1	Top cover of Sump (East Side)
Fiberglass Sign	White	Helvetica	Black	COND SUMP 11-70-2	1	Top cover of Sump (East Side)
Fiberglass Sign	White	Helvetica	Black	COND SUMP 11-70-3	1	Top cover of Sump (East Side)
Fiberglass Sign	White	Helvetica	Black	COND SUMP 11-70-6	1	Top cover of Sump (West Side)
Fiberglass Sign	White	Helvetica	Black	COND SUMP 11-70-7	1	Top cover of Sump (West Side)
Fiberglass Sign	White	Helvetica	Black	DEW-22	1	Bay 17 East, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-24	1	Bay 18 East, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-26	1	Bay 20 East, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-26.5	1	Bay 21 East, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-28	1	Bay 22 East, Mount Label at top center of headwall

IDENTIFICATION LABEL AND SIGN SCHEDULE						
		Lettering				Other Requirements
Type	Color	Style	Color	Message	Faces	
Fiberglass Sign	White	Helvetica	Black	DEW-23	1	Bay 17 West, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-25	1	Bay 17 West, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-27	1	Bay 19 West, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-29	1	Bay 20 West, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	DEW-31	1	Bay 22 West, Mount Label at top center of headwall
Fiberglass Sign	White	Helvetica	Black	P-11-10-1	1	Primary leachate pump, Mount on discharge pipe support
Fiberglass Sign	White	Helvetica	Black	P-11-10-2	1	Primary leachate pump, Mount on discharge pipe support
Fiberglass Sign	White	Helvetica	Black	P- 11—20-1	1	Secondary Leachate Pump, Mount on discharge pipe support
Fiberglass Sign	White	Helvetica	Black	P-11-20-2	1	Secondary Leachate Pump, Mount on discharge pipe support
Fiberglass Sign	White	Helvetica	Black	AIR COMP C-11-51-1	1	Air Compressor, North at PS-2A, Sign Location to be determined

IDENTIFICATION LABEL AND SIGN SCHEDULE						
		Lettering				
Type	Color	Style	Color	Message	Faces	Other Requirements
Fiberglass Sign	White	Helvetica	Black	AIR COMP C-11-51-2	1	Air Compressor, South at PS-2A, Sign Location to be determined
Fiberglass Sign	White	Helvetica	Black	GENERATOR M-11-60-1		Generator at PS-2A, Sign Location to be determined

SECTION 11 40 00
LANDFILL GAS PASSIVE VENT FLARE

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers the design, supply, delivery, site storage, installation, testing and placement into operation of a completely functional solar vent flare including but not limited to flare stack, flame arrester, igniter system, burner assembly, ancillary equipment, guy wires and soil anchors. The flare manufacturer shall have a minimum of 10 years' experience in the design and fabrication of open flare system.
- B. Conform to other related work specified elsewhere.

1.02 REFERENCE

- A. The flare shall conform to all applicable national, state, and local codes; including, but not limited to:
 - 1. 40 CFR 60.18 General Control Device and Work Practice Requirements.
 - 2. 40 CFR 60.33c Emission Guidelines for Municipal Solid Waste Landfill Emissions.
 - 3. IEEE Standards.
 - 4. American Institute of Steel Construction (AISC).
 - 5. Florida Building Code Sixth Edition (2017).
 - 6. Design criteria Structural General Notes Sheet on Drawings.

1.03 SUBMITTALS

- A. Action submittals:
 - 1. Product data sheets for make and model.
 - 2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - 3. General layout, details, sizes, performance characteristics and engineering description of system.
 - 4. Flare stack support guy wiring and soil anchoring system design details.
 - 5. Instrument details.
 - 6. Commissioning report.

B. Informational submittals:

1. Information records of manufacturer and installer.
2. Certification that codes and referenced standard have been met.
3. Calculations signed and sealed by an engineer licensed in the state of Florida.
4. Shop Drawings signed and sealed by an engineer licensed in the state of Florida.
5. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

C. Quality Control Submittals:

1. Tests and inspection data.
2. Manufacturer's Certificate of Proper Installation.
3. Three copies of operation and maintenance manual.

1.04 DESIGN CRITERIA

A. The vent flare system shall be designed and built to operate continuously with landfill gas as the primary source of fuel.

B. The flare system shall meet the following site conditions:

Elevation:	92 feet above sea level
Ambient Temp. Range:	49 to 92 8F

C. The composition range of landfill gas is anticipated to be approximately as follows:

Maximum landfill gas flow rate:	140 scfm
LFG Composition Range (% by volume)	
	<u>Range</u>
CH ₄	60 35
CO ₂	40 20
N ₂	1.0 25
O ₂	0.0 4
H ₂ O vapour	Saturated (assumed)
Trace Compounds:	
Volatile Organic Compounds (as C6):	200 – 2,000 ppmv
Hydrogen Sulphide:	0 – 100 ppmv
Inlet temperature:	0 to 288C
Inlet pressure:	0.5 to 5 in. of WC vacuum
Flow rate (minimum):	5 scfm
Flow rate (maximum):	140 scfm

1.05 PERFORMANCE REQUIREMENT

- A. The Candlestick flare system must be capable of achieving the following performance requirement: The flare shall be capable of achieving a minimum Destruction Efficiency of 98 percent of total non-methane organic compounds (NMOCs).

PART 2 PRODUCTS

2.01 GENERAL

- A. The flare shall be open type Spark Passive Vent Flare CF-10 as manufactured by LCS Environmental Products, LLC or Engineer approved equal.
- B. All equipment shall be designed in according to these Specifications, as a minimum.
- C. Renewable parts not to be of a lower quality than specified.
- D. Equipment:
 - 1. The open flare system shall include the following items, but not limited:
 - a. Vent Flare Stack.
 - b. Combustion Flarehead.
 - c. Electronic Igniter System.
 - d. Flame Visibility Shield - Wind Screen (Shroud).
 - e. Guide Wires and Soil Anchors.
 - f. Piping and Valves.
 - g. Flame Arrestor.
- E. Equipment Description:
 - 1. Vent Flare Stack:
 - a. The flare stack shall be fabricated from schedule 40 black steel.
 - b. The stack shall have a 4-inch LFG inlet connection.
 - 2. Flare Head:
 - a. 2-inch inlet, 8-inch outlet.
 - b. Two pilot taps for low/normal gas flows and safety ignition system redundancy.
 - 3. Igniter System:
 - a. 120 VAC ignitor panel .
 - b. Igniter; Sparkplug type.
 - c. Spark Interval: 1.5 Seconds Continuous.
 - d. Ignition Wire: Insulated ignition cable.
 - e. Flame Zone Spark Strap: 1/8-inch stainless steel.
 - f. Grounding Stake: Galvanized steel with eyelet terminal.

4. Piping: All piping unless otherwise stated shall be standard Schedule 40, black steel pipe with flanged connections for equipment and valving. All piping shall be fully assembled, mounted, supported throughout the system.
 5. Guide Wire: Guy-wires (four total) shall be stainless steel with all parts to attach to vent flare stack and soil anchors. Guy wires to be of sufficient length required based on soil anchor location requirements.
 6. Ball Valve: 2-inch carbon steel body with stainless steel inner trim and ball valve.
 7. Flame Arrester: The flame arrester shall be Inline stainless steel wire-gauze flame arrester.
 8. Flame Visibility Shield: Stainless steel.
- F. Factory Testing: The equipment shall be tested prior to shipment by the flare manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install according to the manufacturer's suggested method.

3.02 FIELD TESTS AND INSPECTION

- A. Functional Test: Prior to operational startup, inspect and test for proper alignment, operation, connection and performance.
- B. Test Reports: Make commercial test and provide test reports.
- C. Warranty: The equipment manufacture shall warrant all products supplied to the Owner against defects in workmanship and material for period of no less than one year from the date of final acceptance by the Owner.

END OF SECTION

SECTION 13 34 19
METAL BUILDING SYSTEM CANOPY WITH SCREENS

PART 1 GENERAL

- A. The following is a list of standards which may be referenced in this section:
1. Aluminum Association of Florida (AAF).
 2. American Architectural Manufacturers Association (AAMA): 101, and General Finishing Documents.
 - a. AAMA 605, Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels
 - b. AAMA 605 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels
 3. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
 4. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
 5. American Institute of Steel Construction (AISC):
 - a. 360, Specification for Structural Steel Buildings.
 - b. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
 - c. Design Guide 3: Serviceability Design Considerations for Steel Buildings.
 6. American Iron and Steel Institute (AISI): Specification for the Design of Cold-Formed Steel Structural Members.
 7. ASTM International (ASTM):
 - a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - d. C150, Standard Specification for Portland Cement.
 - e. C920, Standard Specification for Elastomeric Joint Sealants.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - g. A36/A36M, Standard Specification for Carbon Structural Steel.
 - h. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - i. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - j. A490/A490M, Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength.

- k. A529/A529M, Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
- l. A572/A572M, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- m. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- n. A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- o. A992/A992M, Standard Specification for Steel for Structural Shapes.
- p. E1514, Standard Specification for Structural Standing Seam Steel Roof Panel Systems.
- q. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 8. American National Standards Institute (ANSI)
- 9. Aluminum Association
- 10. Concrete Reinforcing Steel Institute (CRSI).
- 11. National Fire Protection Association (NFPA):
 - a. 10, Standard for Portable Fire Extinguishers.
 - b. 70, National Electrical Code.
 - c. 101, Life Safety Code.

1.02 SYSTEM DESCRIPTION

- A. Structural design and installation of the concrete foundation is shown on project drawings. Structural floor slab and equipment pads as shown on Drawings.
- B. Complete package including design, fabrication and installation of a complete structure to be installed on the prepared concrete slab is based structural criteria and this performance specification.
- C. Two structures are included as shown on the construction drawings:
 - 1. Air Compressor Enclosure 1.
 - 2. Air Compressor Enclosure 2.
 - 3. Size:
 - a. Interior, Minimum: as shown on project drawings.
 - b. Clear Ceiling Height: Height: MINIMUM 10 feet – 0 inches high at eave.
 - c. Bay Spacing: As shown on project drawings.
 - 4. Roof Slope: minimum 1 inch per foot and as shown on Drawings.
 - 5. Include: Screen doors and walls and solid roof.

6. Primary Framing System: Clear Span Rigid Frame. Rigid Frame at End Walls. Lateral Support System in Longitudinal Direction: Portal frames or moment frame.
7. Clear span, modular rigid frame supported with multiple intermediate columns and beams with solid steel panel roof and aluminum screen with aluminum screen frame walls. Provide separation between dissimilar metals.
8. Floor/Foundation: Coordinate enclosure design with raised concrete equipment pads for compressors and other electrical equipment
9. Provide electrical illumination and power.

D. Design Requirements:

1. Steel framing:
 - a. Refer to design criteria on Drawing General Structural Notes.
 - b. Building system dead load.
 - c. Deflection Criteria.
 - d. In accordance with the applicable provisions of the AISC Design Guide 3. Conformance is required to deflection criteria as stated in the Appendix.
 - e. Applies to primary and secondary framing members, bracing members.
2. Design Standards:
 - a. AISC 360.
 - b. AISC RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
 - c. AISI Specification for the Design of Cold-Formed Steel Structural Members.
 - d. AWS D1.1/D1.1M.
3. Consider prying action of bolts for bolted moment-resistant connections in primary framing.
4. Design shall incorporate column bases as pinned.
5. Steel Deck/Roof Panel with overhang around all sides.
6. Building Code: Florida Building Code, 2017 with Amendments/Supplements.

1.03 CONTRACTOR/METAL BUILDING MANUFACTURER COORDINATION

- A. Metal building Shop Drawings shall be submitted and approved prior to forming of foundation concrete or fabrication of foundation reinforcing steel. Specific attention shall be given to providing for adequate size of concrete foundation for steel column baseplates and its associated anchor bolt template.
- B. Contractor shall verify interface of building components with foundation and coordinate required foundation revisions with Engineer.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Manufacturer's literature and technical data.
 - b. Drawings Stamped by Engineer:
 - 1) Drawings shall be specifically prepared for this Project.
 - 2) All opening components including doors, frames and hardware, shown on the drawings.
 - 3) Mark out details that do not apply to Project.
 - 4) Show design load criteria, material specifications for framing members and connections, roof framing plan with dimensions and member sizes, baseplate details showing anchor bolt size and bolt layout, elevations of wall framing, instructions for temporary bracing, framing around roof openings, details for joining and sealing of roof panels and sections and details for all components and accessories.
 - c. Painting System: Specifications; include paint manufacturer's name, product trade name, and preparation for shop and field coats.
2. Samples: Minimum 2-inch by 3-inch metal for components requiring color selection.

B. Informational Submittals:

1. Structural Calculations Stamped by Engineer:
 - a. Complete analysis and design of structural components and connections in accordance with design requirements indicated.
 - b. Summary of building column reactions to foundation level for load cases.
 - c. Mark out calculations that do not apply to Project.
2. Manufacturer's written instructions for shipping, handling, storage, protection, and erection or installation of building and components.
3. Manufacturer: IAS Quality Certification: IAS certificate showing name and address of manufacturer, effective date, and category of certification.
4. Erector:
 - a. IAS Quality Certification: IAS certificate showing name and address of erector, effective date, and category of certification, or, in lieu of IAS certification, documentation of past 5 years' experience record to include project name, location, date of completion, building manufacturer, and name and phone number of Owner's contact person.
 - b. Certification of approval by manufacturer.
5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Designer: Registered professional engineer valid in same state as Project.
2. Manufacturer: IAS Quality Certification: Metal Building Systems (MB).
3. Erector:
4. Installer Qualifications: Minimum 2 years' experience in erecting covers/canopies of the type specified.
 - a. IAS Quality Certification as Certified Steel Erector (CSE), or 5 years of experience in erection of metal building systems in lieu of IAS certification.
 - b. Approval by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect building components and accessories from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Deliver to Site with parts individually tagged.
- C. Store on wood blocking or pallets, flat and off ground, to keep clean and to prevent damage or permanent distortion. Support bundles so there is no danger of tipping, sliding, rolling, shifting, or material damage. Cover with tarpaulins or other suitable weathertight ventilated covering.
- D. Protect finish of metal panels by application of removable plastic film or other suitable material placed between panels. Do not allow panels to come in contact with other material that would result in scratching, denting, staining or other damage to panel finish.

1.07 SPECIAL GUARANTEE

- A. Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this Specification section found defective during a minimum period of 5 years and as stated below after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.
- B. Conditions:
 1. Finish on metal roof, flashing, and trim will not chalk, crack, check, blister, peel, flake, chip, or lose adhesion for 5 years.
 2. Roofing will remain weathertight for 20 years.

1.08 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and screen materials for repair:

Item	Quantity
Screen and Installation Tools	100 square feet of screen material.
Special tools required to maintain or dismantle	One of each tool.

- B. Delivery: Deliver to Owner at time at substantial completion.

PART 2 PRODUCTS

2.01 BUILDING SYSTEM MANUFACTURERS

- A. Products manufactured or supplied by the following, and meeting these Specifications, may be used on this Project:
 1. American Buildings Company, Columbus, GA.
 2. Bigbee Steel Buildings, Inc., Muscle Shoals, AL.
 3. Ceco Corp., Columbus, MS.
 4. Inland Buildings, Cullman, AL.
 5. Kirby Building Systems, Inc., Columbus, GA.
 6. Ruffin Building Systems, Oak Grove, LA.
 7. Varco-Pruden Buildings, Memphis, TN.

2.02 COMPONENTS

- A. Substructure: Cast-in-place concrete foundation.
- B. Structural Framing:
 1. Primary Framing: ASTM A36/A36M, ASTM A529/A529M, ASTM A572/A572M, or ASTM A992 with 3/16-inch minimum thickness and factory primer compatible with finish coating.
 2. Secondary Framing: Steel for cold-formed galvanized channel and z-sections shall be ASTM A653/A653M, Structural Steel (SS) Grade 33 or High-Strength Low-Alloy Steel (HSLAS) Grade 50 Type A or B, with G60 galvanized coating and minimum design thickness equal to 0.0346 inch. Factory primed similar to primary framing.
 3. Bolted Connections:
 - a. Primary Framing: ASTM A325 or ASTM A490/A490M high-strength bolted connections.
 - b. Secondary Framing: ASTM A307 or ASTM A325.

C. Roof Panels:

1. Material:
 - a. ASTM A653/A653M or ASTM A792/A792M preformed ribbed steel panels, Grade 50, minimum.
 - b. Minimum 24-gauge galvanized steel with roll-formed corrugations for structural stiffness and appearance.
 - c. Finish: Factory-applied baked enamel, in color selected by Engineer.
2. Roof Panel System:
 - a. ASTM E1514 structural standing seam steel roof panel system.
 - b. Panels shall be one piece from eave to ridge, with concealed clips and fasteners to purlins to allow for thermal movement over 120-degree ambient temperature range.
 - c. Sidelap joints shall be made with a factory caulked, mechanically seamed cleat.
 - d. Tested and certified to meet UL 580, Class 90 wind uplift rating.

2.03 ACCESSORIES

A. Trim: Factory-formed and factory-painted ridge cap, rake trim, simple eave trim, panel side trim, corner trim, and other trim as necessary.

B. Screen Enclosure:

1. Framing: 6063-T6 Aluminum alloy box framing with screen spline channels factory finished as noted in paragraph 2.04.E.
2. Screen:
 - a. Material: Stainless steel.
 - b. Mesh Weight (oz/td sq): ASTM D3776 7.0-8.0.
 - c. Wire Diameter (inch): ASTM B557 .006-.007.
 - d. Fabric Thickness (inch): ASTM D1777 .012-.018.
 - e. Openness Percentage: TMS-TM-009 68-74.
 - f. Tensile Strength: ASTM B557 210ksi-280ksi.
 - g. Elongation: ASTM B557 1 percent -10 percent.
 - h. Mesh (ends/inch): ASTM D3775 17-18.25 Warp and Fill.
 - i. Stiffness (mg) ASTM D3656 1200-2600 Warp and Fill.
 - j. Manufacturer and Product: Phifer SeeVue Stainless Steel Insect Screen or approved equal.
3. Spline: Foam core type of diameter to precisely fit screen in selected framing spline channels.
4. Screen Door:
 - a. Metal: Match screen enclosure aluminum framing.
 - b. Hardware:
 - 1) Hinges.
 - 2) Door latch with push and pull latch releases.

- 3) Pneumatic closer.
- 4) Aluminum kick plate on push side of door to protect screen.
- 5) Diagonal rod with turnbuckle adjustment to prevent door sag.

C. Miscellaneous:

1. Furnish fasteners, metal-backed neoprene washers, weather stripping, sealants, roof jacks, roof curbs, gaskets, and other items as required for a complete installation.
2. Furnish diagonal rods with turnbuckle adjustment to prevent door sag.

2.04 FABRICATION

- A. Factory Fabricate: To manufacturer's written standards, MBMA Metal Building Systems Manual, and AISC Specification for Structural Steel Buildings.
- B. Building Parts: Accurate and true to dimension to facilitate building erection without cutting, fitting, or other alterations.
- C. Welded Connections: In accordance with AWS D1.1/D1.1M.
- D. Shop Primer for Primary Framing: Clean and apply one coat of manufacturer's standard primer in accordance with MBMA Metal Building Systems Manual.
- E. Finishes:
 1. Flooring: Cast-in place Concrete sealed.
 2. All Steel framing: Factory primed with universal primer compatible with field applied paint system: Epoxy Primer (1 coat 2.5 Medium Dry Film Thickness MDFT); Polyamide High Build Epoxy (1 coat 4 MDFT); Finish Coat (1 coat 3 MDFT).
 3. Screen Framing Factory Finishes:
 - a. Coatings: Manufacturer's standard 360-degree anodized aluminum finish as selected by Architect, Engineer or Owner.
 - OR
 - b. Fluoropolymer Coating: 70 percent PVDF resin-based fluoropolymer, AA-C-12C-42R-1, color as selected by architect from manufacturers standard colors, nonmetallic, comply with AAMA 605.
 - 1) Two coat application.
 - 2) Maximum of two Manufacturer's standard colors as required by Owner.

- F. Colors: Roof, frame, screen and door and frames to be as selected by Owner or Engineer from manufacturer's standard color selection.
- G. Plumbing Systems: Not required.
- H. Fire Protection: 40 ABC fire extinguishers in ac mounted by brackets to interior of enclosure accordance with NFPA 10.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine footings in which bents will be set. Verify footing locations and elevations comply with Shop Drawings.
- B. Coordinate with responsible trade to perform corrective work on unsatisfactory footings or surfaces.
- C. Commencement of work by installer is acceptance of existing conditions.
- D. Examine Site and access to determine effect on proposed building. Investigate soils conditions and their effect on proposed building.

3.02 PREPARATION

- A. Provide temporary bracing in accordance with MBMA standards and as required for safe installation.
- B. Structural Framing:
 - 1. Do not field cut or alter primary or secondary framing members.
 - 2. Installation and tolerances shall be in accordance with MBMA Metal Building Systems Manual.
- C. Roof Panels:
 - 1. Field cutting of panels by torch is not permitted.
 - 2. Attach panels to structural supports to maintain a weathertight seal while allowing for thermal and structural movement.
 - a. Install exposed fasteners in true vertical and horizontal alignment.
 - b. Field seam side laps of standing seam roof panels using electrically operated seaming machine.
 - c. Use proper tools to install screw fasteners to compress neoprene washer without damaging washer or stripping metal.
 - 3. Install manufacturer's standard joint sealants, gaskets, and closure strips as required for weathertight installation.

4. Field Cutting and Patching: Perform in manner not to impair appearance, weathertightness, or structural capacity of panel system.

D. Screen Enclosure:

1. Frame Installation: Provide and attach screen framing to building system structural frame in configuration and anchorage that is in accordance with the AAF Guide to Aluminum Construction in High Wind Areas.
2. Screen Installation: Install screen with mesh pattern in a horizontal and vertical orientation and to be taught, without sag.
3. Area of Enclosure: Enclose all open areas of building structure with screen to prevent passage of insects, that are larger than screen mesh size, to interior side of building space.
4. Field Cutting and Patching: Perform in manner not to impair appearance or structural capacity of screen enclosure system.

3.03 ERECTION

- A. Concrete: As specified in Section 03 30 11, Structural Concrete.

- B. Erect structural components in accordance with manufacturer's instructions and approved shop drawings. Securely anchor to concrete foundation.

- C. Erect protective covers in accordance with manufacturer's installation instructions.

1. Set bents plumb, straight, and true to line, adequately braced to maintain position until grout has cured.
2. Keep aluminum surfaces from direct contact with ferrous metal or other incompatible materials by applying one coat of clear acrylic coating.
3. Field connections shall be bolted or fastened. Field welding will not be permitted.
4. Provide temporary bracing for erection and wind loads during installation. Maintain temporary bracing to hold structure plumb and in alignment until completion of permanent, stable structure.

D. Field Finishing:

1. Minimize all field finishing of structural system of building. Doors and Frames and screen frame system: Factory finished. Touch-up per manufacturer's recommendations.
2. Screen repair manufacturer's instructions.
3. Do not paint electrical equipment.
4. Water test solid surface of roof for water tightness and repair as required.

3.04 ELECTRICAL SYSTEMS

- A. In accordance with requirements of NFPA 70.
- B. Install products in accordance with manufacturers' instructions and recommendations.
- C. Provide grounding for building.

3.05 FIELD QUALITY CONTROL

- A. Electrical Continuity: Test continuity of completed metal structure and installed equipment to ground.

3.06 MANUFACTURER'S SERVICES

- A. Provide manufacturers' representatives at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and certification of proper installation.

3.07 REPAIR, CLEANING, AND PAINTING

- A. Immediately following erection, remove unused material, screws, fasteners, and other debris from completed installation. Use caution in removing metal cuttings from surface of prefinished metal panels.
- B. Replace damaged, dented, buckled, or discolored metal panels.
- C. Repair damaged painted and galvanized surfaces as required for paint system.
- D. Finish Painting: As specified in this specification.
- E. Verify Site conditions and make necessary field measurements.
- F. Thoroughly clean interior and exterior of building and leave roof weathertight and ready for use.

END OF SECTION

**SECTION 26 05 01
ELECTRICAL**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
 - c. C80.5, Aluminum Rigid Conduit.
 - d. C80.6, Intermediate Metal Conduit (IMC)-Zinc Coated.
2. Federal Specifications (FS):
 - a. W-C-596, Connector, Receptacle, Electrical.
 - b. W-S-896, Switches, Toggle, Flush Mounted.
3. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation. 407, Recommended Practice for installing Maintaining Panelboards.
4. National Electrical Manufacturers Association (NEMA):
 - a. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
 - b. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - c. ICS 2, Standard for Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts ac or 750 volts dc.
 - d. 289, Application Guide for Ground Fault Circuit interrupters.
 - e. KS 1, Enclosed Switches.
 - f. PB 1, Panelboards.
 - g. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less.
 - h. ST 20, Dry-Type Transformers for General Applications.
 - i. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - j. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - k. WD 1, General Requirements for Wiring Devices.
5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. Underwriters Laboratories, Inc. (UL):
 - a. 1, Standard for Safety Flexible Metal Conduit.
 - b. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
 - c. 845, Standard for Safety Motor Control Centers.
 - d. 1561, Standard for Dry-Type General Purpose and Power Transformers.
 - e. 67, Standard for Panelboards.

- f. 98, Standard for Enclosed and Dead-Front Switches.
- g. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
- h. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
- i. 508, Standard for Industrial Control Equipment.
- j. 870, Wireways, Auxiliary Gutters and Associated Fittings.
- k. 943, Ground-Fault Circuit-Interrupters.
- l. 1699, Standard for Arc-Fault Circuit-Interrupters.

1.02 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. MCOV: Maximum Allowable Continuous Operating Voltage.
- C. SPD: Surge Protective Devices.
- D. NTRL: Nationally Recognize Testing Laboratory.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Manufactured or Fabricated Control Panels: Summary and catalog cuts.
 - 2. Transformers.
 - 3. Circuit Breakers.
 - 4. Combination full-voltage, magnetic starter including control diagram.
 - 5. Disconnect Switch.
 - 6. Nameplates and nameplate schedule.
 - 7. SPD equipment.
 - 8. Conduit, fittings, and accessories.
 - 9. Conductors, cable, and accessories.
 - 10. Precast handholes.
 - 11. Junction and Pullboxes.
 - 12. Terminal Blocks
 - 13. Support and Framing Channels.
 - 14. Grounding Materials.
 - 15. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
 - 16. Manufacturer's shop drawings including dimensioned plan, section, and elevation for each panelboard type, enclosure, and general arrangement.
 - 17. Tabulation of features for each panelboard to include the following:
 - a. Protective devices with factory settings.
 - b. Provisions for future protective devices.
 - c. Space for future protective devices.

- d. Voltage, frequency, and phase ratings.
- e. Enclosure type.
- f. Bus and terminal bar configurations and current ratings.
- g. Provisions for circuit terminations with wire range.
- h. Short circuit current rating of assembled panelboard at system voltage.
- i. Features, characteristics, ratings, and factory settings of auxiliary components.
- j. Wiring and schematic diagrams detailing control wiring and differentiating between manufacturer-installed and field-installed wiring.
- k. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Field test reports.
- 2. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
- 3. Operation and Maintenance Data:
 - a. As specified in Section 01 78 23, Operation and Maintenance Manuals and Data.
 - b. Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance.
 - c. Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

C. Contract Closeout: Signed permits indicating Work is acceptable to regulatory authorities with jurisdiction.

1.04 APPROVAL BY AUTHORITY HAVING JURISDICTION

- A. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a NTRL or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied listing mark or label from an NTRL.

1.05 ENVIRONMENTAL CONDITIONS

- A. The following areas are classified hazardous, Class I, Division 1, Group C, due to the potential for accumulation of hazardous concentrations of combustible gases, and for exposure to corrosive environment. Use materials and methods required for such areas.
 - 1. Inside the leachate wet well on both primary and secondary pump station.
 - 2. 3 feet by 0 inches radius around the vent opening.
- B. The following areas are classified hazardous, Class I, Division 2, Group C due to the potential for accumulation of hazardous concentrations of combustible gases, and for exposure to corrosive environment. Use materials and methods required for such areas.
 - 1. 5 feet by 0 inches radius around the vent opening.
 - 2. 3 feet by 0 inches around hatch opening.
 - 3. 0 feet by 18 inches above hatch opening.
 - 4. Non-sealed piping and conduits that may convey combustible gases away from the wet well and connecting terminal junction boxes.
- C. The following areas are classified corrosive and wet. Use materials and methods required for such areas.
 - 1. Outdoor above grade areas not covered above.

1.06 QUALITY ASSURANCE

- A. Short circuit and protective device coordination and arc flash studies shall be prepared by a professional electrical engineer (PE) registered in the State of Florida.
- B. The studies shall be signed and sealed by a professional Engineer registered in the State of Florida.

1.07 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for Service Entrance rated equipment, transformers, automatic transfer switch, Generator, panelboards, Control Panels, service conductors, and feeders. The cost of all subsequent studies necessary to resolve problems found shall be included in the Bid amount.
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.
- C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.

- D. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 30 days before energizing electrical equipment.
- E. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.08 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.
- B. Perform studies using one of the following electrical engineering software packages:
 - 1. SKM Power Tools for Windows.
 - 2. ETAP.
 - 3. Paladin.
 - 4. Easy Power.
- C. Perform complete fault calculations for each proposed and ultimate source combination.
 - 1. Source combination may include present and future power company supply circuits, large motors, or generators.
- D. Utilize proposed load data for study obtained from Contract Documents obtained from field investigation of system configuration, wiring information, and equipment.
- E. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.09 SHORT CIRCUIT AND ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

- C. Base Calculation:
 - 1. For each major part of electrical power system, determine the following:
 - a. Arc Flash hazard protection boundary.
 - b. Limited approach boundary.
 - c. Restricted approach boundary.
 - d. Prohibited approach boundary.
 - e. Incident energy level.
 - f. Personal protection equipment (PPE) hazard/risk category.
 - g. Type of PPE required.
 - h. Working distance.
 - i. Glove Class.

- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
 - 1. Bus name.
 - 2. Bus voltage.
 - 3. Calculation method.
 - 4. Label expiration date.
 - 5. Reference to NFPA 70E for PPE requirements.

- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, and settings.
 - 3. Bus line-to-line voltage.

- F. Produce arc flash evaluation summary sheet listing the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, settings.
 - 3. Bus line-to-line voltage.
 - 4. Bus bolted fault.
 - 5. Protective device bolted fault current.
 - 6. Arcing fault current.
 - 7. Protective device trip/delay time.
 - 8. Breaker opening time.
 - 9. Solidly grounded column.
 - 10. Equipment type.
 - 11. Gap.
 - 12. Arc flash boundary.
 - 13. Working distance.

- 14. Incident energy.
 - 15. Required protective fire rated clothing type and class.
 - 16. Table of required PPE
- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm^2 . Propose approaches to reduce energy levels.
- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
- 1. Equipment manufacturer's information used to prepare study.
 - 2. Assumptions made during study.
 - 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
 - 4. Arc flash evaluations summary spreadsheet.
 - 5. Bus detail sheets.
 - 6. Arc flash warning labels printed in color on adhesive backed labels.

1.10 PROTECTIVE DEVICE COORDINATION STUDY

- A. General:
- 1. Prepare in accordance with IEEE 242.
 - 2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
 - d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.
- B. Plot Characteristics on Curve Sheets:
- 1. Electric utility's relays.
 - 2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 3. Medium-voltage equipment relays.

4. Medium-voltage and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
 6. Pertinent transformer full-load currents at 100 percent.
 7. Transformer magnetizing inrush currents.
 8. Transformer damage curves; appropriate for system operation and location.
 9. ANSI transformer withstand parameters.
 10. Significant symmetrical and asymmetrical fault currents.
 11. Ground fault protective device settings.
 12. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
- C. Primary Protective Device Settings for Delta-Wye Connected Transformer:
1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
 2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.
- D. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.
- E. Tabulate Recommended Protective Device Settings:
1. Relays:
 - a. Current tap.
 - b. Time dial.
 - c. Instantaneous pickup.
 - d. Electronic settings data file.
 2. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.
 - c. Adjustable time delays.
 - d. Adjustable instantaneous pickups.
 - e. I^2t In/Out.
 - f. Zone interlocking.
 - g. Electronic settings data file.
- F. Written Summary:
1. Scope of studies performed.
 2. Summary of protective device coordination methodology.
 3. Prevailing conditions.

4. Selected equipment deficiencies.
5. Results of coordination study.
6. Appendix of complete relay and circuit breaker electronic setting files, submit electronic data files from manufacturer's software.
7. Comments or suggestions.

1.11 QUALIFICATIONS

- A. PVC-Coated, Rigid Steel Conduit Installer: Must be certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures and manufacturer's on-site verification that the proper equipment for bending, threading, and installation of PVC-coated steel conduit is at the site. The manufacturer shall inspect all repairs to the coating and provide the Owner with written assurance that all repairs have been completed in a manner that will maintain the integrity of the factory coating.

PART 2 PRODUCTS

2.01 GENERAL

- A. Products shall comply with all applicable provisions of NFPA 70.
- B. Like Items of Equipment: End products of one manufacturer in order to achieve standardization.
- C. Equipment and Devices Installed Outdoors or in Unheated Enclosures: Capable of continuous operation within ambient temperature range of 20 degrees F to 105 degrees F.
- D. Hazardous Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the class, division (or zone), and group of hazardous area indicated.
- E. Equipment Finish: Manufacturer's standard finish color, except where specific color is indicated.

2.02 REDUCE VOLTAGE STARTER

- A. Combination Reduced Voltage, Solid State Starter:
 1. Rating: Horsepower rated at 600 volts, UL labeled for 65,000 amperes at 480 volts short circuit capacity with overload protection.
 2. Three-phase, nonreversing with bypass run contactor.
 3. Control: As per Section 40 90 00, Instrumentation and Control of Process Systems.
 4. Disconnect Type: Motor circuit protector.

5. Class 10/20/30 electronic overload relay, switch, or dip switch selectable.
 6. Kick start, with adjustable torque and time settings.
 7. Ramp start, selectable current or torque, and adjustable time.
 8. Smooth stop ramp, adjustable time.
 9. Phase loss unbalance and phase reversal protection.
 10. LED display or LCD of fault, N.O. contact to communicate fault conditions.
 11. Enclosure: NEMA 250, Type 4X Type 316 stainless steel.
 12. Pilot Lights: Red-ON and Green-OFF.
- B. Solid State Motor Overload Protection:
1. Inverse-time-limit characteristic.
 2. Phase loss, phase unbalanced and Class II ground fault protection.
 3. Current operated electronic circuitry with adjustable trip.
 4. Class 10/20/30 relay trip, switch selectable.
 5. N.O. auxiliary contact for remote monitoring.
 6. Manual reset.
 7. Provide in each ungrounded phase.
 8. Mount within starter unit.
 9. Communications: None.
- C. Control Transformer:
1. Two winding, 120-volt secondary, primary voltage to suit.
 2. Two current-limiting fuses for primary circuit.
 3. One fuse in secondary circuit with blown fuse indicator.
 4. Mount within starter unit.
- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Lifting lugs on equipment and devices weighing over 100 pounds.
- F. Anchor Bolts: Type 316 stainless steel, 1/2-inch minimum diameter.
- G. Operating Conditions:
1. Ambient Temperature: Maximum 40 degrees C.
 2. Altitude: 3,000 feet above sea level.
 3. Equipment to be fully rated.
- H. Control Wiring:
1. Minimum Wire Size: 14 AWG copper.
 2. Permanent sleeve type markers.

- I. Materials, equipment, and accessories specified in this section shall be products of:
 - 1. Schneider Electric/Square D Services.
 - 2. Eaton Electrical/Cutler-Hammer.
 - 3. General Electric Co.

- J. Control Wiring:
 - 1. Minimum Wire Size: 14 AWG copper.
 - 2. Permanent sleeve type markers.

2.03 MOTOR STARTER PANELS

- A. In accordance with Section 40 90 00, Instrumentation and Control Process System.

- B. System: Three-phase, 480Y/277 volts.

- C. Panel Enclosure: Wall mounted, NEMA 250, Type 4X, minimum 12-gauge stainless steel cabinet, in accordance with UL 689A.

- D. Bus Assembly: Continuous from main incoming terminal to main and branch circuit breakers without use of cables.
 - 1. Current Rating: As required for starter size.

- E. Circuit Breakers:
 - 1. Circuit Breaker: Bolt-on connection, quick-make, quick-break, trip indicator and common trip on multiple circuit breakers.
 - 2. Magnetic only for starter units.
 - 3. Thermo-magnetic for main and branch circuit breakers.
 - 4. Enclosure: Interlocked to prevent opening with breaker energized.
 - a. Interlock Release: For inspection purposes.

- F. Solid State Motor Starter:
 - 1. Across-the-line magnetic type in own enclosure.
 - 2. Contact: Double-break silver alloy type.
 - 3. Overload Relay: Melting alloy type.

- G. Thermal Unit: One-piece construction and interchangeable.

- H. Door Lock: Provide with two keys.

- I. Starter Circuit Identification: Typewritten sheet installed on door with proper identification.

2.04 DRY TYPE POWER TRANSFORMERS (0 TO 600 VOLT PRIMARY)

- A. Type: Self-cooled, two-winding.
- B. UL 1561 and NEMA ST 20.
- C. Insulation Class/Temperature Rise: Standard.
- D. Core and Coil: 30 kVA or Less: Encapsulated.
- E. Enclosure: NEMA 250, Type 3R, nonventilated.
- F. Winding: Copper.
- G. Voltage Taps: Full capacity, 2-1/2 percent, two above and two below normal voltage rating.
- H. Sound Level: Not to exceed NEMA ST 20 levels.
- I. Vibration isolators to minimize and isolate sound transmission.
- J. Manufacturer:
 - 1. Cutler Hammer.
 - 2. General Electric.
 - 3. Square D.

2.05 CONTROL PANELS

- A. Enclosure:
 - 1. NEMA 250, Type 4X stainless steel.
 - 2. Minimum Metal Thickness: 14 gauge.
 - 3. Doors: Rubber gasketed with continuous hinge.
 - 4. LED Light: Hand switch controlled, 10 watts.
 - 5. Receptacle: Breaker protected 120-volt, 15-amp duplex.
 - 6. Size panels to adequately dissipate heat generated by equipment mounted in or on panel.
 - 7. Manufacturer:
 - a. Hoffman.
 - b. H. F. Cox.
 - c. Or approved equal.
- B. Wiring:
 - 1. Power and Control Wiring: 600-volt class, insulated, stranded copper.
 - a. Size: Minimum 14 AWG enclosed in either sheet metal raceway or plastic wiring duct.

2. Signal Circuit Wiring: Twisted shielded pairs minimum No. 16 AWG, separated at least 6 inches from power wiring.
3. Identification: Permanent heat impregnated polyvinyl chloride (PVC) alpha-numeric labels.

2.06 CIRCUIT BREAKER, INDIVIDUAL, 0 TO 600 VOLTS

- A. UL 489 listed for use at location of installation.
- B. Voltage and Trip Ratings: As shown.
- C. Minimum Interrupt Rating: 35,000 amps rms symmetrical at 480 volts.
- D. Thermal-magnetic, quick-make, quick-break, indicating type showing ON/OFF and TRIPPED indicating positions of operating handle.
- E. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- F. Locking: Provisions for padlocking handle.
- G. Enclosure: As shown.
- H. Interlock: Enclosure and switch shall interlock to prevent opening cover with breaker in the ON position.
- I. Accessories: Shunt trip, auxiliary switches, handle lock-on devices, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
- J. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
- K. Indicating type, with ON/OFF and TRIPPED positions of the operating handle.
- L. Bolt-on thermal-magnetic, quick-make, quick-break non-interchangeable.
- M. Tandem or dual circuit breakers in normal single-pole spaces not permitted.
- N. Multipole Circuit Breakers:
 1. All poles to automatically open when an overload occurs on one-pole.
 2. Single-pole with handle ties not permitted.
- O. Manufacturers:
 1. Square D Co.
 2. Eaton.
 3. General Electric Co.

2.07 PANELBOARDS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 - 1. Schneider Electric / Square D.
 - 2. Eaton / Culter – Hammer.
 - 3. Siemens.
- B. No “or-equal” or substitute products will be considered.
- C. Provide low voltage panelboards for application at 600V or less in accordance with this section, including panelboards installed in other equipment specified in Section 26 32 13.13, Diesel Engine Generator Set.
- D. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.
- E. Wire Terminations:
 - 1. Provide panelboard assemblies, including protective devices, suitable for use with 75 degrees C or greater wire insulation systems at NFPA 70, 75 degrees C conductor ampacity, and in accordance with UL 486E.
 - 2. Lugs for termination of conductors shall comply with paragraph 2.09, Conductors.
- F. Load Current Ratings:
 - 1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.
 - 2. Where indicated “continuous” or “100 percent”, selected components and protective devices shall be rated for continuous load current at value shown.
- G. Short Circuit Current Rating (SCCR): Integrated equipment short circuit rating for each panelboard assembly shall be no less than the following:
 - 1. Minimum SCCR at 208Y/120 or 120/240 volts shall be 10,000 amperes rms symmetrical.
 - 2. Minimum SCCR at 480Y/277 volts shall be 42,000 amperes rms symmetrical.
- H. Overcurrent protective devices:
 - 1. Overcurrent Device Mounting and Arrangement: Design panelboards to accommodate device installation and replacement without disturbing adjacent devices and without removing main bus.

2. Overcurrent Protective Devices: In accordance with NEMA KS 1, UL 98, and UL 489. Protective devices shall be adapted to panelboard installation.
 3. Provisions for Future Overcurrent Device:
 - a. Provide space, mountings and bus connections such that like device may be installed without additional hardware.
 - b. Panel openings shall be closed with individual removable cover for each provision for future device.
 - c. Unless otherwise indicated, “spaces” in panelboards shall be fully equipped provision for future like devices.
 - d. Provisions for future devices shall be suitable devices rated no less than 60 amperes.
 4. Protective Device Locking: Furnish provisions for handle padlocking for main, subfeed, and branch devices where indicated.
 5. Branch Protective Devices:
 - a. Provide Wire Lug Load Connections removable/replaceable, and suitable for 75 degrees C rated conductors without derating switch nor conductor ampacity.
 - b. Provide a nameplate for each circuit, blanks for spares.
- I. Circuit Breakers:
1. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle. Circuit breakers shall comply with other parts of this section.
 2. Bus Connection: Bolt-on circuit breakers in all panelboards.
 3. Trip Mechanism:
 - a. Individual permanent thermal and magnetic trip elements in each pole.
 - b. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 - c. Two and three pole, common trip.
 - d. Automatically opens all poles when overcurrent occurs on one pole.
 - e. Test button on cover.
 - f. Calibrated for 40 degrees C ambient, unless shown otherwise.
 4. Unacceptable Substitution:
 - a. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
 - b. Do not use tandem or dual circuit breakers in normal single-pole spaces.

5. Specialty Breakers: Where indicated, provide breakers with the following features:
 - a. Ground Fault Circuit Interrupter (GFCI): Rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel). Ground fault sensor shall be rated same as circuit breaker. Breaker shall include push-to-test and reset buttons.
 - b. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker with ground fault sensor and rated to trip on 30-mA ground fault (UL listed for equipment ground fault protection).
 - c. Switching Duty (SWD) Rated: Where indicated, provide breaker UL listed for frequent switching of lighting and other branch circuit loads.
6. Solid State Trip Units: Where indicated, equip breakers with solid state trip units in accordance Division 26, Electrical.
 - a. Long (Time) Short (Time) Instantaneous (LSI): Electronic trip unit with fixed long-time trip, adjustable short-time trip and delay, and adjustable instantaneous trip settings.
 - b. Long (Time) Short (Time) Instantaneous Ground (Fault) (LSIG): Electronic trip unit as above and also with adjustable ground fault trip and delay settings.

J. Enclosures:

1. NEMA 250 Type 4X 316 Stainless Steel Branch Panelboard Enclosure:
 - a. Secure front trim to box with concealed trim clamps.
 - b. Overlap flush panelboards front trims with box nominal 3/4 inch on all sides.
 - c. Provide door in panelboard front trim, with concealed hinges, to access protective device operating handles.
 - d. Provide multi-point latching for doors over 30 inches in height.
 - e. Door Lock: Secure with flush catch and tumbler lock; all panelboards keyed alike, with two milled keys each lock.
 - f. Circuit Directory: Metal frame with transparent plastic face and enclosed card, mounted inside each panel door.
2. Hinged Front Cover (Door In Door): Entire front trim hinged to surface box with standard door within hinged trim cover as detailed on Drawings.

K. Bus:

1. Material: Tin-plated copper full sized throughout length.
2. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

3. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors and bonded to box.
 - a. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
 - b. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.
 - c. Termination points shall be bolted crimp compression lugs for conductors 6 AWG and larger.
4. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.
 - a. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
 - b. Provide individual termination points for all other neutral conductors.
 - c. Termination Points: Bolted crimp compression lugs for conductors 6 AWG and larger.
 - d. Oversize Neutral: Provide oversized neutral terminal bus as indicated.
5. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.

2.08 CONDUIT AND FITTINGS

A. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1.
2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish: PVC coating, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2 mils nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to either interior or exterior coating.
5. Robroy PERMA-COTE.
6. OCAL-Blue.
7. Or approved equal.

B. Polyvinyl Chloride Conduit (PVC):

1. Rigid, Schedule 40 and 80, NEMA TC 2.
2. UL 651 listed for concrete encased, direct burial, concealed and direct sunlight exposed use.
3. UL 651 listed and marked for use with conductors having 90 degrees C insulation.
4. Fittings: NEMA TC 3, for intended use.

C. Fittings:

1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
2. PVC-Coated Rigid Galvanized Steel Conduit:
 - a. Meet requirements of UL 514B.
 - b. Fittings: Rigid galvanized steel type, PVC-coated by conduit manufacturer.
 - c. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC-coated by conduit manufacturer.
 - d. Finish: 40-mil PVC exterior, 2-mil urethane interior.
 - e. Overlapping pressure sealing sleeves.
 - f. Conduit Hangers, Attachments, and Accessories: PVC-coated.
 - g. Manufacturers:
 - 1) Robroy Industries.
 - 2) Ocal.
 - 3) Or approved equal.
 - h. Expansion Fitting Manufacturer and Product:
 - 1) Ocal; Ocal-Blue XJG.
 - 2) Or approved equal.
3. Flexible Metal, Liquid-Tight Conduit:
 - a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - b. Insulated throat and sealing O-rings.

2.09 CONDUCTORS

A. Conductors 600 Volts and Below:

1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
2. Conductor Type:
 - a. 120- and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
 - b. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
 - c. All Other Circuits: Stranded copper.
3. Insulation: Type XHHW.

B. 600-Volt Rated Cable:

1. General:
 - a. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.

- b. Permanently and legibly marked with manufacturer’s name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
- c. Suitable for installation in open air, in cable trays, or conduit.
- d. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
- e. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

C. Type 1, Multiconductor Control Cable:

- 1. Conductors:
 - a. No. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
- 2. Cable: Passes the ICEA T-29-520 210,000 Btu per hour Vertical Tray Flame Test.
- 3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

- 4. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.
 - c. Or approved equal.

D. Type 3 No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

- 1. Outer Jacket: 45 mils nominal thickness.
- 2. Individual Pair Shield: 1.35 mils, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.

3. Dimension: 0.31-inch nominal outside diameter.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15 mils nominal PVC.
 - d. Jacket: 4 mils nominal nylon.
 - e. Color Code: Pair conductors black and red.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Or approved equal.
- E. Type 30, unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:
1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
 2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
 3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
 4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
 5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
 6. Manufacturer and Product:
 - a. Belden; 7852A.
 - b. Or approved equal.
- F. Accessories:
1. Tape:
 - a. General Purpose, Flame Retardant: 7 mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - b. Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.
 - c. Arc and Fireproofing:
 - 1) 30 mils, elastomer.
 - 2) Manufacturers and Products:
 - a) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - b) Plymount; Plyarc 53, with Plyglas 77 glass cloth tapebinder.
 - c) Or approved equal.

2. Identification Devices:
 - a. Sleeve-type, permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturer and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Or approved equal.
3. Connectors and Terminations:
 - a. Nylon, Self-Insulated Crimp Connectors:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Sta-Kon.
 - b) Burndy; Insulug.
 - c) ILSCO.
4. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. Plated steel, square wire springs.
 - b. UL Standard 486C.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
 - 3) Or approved equal.
5. Cable Lugs:
 - a. In accordance with NEMA CC 1.
 - b. Rated 600 volts of same material as conductor metal.
 - c. Uninsulated Crimp Connectors and Terminators:
 - 1) Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - 2) Manufacturers and Products:
 - a) Thomas & Betts; Color-Keyed.
 - b) Burndy; Hydent.
 - c) ILSCO.
 - d. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Locktite.
 - b) Burndy; Quiklug.
 - c) ILSCO.
6. Cable Ties:
 - a. Nylon, adjustable, self-locking, and reusable.
 - b. Manufacturer and Product:
 - 1) Thomas & Betts; TY-RAP.
 - 2) Or approved equal.
7. Heat Shrinkable Insulation:
 - a. Thermally stabilized, crosslinked polyolefin.
 - b. Manufacturer and Product:
 - 1) Thomas & Betts; SHRINK-KON.
 - 2) Or approved equal.

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2.10 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN insulation.
- B. Direct buried: Tin-plated stranded copper.

2.11 GROUNDING

- A. As specified in Section 26 05 26, Grounding.

2.12 TERMINAL BLOCKS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.
 - 3. Electrovert USA Corp.

2.13 LUMINAIRES

- A. Furnish and install LED light fixture inside the pump control panel. Reference 40 99 90 Package Control for more details.

2.14 RECEPTACLES

- A. NEMA WD 1 and FS W-C-596.
- B. Specification Grade:
 - 1. Type: Three-wire grounding, with screw type terminals suitable for No. 10 AWG wire. Contact to be made on two sides of each inserted blade without detent.
 - 2. Number of Poles: Two.
 - 3. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 - 4. Base: Phenolic composition.
 - 5. Color: Gray.
- C. Special Purpose:
 - 1. NEMA type as noted on Drawings.
 - 2. Furnish matching plug with cord grip features for each special purpose receptacle.
- D. Provide with weatherproof cover and ground fault interrupter where exposed to weather or in wet location.

2.15 SWITCHES

- A. NEMA WD 1 and FS W-S-896E.
- B. Totally enclosed, ac type, snap-action switches, with screw terminals.
- C. Capable of control of 100 percent tungsten filament and fluorescent lamp loads.
- D. Rating: 20 amps, 120/277 volts.
- E. Color: Gray.

2.16 SUPPORT AND FRAMING CHANNELS

- A. PVC Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.
- B. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12-gauge minimum.
- C. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.

2.17 BAKED ENAMEL DANGER SIGNS

- A. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gauge steel, of standard red, black, and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.
- B. Engraved Plastic Laminate Signs:
 - 1. General: Provide engraving stock melamine plastic laminate lamicoid-type engraved nameplates, complying with FS L P 387, in sizes and thickness indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 - 2. Thickness: 1/8-inch except as otherwise indicated.
 - 3. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.18 SEALANT MATERIALS

- A. Characteristics:
 - 1. Uniform, homogeneous.
 - 2. Free from lumps, skins, and coarse particles when mixed.
 - 3. Nonstaining, nonbleeding.
 - 4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
- B. Type 5—One-part Polyurethane, Immersible:
 - 1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturers and Products for Nonsag:
 - a. Sika Chemical Corp.; Sikaflex-1a.
 - b. Tremco; Vulkem 116.
 - 4. Manufacturers and Products for Self-leveling:
 - a. BASF; MasterSeal, SL-1.
 - b. Tremco; Vulkem 45.
 - c. Sika Chemical Corp.; Sikaflex 1c SL.

2.19 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in electrical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical system and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

2.20 ARC FLASH WARNING LABELS

- A. Printed in multicolor on adhesive backed labels. An example label is located following end of section in Figure 1.

PART 3 EXECUTION

3.01 GENERAL

- A. Workmanship shall comply with all applicable provisions of NECA 5055.
- B. Install materials and equipment in hazardous areas in a manner acceptable to regulatory authority having jurisdiction for the class, division, and group of hazardous area indicated.
- C. Ground equipment, enclosures, and complete conduit system securely in accordance with applicable sections of NFPA 70.
- D. Provide arc flash warning labels on equipment as specified in this section.

3.02 MOTOR STARTER

- A. Field adjust trip settings of motor starter magnetic, trip-only circuit breakers in accordance with manufacturer's instructions.
- B. Existing Connection: Reconnect control wiring to new magnetic starters to perform same functions as existing connections.

3.03 PANELBOARDS

- A. General:
 - 1. Install in accordance with NECA 407, NEMA PB 1.1, and manufacturers' written installation instructions.
 - 2. Install securely, plumb, in-line and square with walls.
 - 3. Install top of cabinet trim 78 inches above floor, unless otherwise shown. Install cabinet so tops of protective device operating handles are no more than 78 inches above the floor.

4. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.
5. Install filler plates in unused spaces.
6. Wiring in Panel Gutters: Train conductors neatly in groups; bundle and wrap with nylon wire ties.
7. Mount flush panels uniformly flush with wall finish.
8. Provide typewritten circuit directory for each panelboard.
9. Provide engraved identification for each protective device.

3.04 CONDUIT AND FITTINGS

A. General:

1. Do not install crushed or deformed raceways.
2. Avoid trapped raceways in damp and wet locations.
3. Prevent plaster, dirt, or trash from lodging in raceways, boxes, fittings, and equipment during the course of construction. Clear clogged raceways of obstructions.
4. Maintain conduit runs within furring lines of building, unless otherwise shown.
5. Secure conduits entering cabinets, pull boxes or outlet boxes with galvanized locknuts and bushings, on both sides of box wall.

B. Applications:

1. Exposed Corrosive: Type PVC-Coated RGS.
2. Exposed Exterior: Type PVC-Coated RGS.
3. Concrete Embedded: Type PVC Schedule 40.
4. Direct Buried: Type PVC Schedule 80.
5. Vertical Runs Through Slab: Convert PVC conduit to PVC-Coated RGS.

C. PVC- Coated RGS:

1. Install in accordance with manufacturer's instructions.
2. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.
3. Provide PVC-Coated boot to cover exposed threading.

D. Final Connection to Motors:

1. Conduit Size 4 Inches or Less: 18-inch minimum, 60-inch maximum length of flexible nonmetallic conduit.

- E. Penetrations:
 - 1. Flash and counterflash conduits penetrating roofing membrane.
 - 2. Seal penetrations with oakum or expandable plastic compound.
 - 3. Provide sleeves and chases where conduits pass through floors or walls. Finish to match adjacent surfaces.
 - 4. Provide escutcheon plates where exposed conduits pass through walls, floors or ceilings.
- F. Slab-On-Grade or Direct Buried: Install horizontal runs below floor slab. Horizontal runs within slab will not be permitted.
- G. Slabs Other Than On-Grade:
 - 1. Install as close to horizontal center of concrete slabs as practicable without disturbing reinforcement.
 - 2. Maximum outside diameter of conduit shall not exceed 1/3 of the slab thickness.
 - 3. Space raceways a minimum of six times the raceway outside diameter, on center, except at cabinet locations where slab thickness shall be increased as required.
- H. Exposed Raceways: Install parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.
- I. Changes in Direction of Runs:
 - 1. Make with symmetrical bends or cast metal fittings.
 - 2. Bends and offsets shall be made with a hickey or conduit bending machine.
- J. Supports:
 - 1. Provide pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps with retainers, or ceiling trapeze.
 - 2. Securely and rigidly fasten in place.
 - 3. Maximum Interval: 10 feet.
- K. Adjust relay and protective device settings according to values established by coordination study.
- L. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- M. Notify Engineer in writing of required major equipment modifications.
- N. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- O. Provide arc flash warning labels on equipment as specified in this section.

3.05 CONDUCTORS

- A. Conduit system shall be complete prior to installing conductors.
- B. Lubricate prior to installing into conduit. Lubrication type shall be as approved by conductor manufacturer.
- C. Connections: Pressure type solderless, complete with insulator and security ring.
- D. Control Circuits:
 - 1. Where multiple units perform parallel operations, do not group all devices on same branch circuit.
 - 2. Do not exceed the ampacity of the branch circuit, or 12 amperes continuous.
 - 3. Terminate feeder and interconnecting conductors between panel mounted equipment and external equipment at numbered terminal blocks.
- E. Identification:
 - 1. Where two or more conduits run to a single outlet box, color code each circuit as a guide in making connections.
 - 2. Carry colors continuously throughout the system if more than one multiwire branch circuit is carried through a single raceway.
 - 3. Connect circuit conductors of same color to same underground feeder conductor throughout installation.
 - 4. Colors:
 - a. Neutral Wire: White.
 - b. Live Wire, 120/208-Volt System: Black, red, or blue.
 - c. Live Wire, 277/480-Volt System: Brown, orange, or yellow.
 - d. Ground Wire: Green.

3.06 TERMINAL BLOCKS

- A. Install for termination of all control circuits leaving or entering equipment, panels, or boxes.

3.07 TRENCH BACKFILL

- A. In accordance with Section 31 23 23.15, Trench Backfill.

3.08 FIELD QUALITY CONTROL

- A. In accordance with Section 26 44 00, Electrical Testing.
- B. Balance electrical load between phases on switchboards, panelboards, and motor control centers after installation.

C. Voltage Testing:

1. When installation is complete and facility is in operation, check voltage at point of termination of electric utility supply system to Project.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage for 24 continuous hours.
4. If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to electric utility to correct condition.
5. If corrections are not made, obtain written statement from a responsible electric utility official that voltage variations and/or unbalance are within their normal standards.

D. Equipment Line Current:

1. Check line current in each phase for each piece of equipment.
2. If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

E. Service Entrance:

1. Prior to energization of service entrance equipment, check accessible connections for compliance to manufacturer's torque tightening specifications.
2. Prior to energization of service entrance equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
3. Prior to energization, check circuitry for electrical continuity and for short-circuits.

3.09 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation.
- B. Cap conduit runs during construction with manufactured seals.
- C. Close openings in boxes or equipment during construction.
- D. Energize space heaters furnished with equipment.

3.10 INSTALLATION OF SWITCHES AND PROTECTIVE EQUIPMENT

- A. Circuit Breakers: Install at location indicated on Drawings and as required by NEC at approximately 60 inches AFF to top of box. Provide work space as required by NEC Article 110.

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3.11 RECORD DOCUMENT

- A. See Section 01 32 23, Sureveying.

3.12 SUPPLEMENTS

- A. The supplement listed below, following “END OF SECTION,” is a part of this Specification:

- 1. Figure 1: Example Arc Flash Label.

END OF SECTION

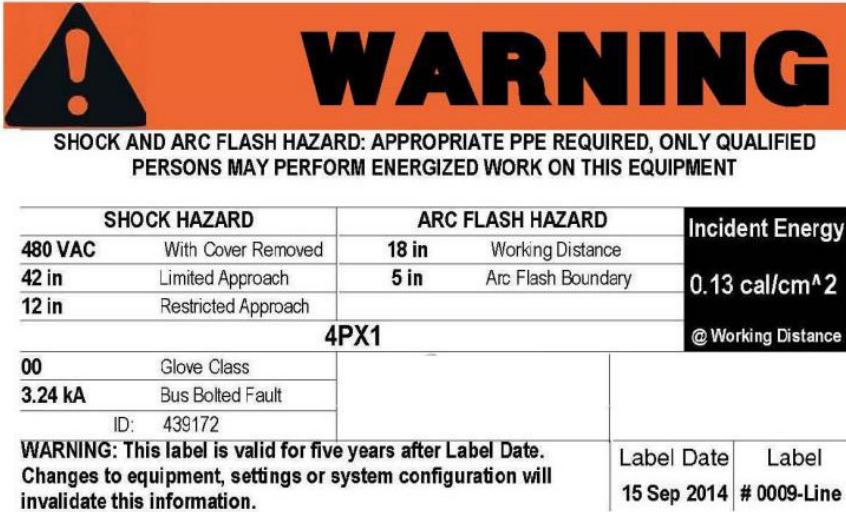


Figure 1
Example Arc Flash Label

**SECTION 26 05 26
GROUNDING**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NESC).
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Product Data:
 - a. Exothermic weld connectors.
 - b. Mechanical connectors.
 - c. Compression connectors.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory (NTRL) or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied listing mark by an NTRL

PART 2 PRODUCTS

2.01 GROUND ROD

- A. Material: Copper-clad steel.
- B. Diameter: Minimum 3/4 inch.
- C. Length: 20 feet.

2.02 GROUND CONDUCTORS

- A. As specified in Section 26 05 01, Electrical.

2.03 CONNECTORS

- A. Exothermic Weld Type:

- 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
- 2. Manufacturers:
 - a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - b. Or approved equal.

- B. Compression Type:

- 1. Compress-deforming type; wrought copper extrusion material.
- 2. Single indentation for conductors 6 AWG and smaller.
- 3. Double indentation with extended barrel for conductors 4 AWG and larger.
- 4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
- 5. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. Ilso Corp.

- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

- 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. Or approved equal.

2.04 GROUNDING WELLS

- A. H-20 Ground rod box traffic rated complete with cast iron riser ring and H-20 traffic rated cover marked GROUND ROD.

- B. Manufacturers and Products:

- 1. Christy Co.; No. G5.
- 2. Or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Grounding shall be in compliance with NFPA 70 and ANSI C2.
- B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.
- C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- D. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- E. Shielded Instrumentation Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- F. Shielded Control Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.03 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Motors Less than 10 Horsepower: Furnish compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 Horsepower and Above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.
- C. Space multiple ground rods by one rod length.

3.05 GROUNDING WELLS

- A. Install inside buildings, asphalt, and paved areas.
- B. Install riser ring and cover flush with surface.
- C. Place 9 inches crushed rock in bottom of each well.

3.06 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper, rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

- A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 FIELD QUALITY CONTROL

- A. As specified in Section 26 44 00, Electrical Testing.

END OF SECTION

SECTION 26 32 13.13
DIESEL ENGINE GENERATOR SET

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Covers the work necessary to furnish, install, connect, and test once completely factory-assembled skid mounted diesel engine generator set with a minimum Stand-By rating of 175 kW / 218.8 kVA. The engine generator set shall be complete and inclusive of an engine control panel and a weatherproof marine grade aluminum sound attenuated enclosure, sub-based fuel storage tank, and landing with steps (ladder) as shown on Drawing E-02. The engine generator set and enclosure, and subbase tank shall be skid mounted and designed to rest directly on a concrete pad.
- B. See Section 26 36 23, Automatic Transfer Switch for interface requirements.
- C. See P&ID Drawing IC-3 for additional control and instrumentation requirements.

1.02 SYSTEM RESPONSIBILITIES

- A. The Electrical Subcontractor (EC) shall be responsible for furnishing and installing the complete engine generator system described herein and shown on the Drawings. The EC shall be responsible for furnishing all materials, labor, equipment, and coordinating the interface to piping connections and other electrical equipment.
- B. The Electrical Subcontractor (EC) shall be responsible for furnishing, installing, and testing the Service Entrance Rated Main Breaker, Automatic Transfer Switch as specified in Section 26 36 23, Automatic Transfer Switch, for coordinating its operation with the engine generator set.
- C. The Electrical Subcontractor (EC) shall be responsible for furnishing and installing all incidental materials not specifically shown on the Drawings or described in these Specifications, and for the testing required for the complete and operational system as specified.
- D. The Electrical Subcontractor (EC) is responsible for supplying the diesel engine generator set, the sound-attenuated enclosure, the engine control panel, sub-based fuel tank and landing with steps (ladder) as specified herein. All equipment and materials shall be completely integrated as a single unit.

1.03 SYSTEM DESCRIPTION

- A. The engine generator system shall be comprised of a completely wired and operating system to automatically or manually start one diesel engine generator unit, with provisions for full system protection as outlined in this Specification.
- B. The generator system will be nameplate rated as a standby power source as required during emergency conditions. All protection and control systems required to meet this requirement shall be provided. The protection and control scheme proposed by the Manufacturer shall be subject to the Contractor and Owner's review and approval.
- C. The new generator set shall be a totally assembled package, unit mounted on its own rigid base, supplied with spring type vibration isolators as recommended by the engine generator manufacturer. They shall be free of harmful critical speeds and torsional vibrations within the operating range of speed and capacity.
- D. The generator set shall include, but not be limited to, the diesel engine, generator, generator circuit breaker, battery system, control system, unit instrumentation, sound-insulated weather-proof marine grade aluminum enclosure, stainless steel exhaust silencer, sub-base fuel storage tank and electrical accessories as specified herein.
- E. The PLC based Automatic Transfer Switch Control requirements are specified in Section 26 36 23, Automatic Transfer Switch.
- F. The engine generator system is required to supply a significant nonlinear load. Provide the generator with features that allow satisfactory operation in presence of high harmonic content. Harmonic content may range between 50 percent and 75 percent of the total demand.
- G. The generator shall be designed to start and maintain priority loads specified on Supplement 1, Project sizing report, without exceeding the specified voltage drop limits.
- H. The fully integrated mechanical and electrical components that constitute this system shall be designed to enable either a fully automatic mode of operation from the ATS or a fully manual system that can be started, governed, and protected with safety shutdown for low oil pressure, high water or oil temperature, over-speed and other indicated conditions.

1.04 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): A335/A335M, Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service.
2. California Air Resources Board (CARB).
3. Code of Federal Regulations (CRF): Title 40 Volume 18, Control of Emissions from New and In-Use Non-road Compression-Ignition Engines.
4. International Organization for Standardization (DIN/ISO): 9001, Quality Management Systems—Fundamentals and Vocabulary.
5. National Electric Manufacturer’s Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. MG 1, Motors and Generators.
6. National Electrical Contractors Association (NECA): 404, Recommended Practice for Installing Generator Sets.
7. National Fire Protection Association (NFPA):
 - a. 37, Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - b. 70, National Electric Code.
 - c. 110, Emergency and Standby Power Systems.
8. SAE International (SAE): J1074, Engine Sound Level Measurement.
9. UL:
 - a. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - b. 508, Industrial Control Equipment.
 - c. 1236, Battery Chargers for Charging Engine-Starter Batteries.
 - d. 2085, Protected Aboveground Tanks for Flammable and Combustible Liquids.
 - e. 2200, Stationary Engine Generator.
10. Design criteria on General Structural Notes Sheet on Drawings.

1.05 SUBMITTALS

A. Action Submittals:

1. Dimensioned outline drawing showing plan and elevations of engine generator set and drive system.
2. Paragraph by paragraph specification compliance statement, describing differences between specified and proposed equipment.
3. Engine and generator weight, and anchoring requirements.
4. Catalog information and technical description; include materials for block, heads, valves, rings, cylinders, pistons, crankshaft, and major bearings and wear surfaces.

5. Complete list of accessories provided.
6. Performance curves showing engine efficiency (fuel consumed per kWh output), gross fuel consumption rate, and kW output at design rated output, one-half load, and one-quarter load. Account for design altitude, temperature corrections, and engine parasitic loads.
7. Transient and sub-transient reactances per unit.
8. Output waveform and telephone interference factor (TIF).
9. Circuit breaker data, including make model, catalog number, settings, and time current curves and enclosure size.
10. Cable termination lug data sheets.
11. Control panel instrument identification inscriptions.
12. Sample guarantee.
13. Electrical schematic and wiring diagrams for the following:
 - a. Generator control panel.
 - b. Main generator.
 - c. Voltage regulator.
 - d. Battery charging system.
 - e. Governing system.
 - f. Interconnection wiring diagram for automatic transfer switch specified in Section 26 36 23, Automatic Transfer Switch.
 - g. Enclosed electrical components.
14. Engine generator set motor starting capability and percent voltage dip curve.
15. Jacket water heater size and voltage.
16. Subbase tank size and dimensions.
17. Noise data for enclosed engine generator at 50 percent, 75 percent, and full load.
18. Exhaust system silencer pipe supports.
19. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Generator set manufacturer qualifications.
3. Generator set UL 2200 certification documentation or independent certification.
4. Certification, copies of analyses, or test reports demonstrating appropriate vibration analysis and design in all modes.
5. Component and attachment testing seismic certificate of compliance as required by Division 1, General Requirements.
6. Certified Factory Test Report.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

8. Description of parts and service availability.
9. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
10. Special guarantee.

1.06 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Provide materials and equipment manufactured within the scope of standards published by UL in conformance with those standards documented with an applied UL listing mark.

B. Manufacturer Special Requirements:

1. Generator Set: Listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
2. Generator Set Manufacturer: Certified to ISO 9001 with third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
3. A complete, engine-generator package shall be the product of one manufacturer, hereinafter referred to as the "Manufacturer," who has been regularly engaged in the production of complete generating systems for at least 5 years. All components shall have been designed to achieve optimum physical and performance compatibility with each other and prototype tested to prove integrated design capability. The complete system shall have been factory fabricated, assembled, and production tested.

1.07 WARRANTY

- A. A complete engine-generator package including control equipment shall be covered by the system manufacturer for a period of 5 years after acceptance of the system by the Owner. This warranty shall cover all materials provided, labor, and miscellaneous disposal items.
- B. The system Manufacturer shall provide complete contract information to the Owner for purchasing an extended warranty of a 10-year duration.

1.08 EXTRA MATERIALS

A. Fire Extinguisher:

1. A fire extinguisher shall be provided and shall be portable, multi-purpose dry chemical, 10 pound charge, complete with wall mounting weatherproof cabinet manufactured for the purpose and shall be permanently mounted near but not on the generator in a capacious and readily accessible location.
2. Fire extinguisher shall be U.S. Coast Guard rated for 2A20BC duty.

B. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Diesel fuel line filter elements	3 complete sets
Lubricating oil filter elements with gasket	3 complete sets
Air cleaner filter element	1 complete set
Cooling fan drive belt (if applicable)	2 complete sets
Hydrometer	1 each
Two-pronged battery voltmeter	1 each
Spare fuses, if used in control panel	1 complete set
Spare indicating lamps (if applicable)	4 each type used
Touch up paint	1 quart each color used
Special tools required to maintain or dismantle engine generator set	1 complete set

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials and equipment specified in this section shall be products of:

1. Caterpillar.
2. Cummins.
3. Kohler Power Series.

2.02 SERVICE CONDITIONS

- A. Ambient Temperature at Air Intake: 104 degrees F maximum.
- B. Ambient Temperature at Engine Generator Set: 104 degrees F maximum.

2.03 GENERAL

A. Ratings:

1. Operate at 1,800 rpm.
2. Rated at 175 kW / 218.8 kVA at 0.8 PF, based on specified service conditions.
3. Voltage: 480 / 277 volts, three-phase, four-wire, 60-Hz.
4. Rated based on standby service.

B. Emissions:

1. Engines: Meet emission requirements specified in 40 CFR Chapter I Part 89 for off-highway Internal Combustion (IC) engines.

C. Vibration Design:

1. Use vibration analytical techniques to determine shaft critical speeds, and to develop bearing design and shaft balancing to mitigate vibration.
2. Apply torsional analysis and design to mitigate torsional vibration.
3. Engine and generator, individually, shall not exhibit vibration in any plane exceeding 10 mils at continuous rating point, when measured at attachment points to common steel subbase.

2.04 ENGINE

A. General:

1. Manufacturer's standard design, unless otherwise specified.
2. Engine parts designed with adequate strength for specified duty.

B. Type:

1. Diesel Cycle, 4-stroke type with unit mounted radiator and fan cooling.
2. Minimum Displacement: As recommended by generator manufacturer.

C. Starting System:

1. Type: Automatic, using 12-volt or 24-volt battery-driven starter acting in response to control panel.
2. Starter: Capable of three complete cranking cycles without overheating.
3. Batteries:
 - a. Sized as recommended by engine manufacturer.
 - b. Lead-acid type.
 - c. Capable of providing 15 seconds minimum of cranking current at 0 degree C and three complete 15-second cranking cycles at 40 degrees C.

- d. Housed in acid-resistant frame isolated from engine generator main frame.
- e. Located such that maintenance and inspection of engine is not hindered.
- f. Complete with battery cables and connectors.
- 4. Battery Charger:
 - a. UL 1236 listed and labeled.
 - b. 10-amp automatic float, taper and equalize charge type, with plus or minus 1 percent voltage regulation over a plus or minus 10 percent input voltage variation.
 - c. Temperature compensated to operate over an ambient range of minus 30 degrees C to 50 degrees C.
 - d. Located by generator manufacturer in generator control panel, or wall mounted in generator enclosure.
 - e. Include:
 - 1) Ammeter and voltmeter.
 - 2) Fused ac input and dc output.
 - 3) Power ON pilot light.
 - 4) AC failure relay and light.
 - 5) Low and high dc voltage alarm relay and light.
 - f. Alarm relay dry contacts rated 4 amps at 120V ac.
 - g. Wire battery charger status and alarm contacts back to generator control panel, terminate and identify contacts.

D. Fuel System:

- 1. Engine driven, mechanical, positive displacement fuel pump.
- 2. Fuel filter with replaceable spin-on canister element.
- 3. Provide fuel cooler, suitable for operation of generator set at full rated load in ambient temperature specified if required for operation due to design of engine and installation.

E. Governing System:

- 1. Electro-mechanical or electro-hydraulic type.
- 2. Regulates speed as required to hold generating frequency within tolerable limits and within 5 percent of nominal design speed.
- 3. Accessories:
 - a. Manual speed control device.
 - b. Positive overspeed trip switch.

F. Jacket Water Cooling System:

- 1. Radiator:
 - a. Consisting of jacket water pump, fan assembly, fan guard, and duct flange outlet.

- b. Cooling System: Rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at alternator air inlet.
 - c. Fan: Suitable for use in a system with 0.5 in H₂O restriction.
 - d. Sized based on a core temperature that is 20 degrees F higher than rated operation temperature.
 - 2. Engine Thermostat: As recommended by manufacturer to regulate engine water temperature.
 - 3. Jacket Water Heater:
 - a. Suitable for operation on 120-volt, single-phase, 60-Hz current.
 - b. Maintain engine water temperature at 120 degrees F with an ambient temperature of 50 degrees F.
 - c. Thermostatically controlled.
 - 4. Engine Cooling Liquid: Fill cooling system with a 50/50-ethylene glycol/water mixture prior to shipping.
- G. Lubrication System:
- 1. Type: Full-pressure.
 - 2. Accessories:
 - a. Pressure switch to initiate shutdown on low oil pressure.
 - b. Oil filter with replaceable element.
 - c. Bayonet type oil level stick.
 - d. Valved oil drain extension.
 - 3. Oil Cooling System: Water-cooled heat exchanger utilizing jacket water.
- H. Exhaust System:
- 1. Muffler: Rated as recommended by generator manufacturer to meet noise requirements in self-contained units specified under Article Sound Attenuation.
 - 2. Wrap exposed length of exhaust pipe and silencer with thermal insulating wrap.
 - 3. Exhaust Pipe: ASTM A53, ASTM A106, standard wall, with fittings selected to match piping materials.
 - 4. Pipe Connections: Welded.
 - 5. Engine Connection:
 - a. Flanged, flexible, corrugated, Type 321 stainless steel expansion fitting, specifically suited for diesel exhaust service.
 - b. Length as required for flexibility and expansion in piping arrangement shown on Drawings.
- I. Air Intake System: Equip with dry type air cleaner with filter service (restriction) indicator.

2.05 GENERATOR

A. General:

1. Meet requirements of NEMA MG 1.
2. Synchronous type with 2/3 pitch, revolving field, drip-proof construction, air cooled by a direct drive centrifugal blower fan.
3. Stator Windings:
 - a. Skewed for smooth voltage waveform.
 - b. Reconnectable, 12 lead.
4. Overspeed Capability: 125 percent.
5. Waveform Deviation from Sine Wave: 5 percent maximum.
6. Telephone Interference Factor: 50 maximum.
7. Total Harmonic Current and Voltage Distortion: 5 percent maximum, measured at generator main circuit breaker.

B. Insulation System:

1. Class H, with a maximum rise of 155 degrees C over 40 degree C ambient in accordance with NEMA MG 1.
2. Vacuum pressure impregnated (VPI).

C. Excitation System:

1. Field brushless type or permanent magnet generator (PMG) exciter.
2. PMG and Controls: Capable of providing regulated current, at a rate of 300 percent of nameplate current, to a single-phase or three-phase fault for 10 seconds.

D. Voltage Regulation:

1. Solid state, three-phase sensing type.
2. Adjustable output voltage level to plus or minus 5 percent.
3. Provisions for proper voltage regulation for existing or future adjustable frequency drives as part of generator load.

E. Voltage and Frequency Regulation Performance:

1. Steady State Voltage Regulation: Less than plus or minus 1 percent from no load to continuous rating point.
2. NEMA MG 1 Defined Transient Voltage Dip:
 - a. Less than 20 percent at rapid application of rated load.
 - b. Recovery to rated voltage and frequency within 2 seconds following initial load application.
3. Steady State Frequency Regulation: Plus or minus 1.5-Hz overload range.

- F. Short Circuit Capabilities: Sustain 300 percent of rated current for 10 seconds for external three-phase bolted fault without exceeding rated temperatures.
- G. Main Circuit Breaker:
 - 1. Type: Molded Case LSIG.
 - 2. Current Rating: 400A.
 - 3. Interrupt Rating: 35,000 amps RMS symmetrical at 480 volts.
 - 4. Short Time Rating: 35,000 amps RMS symmetrical.
 - 5. Compression lugs for all feeder conductors including neutral and ground.
 - 6. Trips:
 - a. Thermal-magnetic with inverse time characteristics and adjustable magnetic pickup.
 - b. Solid state, RMS sensing.
 - c. Adjustable Functions:
 - 1) Long-time current pickup.
 - 2) Long-time delay.
 - 3) Normal range instantaneous short-time pickup.
 - 4) Short-time delay with I²t function.
 - 5) Ground fault pickup.
 - 6) Ground fault delay.
 - 7. Enclosure:
 - a. Rating: NEMA 250, Type 12.
 - b. Material: Type 316 stainless steel.
 - c. Mounted with vibration isolation from engine generator set.
 - 8. Surge Protective Devices: Three-phase capacitors and arresters mounted in terminal compartment.
 - 9. Oversize enclosure to accommodate multiple parallel feeder conductors.

2.06 BASEPLATE

- A. Mount engine generator set on a rigid common steel base frame.
- B. Stiffen base frame to minimize deflections.

2.07 INTEGRAL SUBBASE FUEL TANK

- A. General:
 - 1. Minimum capacity 450 gallons. Maximum capacity 499 gallons.
 - 2. UL 142 listed and labeled.
 - 3. Installation: In compliance with NFPA 37.
 - 4. Double-walled, steel construction including the following features:
 - a. Emergency tank and basin vents.
 - b. Mechanical level gauge.

- c. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by engine manufacturer and in compliance to UL 2200 and NFPA 37 requirements.
- d. Leak detection provisions, wired to generator set control for local and remote alarm indication.
- e. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
- f. Basin drain.
- g. Integral lifting provisions.

2.08 VIBRATION ISOLATORS

- A. Performance: Meet code requirements specified in Division 1, General Requirements.
- B. Provide vibration isolators, spring/pad type.
- C. Include seismic restraints if required by Site location.

2.09 AUTOMATIC LOAD TRANSFER CONTROL

- A. Provide automatic run controls suitable for remote interface and control by automatic transfer switch. Engine generator set shall start and run upon closure of a remote dry contact provided in Section 26 36 23, Automatic Transfer Switch.

2.10 CONTROL SYSTEM

- A. Control Panel:
 - 1. Rating: NEMA 250, Type 12.
 - 2. Material: 316 stainless steel.
 - 3. Instrument Identification: Face label or engraved, black, laminated plastic nameplate with white 1/4-inch high letters, attached with Type 422 stainless steel screws.
 - 4. UL 508 listed.
 - 5. Tested to meet or exceed IEEE 587 requirements for voltage surge resistance.
 - 6. Controls: Solid-state, microprocessor based.
 - 7. Control Panel: Designed and built by generator manufacturer to provide operating, monitoring, and control functions for generator set.
 - 8. Control Panel Mounting Height: 6 feet 6 inches maximum above where personnel will access panel, modify mounting height if a sub-base fuel tank is used.

B. Instrumentation:

1. Type: Suitable for engine-mounted vibration environment.
2. Mounting: Nonshock mounted.
3. Alarm and Signal Contacts: Rated 5 amps at 120V ac, dry.
4. Fault Indication Lamps: Push-to-test type.
5. Meters: Digital with analog display, plus or minus 2 percent accuracy.

C. Operator Controls and Indicators:

1. HANDCRANK/STOP/AUTO/ENGINE TEST selector switch.
2. Generator voltage adjustment.
3. Voltmeter PHASE SELECTOR switch.
4. Ammeter PHASE SELECTOR switch.
5. Voltmeter.
6. Ammeter.
7. Kilo-Watts (kW).
8. Percent kW.
9. Power Factor.
10. FREQUENCY meter.
11. Engine OIL PRESSURE indicator.
12. Engine jacket WATER TEMPERATURE indicator.
13. Engine SPEED indicator (RPM).
14. Engine OIL TEMPERATURE indicator.
15. RUNNING TIME indicator.
16. DC battery voltage.
17. Emergency Stop button.

D. Alarm Indicators with Manual Pushbutton RESET:

1. Low oil pressure.
2. High jacket water temperature.
3. Engine overspeed.
4. Engine overcrank.
5. Low/high dc voltage.

E. External Interfaces:

1. Furnish a single, common DPDT relay output upon occurrence of alarm condition.
2. Output: Dry contact rated 5 amps at 120V ac.
3. Accept remote dry start contact closure from automatic transfer switch, rated 10 amps at 32V dc.

F. Functional Requirements:

1. LCD text display of alarm/event descriptions.
2. Re-cranking Lockout: When engine fires, starting control shall automatically disconnect cranking control to prevent re-cranking for a preset period of time after engine stop.
3. Over-cranking Lockout: Initiate after four cranking cycles of 10 seconds on and 10 seconds off or provide continuous cranking cycle with crank time limiter.
4. Cooldown timer, adjustable from 5 minutes to 60 minutes.
5. Alarms:
 - a. Low coolant level.
 - b. Low fuel level.
 - c. Low battery voltage
 - d. High battery voltage.
 - e. Battery charger failure.
6. Engine shutdown upon any of the following conditions:
 - a. Engine overspeed.
 - b. Emergency stop button depressed.
 - c. High jacket water temperature alarm setpoint and shutdown setpoint.
 - d. Low oil pressure alarm setpoint and shutdown setpoint.
7. Air Inlet Damper Opening:
 - a. Upon engine start sequence initiation, a normally closed, dry contact, rated 5 amps at 120V ac, from engine start circuit shall open to provide a signal to open air inlet dampers.
 - b. Air Inlet Dampers: Fail open.

G. Special Requirements: Mount battery charger instrumentation on face of control panel and match generator instrumentation.

H. Power Requirements: 120 volts, single-phase.

2.11 SOUND ATTENUATED WEATHERPROOF ENCLOSURE

- A. Provide a walk-in sound attenuated weatherproof (not "weather protective") generator set enclosure, for the engine generator set, complete in every detail and requiring no additional in-field modifications or assembly except where specifically allowed by these specifications. The enclosure is to be accurately dimensioned to be in compliance with the National Electrical Code (NEC) and the National Fire Protection Association (NFPA) for clearance of all specified items included therein, and all applicable fire codes for a structure and application of this type. The enclosure and landings with steps (ladder) shall be designed and signed/sealed by a Professional Structural Engineer (P.E) registered in the State of Florida.

- B. Dimensions: Enclosure dimensions shall be such that a minimum of 36 inches along each side of the engine and 48 inches in front of the generator control panel and circuit breaker shall be kept as walking clearance for maintenance and operating personnel. The height of the enclosure shall provide a minimum of 6-foot 8-inch head room along the interior access.
- C. Design: The enclosure shall be fabricated from anodized marine grade (5053) aluminum alloy and Type 316 stainless steel hardware. A minimum thickness of 14-gauge shall be used for all component parts. The roof of the enclosure shall be strengthened to support the exhaust silencer recommended by the manufacturer for this application. The enclosure shall have a wind load rating of 150 mph.
- D. Doors: All doors on the enclosure shall be located to allow ease of maintenance on the generator set and allow access to instruments, controls, engine gauges, etc. The doors shall be minimum 36 inches wide and fitted with stainless steel hinges with stainless steel pins. Nylon wear bushings shall also be provided. Personnel door shall be fully gasketed to form a weathertight perimeter seal. A three-point latching assembly with interior latch release and exterior padlocking provisions shall also be provided together with stainless steel, flush mounted, adjustable key latches.
- E. Enclosure Access: Provide a fixed 4-foot by 4-foot landing with steps (ladder) on each side of the landing running parallel to the enclosure at each door for easy inspection and entrance into the enclosure.
- F. Louvers: All louvers shall have sufficient free area to allow for 120 percent of the total engine/generator cooling air requirements used in this application. Designed to prevent the entrance of rain when the unit is operating and the wind direction is at 90 degrees to the air intake at 150 mph. Louvers shall be of all aluminum fixed blade construction with insect screen, impact rated for 150 mph wind speed, as manufactured by Ruskin or approve equal The combined air inlet and discharge system shall be designed to maintain a combined total static pressure drop/air restriction of no more than 0.15 inch of water gauge through the enclosure at full rated load.
- G. Details: Provide stainless steel mounting brackets for the exhaust silencer specified. In addition, a stainless steel tail pipe extension terminating in a horizontal plane, cut at a 45-degree angle and fitted with a bird screen shall also be supplied. All components of the enclosure shall be assembled utilizing 0.375-inch minimum stainless steel bolts, nuts, and lock washers. In addition, watertight neoprene washers shall be used on all roof bolts.
- H. Finish: White.

- I. Sound Attenuation (Minimum 30 dB reduction): The entire enclosure including the louvered openings shall have sound attenuation material mechanically attached to the interior surfaces of the unit. Sound absorbing material shall be held in place by a perforated metal liner, painted white, to form a removable section easily inspected by maintenance personnel. The sound attenuation material and fastening system shall apply to the enclosure roof as well as side panels and doors, and shall consist of sound insulation fiberglass covered by sound insulating foam. The louvered openings shall be equipped with sound attenuating tubes, baffles, or hoods as required to meet the specified air flow and decibel ratings noted herein. The sound rating of the unit shall not exceed 85 db at 15 feet from any point of the enclosure when operating at full load.
- J. Internal Wiring: All wiring within each enclosure shall be in conduits specifically manufactured for electrical use. All connections at the generator set shall be flexible, and all shall be provided and installed prior to shipment to the installation site.
- K. Interior Lighting (DC): A battery-operated light deriving its power from other than the engine cranking batteries shall be installed in a strategic location within each enclosure and shall be controlled by a switch located by one of the doors. The light shall be large enough to provide illumination in an emergency situation to both the instrument control panel and the engine cranking battery. The switch controlling this light shall be a wind-up timer type which automatically shuts off after a preset interval not to exceed one hour. A means to automatically charge the emergency light battery shall be included.
- L. Interior Lighting (AC): Provide a minimum of six LED luminaries with 4-foot long impact-resistant polycarbonate, fully-gasketed clear polycarbonate lens, 120-volt, electronic LED driver(10 percent THD), 4,000 lumens output, 400k, self-contained emergency battery pack, and UL listed for wet locations (Lithonia VAP LED series or equal). The Luminaries shall be strategically located on both sides of the generator set to provide a minimum of 40 foot-candles (fc) of uniform light throughout the enclosure. They shall be ceiling mounted and parallel to the length of the unit, properly secured against harmful vibrations. Two 3-way light switches shall operate all of the luminaries and shall be located on the inside on the enclosure adjacent to the enclosure doors. The luminaries shall be wired to the power center.
- M. Interior Receptacles: Provide a minimum of four 20-amp, 120-volt, duplex GFI receptacles located inside the enclosure (two on each side of the enclosure space a minimum of 12 feet apart), wired to the power center.

- N. Exterior Lighting: Each enclosure shall be equipped with LED lights on the exterior of the structure, wired into the commercial power supply load center and activated automatically by way of photoelectric cells which will switch the lights on during evening hours and off during daylight hours. The fixtures for the lights shall be of vandal-proof design, and mounted above each entrance door of the enclosure. Each light shall be equipped with a switch to bypass the photoelectric cell controlling its automatic operation.
- O. Low-Voltage Power: The enclosure shall be equipped with a 480-volt, 3-phase, 3-wire 12 pole power panel and a 15kVA, 480-208/120V ac, single-phase, 12 pole mini-power center. Loads to be powered include, but are not limited to, the battery charger, jacket water heater, lighting, receptacles, etc., as specified and / or as shown on the Drawings. The power panel, and mini power center shall be mounted within the enclosure and allow for site condition conduit entry. The placement of the panels and mini power center shall be shown on the Submittal Drawings. All internal wiring and conduit runs to the various ancillary equipment supplied with the package shall be prewired at the factory in accordance with all governing codes pursuant to this application. The power panel shall be considered as part of the emergency load and shall derive its power source as shown on the Drawings. Refer to Section 26 05 01, Electrical for additional power panel requirements. Refer to Section 26 05 01, Electrical for additional mini-power center requirements.
- P. Running Beacon: A weatherproof, rotating beacon light shall be mounted atop the enclosure and wired to operate off generator output voltage or battery voltage each time the generator runs. This beacon shall be amber in color.
- Q. Fault Beacon: A weatherproof, rotating beacon light shall be mounted atop the enclosure and wired to operate off battery voltage in the event of an engine fault or alarm condition. This beacon will be red in color, and shall be wired to the alarm silence switch in the generator control panel.
- R. Oil and Water Drains: All necessary fittings, hoses, shutoff valves, etc., shall be provided to facilitate lube oil and water drain at the exterior of the enclosure. In addition, engines equipped with crankcase breather tubes shall have this tube terminate at the exterior of the enclosure directly under the radiator air discharge louver.
- S. Enclosure Flooring: The floor of the enclosure shall be designed and constructed in such a manner as to prevent the entrance of rodents. This shall be accomplished with solid metal or "diamond plate" and must be capable of fully supporting any ancillary equipment specified which may be secured to it plus the anticipated weight of maintenance personnel and their tools. Minimum floor thickness shall be 1/4-inch steel.

- T. Skin Cooling: Under no circumstances shall the floor area or any of its parts be considered for cooling air intake or discharge requirements of the generator set or its associated equipment, nor shall its properties as a "heat sink" or heat dissipating medium be utilized in any manner whatsoever in this application.
- U. Ventilation: Provide exhaust fan and intake and exhaust louvers for ventilation when engine/generator is not running. Size to maintain temperature within 5 degrees above the maximum ambient temperature specified in Paragraph Service Conditions. Provide backdraft damper on exhaust louver and motorized damper on intake louver. Control fan and motorized damper with an adjustable thermostat located near a doorway.
- V. See Generator Layout Drawing.

2.12 PLATFORM

- A. Features:
 - 1. Cantilever supported off base with 10-gauge formed steel frame, toe plates, railing posts (pipes), rails, and grate assemblies coated with powder black.
 - 2. Do not connect platform to subbase tank.
 - 3. Laser cut structural materials to a tolerance of 1/16 inch, allowing no sharp edges.
 - 4. Bolts: 5/16-inch diameter, minimum.
 - 5. Design platform to provide access to generator enclosure service doors for maintenance and inspection and, at minimum, wrap around sides and back of generator.
 - 6. Provide ship's ladder to access platform.
 - 7. Platform Height: No greater than 1.5 inches above bottom of generator base frame.
 - 8. Walkway Tread: 1-inch vertical steel grating, black powder coated, on 1-3/16-inch centers, connected by horizontal steel rods on 4-inch centers. Cover cut grate edges with 14-gauge, black powder coated, 1/2-inch by 1/2-inch angled steel.
 - 9. Handrails: Horizontal, 42 inches above walkway.
 - 10. Steel Component Coating: Pressure wash clean with an iron phosphate solution and apply 3 mils of high gloss black powder baked paint.
 - 11. Platform, Walkway, and Ladder: Meet requirements of OSHA 3124.

2.13 FACTORY FINISHING

- A. Engine Generator Set and Instrument Panel: Factory-applied primer and two finish coats of manufacturer's standard heat-resistant engine paint.

2.14 FACTORY TESTS

- A. General: Conform to NFPA 110.
- B. Steady Load Test: Test engine generator set at steady load run of 60 minutes minimum duration at 100 percent full-rated load.
- C. Transient Load Test: Conduct transient load test to demonstrate ability to meet load pickup and load release requirements specified.
- D. Harmonic Test: Conduct at full load conditions on the actual unit or one of the same model and size.
- E. Record and Report:
 - 1. Strip chart recording and full harmonic analysis measuring up to 50th harmonic for both voltage and current and three phases simultaneously.
 - 2. Transient response.
 - 3. Load/speed stability.
 - 4. Engine fuel consumption.
 - 5. Power output.
 - 6. Harmonic analysis.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Level and securely mount engine generator set in accordance with manufacturer's recommendations.
- B. Install in accordance with NECA 404.
- C. Where applicable, mount engine generator set on vibration isolators in accordance with isolator manufacturer's recommendations.

3.02 FIELD FINISHING

- A. Touch up damaged coating with paint system compatible to existing.

3.03 FIELD TESTS BY GENERATOR MANUFACTURER

- A. General:
 - 1. Conform to NFPA 110.
 - 2. Fuel provided by Contractor.
 - 3. Top off fuel after testing.

B. Performance Test:

1. Perform upon completion of installation.
2. Operate 2 hours minimum, 1 hour at 50 percent load and 1 hour at full load.
 - a. Manufacturer shall provide a resistive load bank and all required connecting materials for the load testing.
3. Manufacturer's representative shall make necessary adjustments.
4. Demonstrate ability of engine generator set to carry specified loads.
5. Demonstrate engine generator set safety shutdowns.

C. Test Report: Record and report the following:

1. Electric load on generator.
2. Fuel consumption.
3. Exhaust temperature.
4. Ambient air temperature.
5. Safety shutdown performance results.
6. Noise levels at 7 meters, property line.

D. Post-test Requirements:

1. Make final adjustments.
2. Replace fuel and oil filters.
3. Check belt drive tensions.
4. Demonstrate proper operation of equipment, including automatic operation with control from automatic transfer switch, to Engineer and Owner.

3.04 MANUFACTURERS' SERVICES

A. Manufacturer's Onsite Services shall Include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Revisiting the site as required to correct problems and until installation and operation are acceptable to Contractor.
4. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
5. Assistance during functional and performance testing, and facility startup and evaluation.
6. Training of Owner's personnel in the operation and maintenance of respective product as required.
7. Additional requirements may be specified elsewhere.

B. Manufacturer's Certificate of Proper Installation:

1. A Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this specification shall be completed and signed by the equipment manufacturer's representative.
2. Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

C. Training:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component).
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Paragraph Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

D. Onsite Services:

1. Present at Site or classroom designated by Contractor, the minimum person-days listed below, travel time excluded:
 - a. 3 person-days for installation assistance and inspection.
 - b. 3 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation including testing via plant PLC system.
 - c. 3 person-days for pre-startup classroom onsite training.
 - d. 3 person-days for facility startup.

3.05 SUPPLEMENTS

A. The supplement listed below, following "END OF SECTION," is part of this Specification.

1. Supplement 1, Project Sizing Report.

END OF SECTION

Modified Date	20-Mar-2019	Electricity Supply	60 Hz 480/277 V
Customer Name	Orange County Cell 11	Connection	****
Project Name/Ref #	Cell 11	Max. Ambient Temperature	110.0 F 90% Humidity
Prepared By	Edgar Carrasco	Altitude	200.0 Ft. A.S.L

Load Analysis Summary

Max Transient Load Step	95.3 SkVA	43.2 SkW	
Peak Transient Load	223.2 SkVA	161.7 SkW	
Final Running Load	165.7 kVA	139.2 kW	0.84 PF
Max Running Non Linear Load	0.0 RkVA		
Maximum Running Load	165.7 kVA	139.2 kW	

Generator Set

Genset Model	(1) of D175-4 (C7.1)	Nameplate Rating	175.0 kW / 218.8 kVA
Voltage Regulator and Slope	IVR, 2:1 slope		0.8 PF
Feature Code	****	Site Output	175 kW / 218.8 kVA
Fuel	Diesel	Rating Type	Standby
Dry Weight	****		
Length / Width / Height	**** / **** / ****	Cooling System	Standard
		UL Listed	Yes

Alternator Motor Starting Capability *

Instantaneous Voltage Dip ***	skVA Capability
10%	****
20%	****
30%	****
35%	****

Block Load (only) Transient Response *

Load Change %	FDip %	VDip %	Recovery Time (sec)
0 - 25	1.8	4.1	< 3
0 - 50	4.0	8.0	< 3
0 - 75	7.3	14.6	< 3
0 - 100	10.6	21.3	< 3

Engine Technical Data at 100% Rated Load

Make/Model	C7.1	Emissions/Certifications	EPA T3
Aspiration	****	Governor	ELEC
Cylinder Configuration	****	Aftercooler Type	ATAAC
Displacement	****	Rejection To Jacket Water	****
Speed	RPM	Rejection To Aftercooler	****
Fuel Rate	****	Rejection To Oil Cooler	****
Exhaust Sound Level	****	Rejection To Atmosphere	****
Mechanical Sound Level	****	Rejection To Exhaust	****
Max Combustion Inlet Air Temp	****	Exhaust Recoverable	****
Combustion Airflow	****	Exhaust Stack Temperature	****
Cooling System Ambient Capability	****	Exhaust Flow Rate	****
Cooling System Airflow **	****		
Engine Performance Number	****		

Alternator Technical Data

Alternator Arrangement Number	****	Insulation	****		
Alternator Type / Frame Size	LC / LC5034D	Temperature Rise	****		
Alternator Winding Pitch	****	Rejection To Atmosphere	****		
Number Of Poles	****	Peak Amps / Rated Amps	**** / ****		
Excitation / Winding Type	PM / RANDOM WOUND	Short Circuit Ratio	****		
Reactances	per unit	ohms	Generator Time Constants		
Subtransient - Direct Axis	X"d	****	Open Circuit Transient - Direct Axis	T'd0	****
Subtransient - Quadrature Axis	X"q	****	Short Circuit Transient - Quadrature Axis	T'd	****
Transient - Saturated	X'd	****	Open Circuit Subtransient - Direct Axis	T"d0	****
Synchronous - Direct Axis	Xd	****	Short Circuit Subtransient - Direct Axis	T"d	****
Synchronous - Quadrature Axis	Xq	****	Open Circuit Subtransient - Quadrature Axis	T"q0	****
Negative Sequence	X2	****	Short Circuit Subtransient - Quadrature Axis	T"q	****
Zero Sequence	X0	****	Armature Short Circuit	TA	****

Notes:

* Block Load (only) Transient Response values are at factory conditions. Genset block load capabilities at site conditions may vary from factory transient response test results due to a variance in site altitude or ambient conditions.

** Based on 1/2 inch water (0.12 kPa) external restriction and 1000 ft (300m) altitude.

*** Based on instantaneous voltage dip as defined per NEMA MG-1.

**** See your Caterpillar dealer and/or Spec Sheet for technical information.

***** Package Power Tolerance: +/- 5%

Overall dimensions and weight not to be used for installation. Contact your Caterpillar dealer for specific dimension drawings.

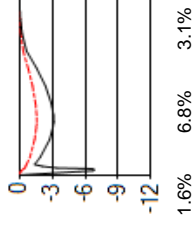
Caterpillar makes no express warranties and disclaims all implied warranties including merchantability and fitness for a particular purpose regarding program. Caterpillar shall have no liability in law or equity for damages consequential or otherwise arising from use of program and related material or any part thereof. The analysis provided from SpecSizer is only for the expected results at the generator terminals. Analysis of transient conditions of any device downstream is the responsibility of the system designer.

Modified Date 20-Mar-2019 **Rating Type** Standby **Max Ambient Temperature** 110 Deg. F
Customer Name Orange County Cell 11 **Fuel** Diesel **Altitude** 200.0 Ft. A.S.L
Project Name/Ref # Cell 11 **Electricity Supply** 60 Hz 480/277 V
Prepared By Edgar Carrasco

Load Step	Load Description	Permitted Dip		Predicted Dip		Load Analysis								
		Frequency	Voltage	Frequency	Voltage	Transient Inrush	Running	Resultant Peak	Cumulative Running	Fdip	Vdip 1:	Vdip 2:		
		SKVA	SKW	kVA	kW	SKVA	SKW	SKVA	SKW	kVA	kW			

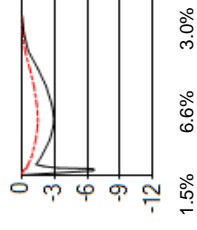
Step 1

1.1	1	30.00 HP - Primary Pump Station 1 NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Intermittent, Single Operating Point	30%	30%	64.3	27.0	28.6	24.6							
1.2	1	5.00 HP - Secondary Pump Station 2 NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Single Operating Point	30%	30%	12.6	7.2	5.6	4.4							
1.3	1	1.60kW - Primary Pump Station 2 Panel Miscellaneous , Non-Motor, Linear	30%	30%	2.0	1.6	2.0	1.6							
1.4	1	1.60kW - Secondary Pump Station 2 Panel Miscellaneous , Non-Motor, Linear	30%	30%	2.0	1.6	2.0	1.6							
		Step 1 Total	30%	30%	80.4	37.4	38.2	32.2	80.6	43.9	38.2	32.2			
		Total Through Step 1	Step Passed												



Step 2

2.1	1	5.00 HP - Secondary Pump Station 2 NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Single Operating Point	30%	30%	12.6	7.2	5.6	4.4							
		Step 2 Total	30%	30%	12.6	7.2	5.6	4.4							
		Total Through Step 2	Step Passed												



Load Step	Load Description	Permitted Dip		Predicted Dip		Load Analysis										
		Frequency	Voltage	Frequency	Voltage	Transient Inrush		Running		Resultant Peak		Cumulative Running				
						SkVA	SkW	kVA	KW	SkVA	SkW	kVA	kW	Fdip:	Vdip 1:	Vdip 2:

2.2	1	30.00 HP - Primary Pump Station 1 NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Single Operating Point	30%	30%	30%	64.3	27.0	28.6	24.6	64.3	27.0	28.6	24.6			
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Step 2 Total 30% 30% 1.5% 6.6% 76.8 34.2 34.2 29.0
Total Through Step 2 112.5 72.9 72.3 61.2

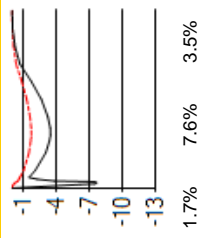
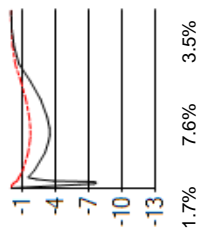
Step 3 Step Passed

3.1	1	30.00 HP - Air Compressor NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Single Operating Point	30%	30%	30%	64.3	27.0	28.6	24.6	64.3	27.0	28.6	24.6			
3.2	1	5.00 kVA - Transformer Air Compressor Steady State Magnetization, 98% Efficiency, 208V Secondary Voltage	-	-	-	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0			
3.3	1	6.25 Amps - Refrigerated Dryer NEMA, Single Phase Air Conditioning, Line 1-2, Intermittent	30%	30%	30%	18.0	16.2	2.3	2.0	18.0	16.2	2.3	2.0			

Step 3 Total 30% 30% 1.7% 7.6% 95.3 43.2 32.4 26.7
Total Through Step 3 163.6 110.4 104.7 87.9

Step 4 Step Passed

4.1	1	30.00 HP - Air Compressor NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Single Operating Point	30%	30%	30%	64.3	27.0	28.6	24.6	64.3	27.0	28.6	24.6			
4.2	1	5.00 kVA - Transformer 2 Air Compressor Steady State Magnetization, 98% Efficiency, 208V Secondary Voltage	-	-	-	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0			



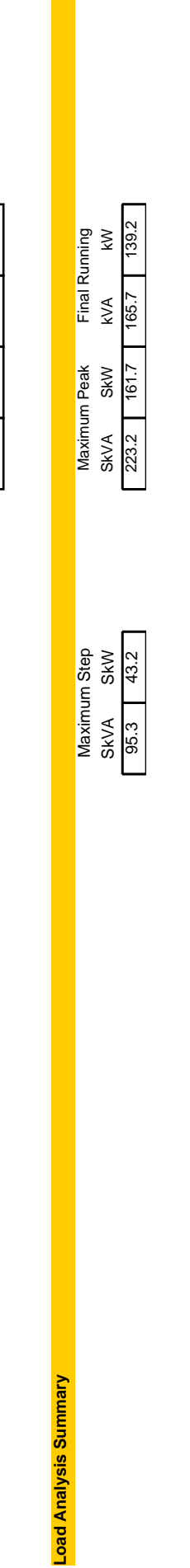
Load Details		Permitted Dip		Predicted Dip		Load Analysis								
Load Step	Load Description	Frequency	Voltage	Frequency	Voltage	Transient Inrush		Running		Resultant Peak		Fdip:	Vdip 1:	Vdip 2:
						SkVA	SkW	kVA	KW	SkVA	SkW	SkVA	kVA	kW

4.3	1 6.25 Amps - refrigerated dryer NEMA, Single Phase Air Conditioning, Line 1-2, Intermittent	30%	30%	1.7%	7.6%	18.0	16.2	2.3	2.0					
Step 4 Total		30%	30%	1.7%	7.6%	95.3	43.2	32.4	26.7	195.2	137.1	137.1	114.6	
Total Through Step 4		Step Passed												

5.1	1 30.00 HP - Future Air Compressor NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Single Operating Point	30%	30%	1.3%	5.6%	64.3	27.0	28.6	24.6					
Step 5 Total		30%	30%	1.3%	5.6%	64.3	27.0	28.6	24.6	196.7	147.6	165.7	139.2	
Total Through Step 5		Step Passed												



6.1	1 30.00 HP - Primary Pump Station 1 NEMA, 3-Phase Motor, Soft Starter, 225% Current Limit, Intermittent, Single Operating Point	30%	30%	1.7%	7.6%	18.0	16.2	2.3	2.0					
Step 6 Total		30%	30%	1.7%	7.6%	95.3	43.2	32.3	26.7	223.2	161.7	165.7	139.2	
Total Through Step 6		Step Passed												



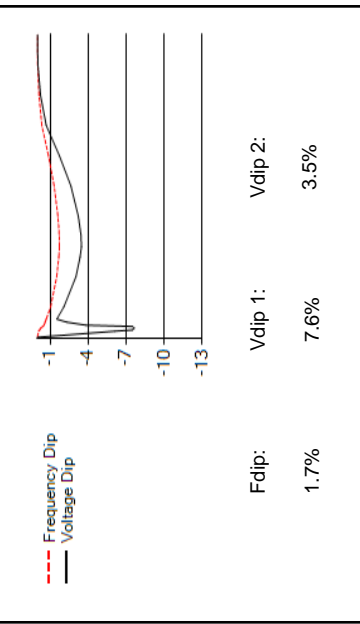
Load Analysis Summary		Maximum Step		Maximum Peak		Final Running	
		SkVA	SkW	SkVA	SkW	kVA	kW
		95.3	43.2	223.2	161.7	165.7	139.2

Transient Performance Report

Modified Date 20-Mar-2019 **Electricity Supply** 60 Hz 480/277 V **Rating Type** Standby
Customer Name Orange County Cell 11 Fuel **Fuel** Diesel
Project Name/Ref # Cell 11 **Max. Ambient Temperature** 110.0 F
Prepared By Edgar Carrasco **Altitude** 200.0 Ft. A.S.L

Load Scenario

Intermittent Step



Voltage Dip

Permitted-30.0%
 Predicted - 7.6%
 Synchronous (Vdip 1) - 7.6%
 Frequency-induced (Vdip 2) - 3.5%

Intermittent Step

Frequency Dip
 Permitted-30.0%
 Predicted - 1.7%

Selected Generator Set

175.0 EKW / 218.8 KVA 60 Hz Standby, 480/277V, D175-4 EPA T3, LC5034D PM LC, IVR 2:1 slope

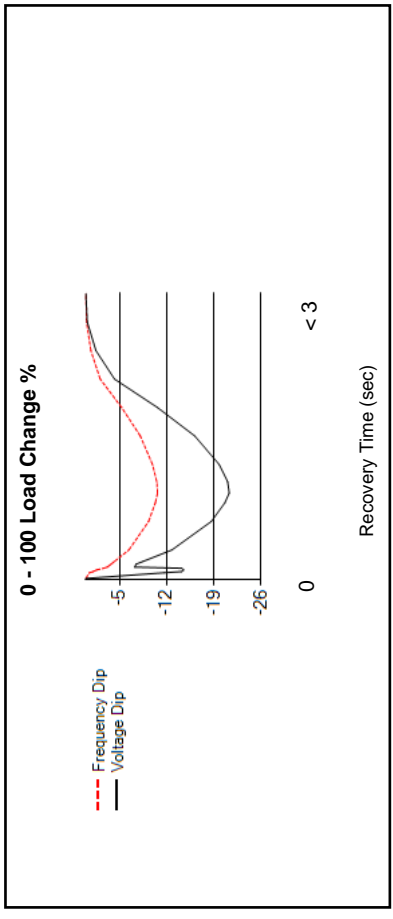
Block Load (only)	Transient Response *	VDip %	Recovery Time (sec)
0 - 25	1.8	4.1	< 3
0 - 50	4.0	8.0	< 3
0 - 75	7.3	14.6	< 3
0 - 100	10.6	21.3	< 3

Transient Performance

The selected representative generator set was factory tested in accordance to NFPA 110 block load step capability and acceptable frequency and voltage response on load addition and rejection.

* Block Load (only) Transient Response values are at factory conditions. Genset block load capabilities at site conditions may vary from factory transient response test results due to a variance in site altitude or ambient conditions.

Note: This information is representative of a typical Caterpillar GenSet, but is not guaranteed. This estimate has tolerances, and there are also GenSet-to-GenSet variations.



**SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Institute of Electrical and Electronics Engineers (IEEE): C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 2. National Electrical Manufacturers Association (NEMA):
 - a. ICS 1, General Standards for Industrial Control and Systems: General Requirements.
 - b. ICS 2, Industrial Control and Systems Controllers, Contactors, and Overload Relays not more than 2,000 volts ac or 750 volts ac.
 - c. ICS 6, Industrial Control and Systems: Enclosures 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 4. UL: 1008, Transfer Switch Equipment.

1.02 SUBMITTALS

- A. Action Submittals:
1. Descriptive product information.
 2. Dimensional drawings.
 3. Control diagrams.
 4. Conduit entrance locations.
 5. Equipment ratings.
 6. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
- B. Informational Submittals:
1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 2. Manufacturer's Certificate of Compliance, in accordance with Division 1, General Requirements.
 3. Factory certified test reports.
 4. Component and attachment testing seismic certificate of compliance as required by Division 1, General Requirements.
 5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ASCO.
- B. Eaton.
- C. Russelectric.
- D. No “or-equal” or substitute products will be considered.

2.02 GENERAL

- A. Transfer switch to be product of a single manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer’s service.
- B. In accordance with applicable standards of NFPA 70, NEMA ICS 1, NEMA ICS 2, NEMA ICS 6, IEEE C37.90.1, and UL 1008.
- C. Transfer switch consisting of inherently double-throw power switch unit with interconnected control module.
- D. Rated 100 percent, in amperes, for total system transfer of motor, electric heating, discharge lamp loads, and tungsten-filament lamp loads.
 - 1. Switches rated 400 amperes and below suitable for 100 percent tungsten-filament lamp loads.
 - 2. Switches rated above 400 amperes suitable for 30 percent tungsten-filament lamp loads.
- E. Main and arcing contacts visible for inspection with cabinet door and barrier covers removed.

- F. Number of Switched Poles: As shown on one-line drawing.
- G. Nominal Voltage, Full Load Current, and Short Circuit Withstand Current Rating: As shown on one-line drawing. Provide a three-cycle Withstand Current Rating, unless a longer time period is shown on the one-line drawing.
- H. Switch Rating: As shown on one-line drawing.
- I. Current carrying capacity of arcing contacts shall not be used to determine the transfer switch rating.
- J. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- K. Operating Conditions:
 - 1. Ambient Temperature: Maximum 40 degrees C.
 - 2. Equipment to be fully rated without any derating for operating conditions listed above.

2.03 ENCLOSURE

- A. Type: NEMA 250, Type 4X 316 stainless steel with enclosure grounding terminal.
- B. Dead front, front accessible cabinet with 14-gauge welded Type 316 stainless steel construction.
- C. Continuously hinged single door, with handle and lock cylinder.
- D. Finish: Baked enamel applied over rust-inhibiting, phosphate based coating.
 - 1. Exterior and Interior Color: Provide Manufacturer's standard white.
 - 2. Unpainted Metal Parts: Plated for corrosion resistance.
- E. Type: Equipment rack mounted enclosure.

2.04 TRANSFER SWITCH

- A. Type: Electrically operated, mechanically held, double-throw.
- B. Momentarily energized, single-electrically operated mechanism energized from source to which load is to be transferred.
- C. Locking mechanism to maintain constant contact pressure.
- D. Mechanical interlock switch to ensure only one of two possible switch positions or time delay in neutral position.

- E. Silver alloy contacts protected by arcing contacts.
- F. Main and arcing contacts visible when door is open and barrier covers removed.
- G. Manual operating handle for transfer in either direction under unloaded conditions.
- H. Internal control wire connections made with ring or spade type terminals, lock washers, and sleeve type marking labels.

2.05 CONTROL MODULE

- A. Completely enclosed and mounted separately from the transfer switch unit.
- B. Microprocessor for sensing and logic control with inherent digital communications capability.
- C. Plug-in, industrial grade interfacing relays with dust covers.
- D. Connected to transfer switch by wiring harness having keyed disconnect plug.
- E. Plug-in printed circuit boards for sensing and control logic.
- F. Adjustable solid state undervoltage sensors for all three phases of normal and for three phases of standby emergency source:
 - 1. Pickup 85 percent to 100 percent nominal.
 - 2. Dropout 75 percent to 98 percent of pickup setting.
- G. Adjustable frequency sensors for standby emergency source:
 - 1. Pickup 90 percent to 100 percent nominal.
 - 2. Dropout 87 percent to 89 percent of pickup setting.
- H. Control module with adjustable time delays:
 - 1. 0.5-second to 6-second engine start delay.
 - 2. 0-minute to 5-minute load transfer to emergency delay.
 - 3. 0-minute to 30-minute retransfer to normal delay.
 - 4. 0-minute to 30-minute unload running time delay.
 - 5. 0-minute to 5-minute time delay neutral on retransfer to normal source.
 - 6. Switch to bypass any of the above time delays during testing.
- I. Form-C start contacts, rated 10 amperes, 32-volt dc, for two-wire engine control, wired to terminal block.

- J. Exerciser, adjustable in 15-minute increments, 7-day dial clock to automatically exercise generator without load transfer.
- K. Adjustable 0-minute to 5-minutes time delay relay for engine starting signal.

2.06 METERING INSTRUMENTS

- A. Connect meters to load side of transfer switch.
- B. Show voltage, current, and kW on an average and per-phase basis, and track and record peak kW.

2.07 INDICATORS

- A. Type: Clustered light-emitting diodes.
- B. Green lens to indicate switch position for normal utility power source.
- C. Red lens to indicate switch position for standby emergency power source.
- D. Green lens to indicate normal utility power source is available within parameters established by pickup and dropout settings.
- E. Red lens to indicate standby emergency power source is available within parameters established by pickup and dropout settings.
- F. Provide one normally open and one normally closed, 5 amperes, 120-volt contact for remote indication when transfer switch is in either position.

2.08 FACTORY TESTS

- A. Test to ensure correct:
 - 1. Operation of individual components.
 - 2. Sequence of operation.
 - 3. Transfer time, voltage, frequency, and time delay settings.
- B. Dielectric strength test per NEMA ICS 1.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer’s instructions.
- B. Secure enclosure to equipment rack using anchor bolts of sufficient size and number adequate for specified seismic conditions.

3.02 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative in accordance with Section 01 43 33, Manufacturers' Field Services, for the following services at Site, for minimum person-days listed below, travel time excluded:
1. 1 person-day for installation assistance, final adjustment, and initial energization of equipment.
 2. 1 person-day for functional and performance testing.
 3. 1 person-day for adjustment of relay settings.
- B. Furnish startup services and training of Owner's personnel at such times as requested by Owner.

END OF SECTION

**SECTION 26 41 00
FACILITY LIGHTNING PROTECTION**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Lightning Protection Institute (LPI): 175, Standard of Practice.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 780, Standard for the Installation of Lightning Protection Systems.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 96, Standard for Lightning Protection Components.
 - b. 96A, Standard for Installation Requirements for Lightning Protection Systems.

1.02 DESIGN REQUIREMENTS

- A. Provide lightning protection system design for the following structures:
 - 1. Air Compressor Building.
 - 2. Diesel Engine Generator.
- B. Design lightning protection system to comply with all applicable provisions of LPI 175, UL 96, UL 96A, and NFPA 780.

1.03 RELATED SECTIONS

- A. Related work specified under other sections: Section 26 43 00, Surge Protective Devices.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Signed and Sealed Lightning protection system layout by a professional engineer (PE) register in the State of Florida.
 - 2. Component locations.
 - 3. Detailed plans.
 - 4. Down conductor.
 - 5. Connecting conductor.
 - 6. Bond strap.
 - 7. Air terminals.
 - 8. Fittings.

9. Connectors.
10. Ground rods.

B. Informational Submittals:

1. Field test report.
2. Ground Witness Certification-Form LPI-175A.
3. Post-Installation Certification-Form LPI-175B.
4. UL 96 Master Label "C" Certification.

1.05 QUALITY ASSURANCE

- A. Designer: Lightning protection system design shall be prepared by a signed and sealed by a PE registered in the State of Florida.
- B. System components shall be the product of a manufacturer regularly engaged in the manufacturing of lightning protection components in accordance with UL 96.
- C. Lightning protection system shall be installed under direct supervision of an LPI 175 Certified Master Installer.
- D. Inspection of final installation and grounding connection shall be performed by an LPI-certified inspector.
- E. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
- F. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 1. Thompson Lightning.
 2. IPC Protection.
 3. Erico Eritech Lightning Protection Systems.
 4. VFC, Inc.

2.02 GENERAL

- A. Complete system shall bear UL 96 Master Label C.
- B. System Material: Aluminum, unless otherwise specified.
- C. Material shall comply in weight, size, and composition for the class of structure to be protected as established by NFPA 780.

2.03 COMPONENTS

- A. Air Terminal:
 - 1. Material: Solid aluminum with tapered or blunt points as required for application.
 - 2. Diameter: 1/2 inch.
 - 3. Length: Sufficient to extend minimum 10 inches above object being protected.
 - 4. UL 96 Label B applied to each terminal.
- B. Conductors:
 - 1. Lightning System Conductors: Tin-Plated Bare medium hard-drawn stranded copper, or stranded aluminum as required for the application.
 - 2. Main Down Conductor: Smooth twist stranding.
 - 3. Connecting Conductor: Concentric stranding.
 - 4. Bonding Conductor: Flexible strap.
 - 5. Main down and connecting conductors shall bear the UL 96 Label A, applied every 10 feet.
 - 6. Grounding Conductors: Tin-Plated Stranded bare copper.
- C. Cable Fastener and Accessories: Capable of withstanding minimum pull of 100 pounds.
- D. Fittings:
 - 1. Heavy-duty.
 - 2. Bolts, Screws, and Related Hardware: Stainless steel.
- E. Ground Rods:
 - 1. Material: Copper-clad.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet.

- F. Grounding Connections:
 - 1. Welds: Exothermic process.
 - 2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
 - 3. Hardware: Silicone bronze.

- G. Cable Connections and Splicers:
 - 1. Welds: Exothermic process.
 - 2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
 - 3. Through-Roof Connectors: Straight or right angle with bronze and lead seal flashing washer.

- H. Conduit: Schedule 40 PVC, as specified in Division 26, Electrical.

PART 3 EXECUTION

3.01 GENERAL

- A. Workmanship to comply with all applicable provisions of LPI 175, UL 96, UL 96A, and NFPA 780.
- B. Aluminum materials shall be used where required to meet the galvanic corrosion requirements of UL 96A.
- C. Provide pitch pockets or method compatible with roofing to waterproof roof penetrations.
- D. Install system in inconspicuous manner so components blend with building aesthetics.

3.02 EXAMINATION

- A. Verify conditions prior to installation. Actual conditions may require adjustments in air terminal and ground rod locations.

3.03 INSTALLATION

- A. Air Terminals:
 - 1. Supports: Brackets or braces.
 - 2. Parapet Bracket Attachment: Lag or expansion bolts.
 - 3. Secure base to roof surface with adhesive or pitch compatible with roofing bond.
 - 4. Provide terminal flashing at roof penetrations.

5. Perimeter Terminals:
 - a. Maximum Spacing: 20 feet.
 - b. Maximum Distance from Outside Edge of Building: 2 feet.
 6. Roof Ridge Terminals: Maximum spacing 20 feet.
 7. Mid-Roof Terminals: Maximum spacing 50 feet.
 8. Provide blunt point air terminals for applications exposed to personnel.
- B. Conductors:
1. Conceal whenever practical.
 2. Provide 1-inch PVC conduit in building walls or columns for main downloads and roof risers.
 3. Support: Maximum spacing for exposed conductors.
 - a. Vertical: 3 feet.
 - b. Horizontal: 4 feet.
 4. Maintain horizontal and vertical conductor courses free from dips or pockets.
 5. Bends: Maximum 90 degrees, with minimum 8-inch radius.
 6. Install air terminal conductors on the structural roof surface before roofing composition is applied.
- C. Bonding:
1. Bond to Main Conductor System:
 - a. Roof mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.
 - b. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.
 2. Bond each steel column or major framing members to grounding system.
 3. Bond each main down conductor to grounding system.
- D. Grounding System:
1. Grounding Conductor:
 - a. Completely encircle building structure.
 - b. Bury minimum 1 foot below finished grade.
 - c. Minimum 2 feet from foundation walls.
 2. Interconnect ground rods by direct-buried copper cables.
 3. Maximum Resistance: 5 ohms when connected to ground rods.
 4. Connections:
 - a. Install ground cables continuous between connections.
 - b. Exothermic welded connections to ground rods, cable trays, structural steel, handrails, and buried and nonaccessible connections.
 - c. Provide bolted clamp type mechanical connectors for all exposed secondary connections.

- d. Use bolted offset parapet bases or through-roof concealed base assemblies for air terminal connections.
- e. Provide interconnections with electrical and telephone systems and all underground water, sewer, and process metal pipes.
- f. Provide electric service arrestor ground wire to building water main.

3.04 FIELD QUALITY CONTROL

A. Field Testing:

1. Isolate lightning protection system from other ground conditions while performing tests.
2. Resistance: Test ground resistance of grounding system by the fall-of-potential method.
 - a. Test Resistance to Ground: Maximum 5 ohms.
 - b. Install additional ground rods as required to obtain maximum allowable resistance.
3. Test Report:
 - a. Description of equipment tested.
 - b. Description of test.
 - c. Test results.
 - d. Conclusions and recommendations.
 - e. Appendix, including appropriate test forms.
 - f. Identification of test equipment used.
 - g. Signature of responsible test organization authority.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES (SPD)

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 2. Underwriters Laboratories, Inc. (UL):
 - a. 1449, Standard for Safety Surge Protective Devices.
 - b. 1283, Standard for Safety Electromagnetic Interference Filters.
 - c. 497A, Standard for Safety Secondary Protectors for Communication Circuits.
 3. American National Standards Institute (ANSI).
 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41.1, Guide on the Surge Environment in Low-Voltage (1,000V and Less) AC Power Circuits.
 - b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits - 1991.
 - c. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000V and Less) AC Power Circuits.

1.02 SUBMITTALS

- A. Submit product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
- B. Submit manufacturer's UL certified test data and nameplate data for each SPD.
- C. Submit electrical single-line diagram showing location of each SPD.

1.03 QUALITY ASSURANCE

- A. UL Compliance and Labeling:
1. For power and signal circuits, TVSS devices shall comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units that are listed and labeled by UL.
 2. For telephone circuit protection, TVSS devices shall comply with UL 497A.

- B. ANSI Compliance: Use TVSS devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Advanced Protection Technologies, Inc.
- B. General Electric, Tranquell.
- C. Square D, Surelogic.

2.02 GENERAL

- A. Unless indicated otherwise SPD devices shall be direct bus connected and factory installed inside the distribution equipment.
- B. SPD devices shall be capable of performance at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.
- C. SPD devices shall be connected through a fused switch or circuit breaker as selected by the manufacturer. The overcurrent protection shall allow full surge handling capabilities and to afford safety protection from thermal overloads and short circuits. The short circuit current rating (SCCR) of the SPD shall be no less than the SCCR of the distribution equipment.
- D. Design SPD devices to protect all modes (L-L, L-N, L-G, N-G) of the electrical system being utilized.
- E. Power Filter: The SPD shall include a high frequency extended range power filter complimentary listed to UL 1283 as an electromagnetic interference filter.
- F. Provide SPDs with the following monitoring and diagnostics:
 - 1. LED-type indication lights to show the normal and failed status of each protected phase.
 - 2. Surge event counter.
 - 3. Form C dry contact which operates when the unit fails.
- G. Provide UL Type 2 SPDs.
- H. EMI/RFI Noise Suppression: minus 50dB attenuation at 100 kHz, tested per MIL-STD 220B.

I. Voltage Protection Rating (VPR):

Voltage Rating	L-N	N-G	L-G	L-L
208Y/120	800	800	800	1200
480Y/277	1200	1200	1200	2000
240 Δ	-	-	1200	1200
480 Δ	-	-	2000	2000

2.03 SERVICE ENTRANCE AND DISTRIBUTION SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.
- B. Surge Current Capacity:
 - 1. Service Entrance: 240 kA per phase; 120 kA per mode.
 - 2. Distribution: 160 kA per phase; 80 kA per mode.
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent of the nominal system voltage.
- D. Nominal Discharge Current (IN): 20 kA.

2.04 PANELBOARD SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category B.
- B. Surge Current Capacity:
 - 1. Distribution: 120 kA per phase; 60 kA per mode.
 - 2. Branch: 80 kA per phase; 40 kA per mode.
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 125 percent of the nominal system voltage.
- D. Nominal Discharge Current (IN): 20 kA.

2.05 PANELBOARD TVSS

- A. Provide TVSS meeting IEEE C62.41.1 and IEEE C62.41.2 Location Category B.
- B. Surge current capacity shall be not less than the following:
 - 1. L-L Capacity: 80 kA.
 - 2. L-N Capacity: 80 kA.

- 3. L-G Capacity: 80 kA.
 - 4. N-G Capacity: 80 kA.
- C. Suppressor shall be in an enclosure that has the same NEMA rating as the panel it protects or the TVSS may be integral to a panelboard.
- D. UL 1449 maximum clamp voltage shall not be more than:

System Voltage	Phase	L-L or L-N Clamp Voltage
120	1	400
208Y/120	3	400
240	3	800
480Y/277	3	800

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

- A. Provide SPDs when indicated on Drawings or in the equipment Specifications.
- B. SPDs shall be factory installed as integral components to new switchgear, switchboards, motor control centers, panelboards and transfer switches. Externally mounted SPDs are not acceptable for new distribution equipment.
- C. When SPDs are indicated to be added to existing equipment then externally mounted SPDs are acceptable as described below.
- D. Electronic Equipment Paired Cable Conductors: Install data line suppressors at the low voltage input and output of each piece of equipment, including telephone cable entrance.
 - 1. Use secondary protectors on lines that do not exit the structure.
 - 2. Use primary protectors on lines that exit and enter the structure.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install suppressors according to manufacturer’s recommendations.
- B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with all conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

- C. Connecting wires shall be as short as possible with gently twisted conductors, tied together, to prevent separation. Connecting wires shall not exceed 24 inches in length at any point.
- D. Field installed conductors shall be the same as specified for building wire, not smaller than 8 AWG and not larger than 4 AWG. Device leads shall not be longer than the length recommended by the manufacturer, unless specifically reviewed and approved by the manufacturer.
- E. Provide dedicated disconnecting means for SPD devices installed at main service entrance location, switchgear, and motor control centers. Provide dedicated 30-ampere to 60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for TVSS devices installed at panelboards. The interrupting capacity of the circuit breakers shall be that specified for the other breakers at that location.

END OF SECTION

**SECTION 26 44 00
ELECTRICAL TESTING**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
 - a. 450, Recommended Practice for Maintenance, Testing, and Replacement of Large lead Storage Batteries for Generator Stations and Substations.
 - b. C2, National Electrical Safety Code.
 - c. C37.20.1, Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
 - d. C37.20.2, Metal-Clad and Station-Type Cubicle Switchgear.
 - e. C37.20.3, Metal-Enclosed Interrupter Switchgear.
 - f. C62.33, Standard Test Specifications for Varistor Surge-Protective Devices.
2. American Society for Testing and Materials (ASTM):
 - a. D665, Standard Test Method for Rust Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.
 - b. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
 - c. D923, Standard Test Method for Sampling Electrical Insulating Liquids.
 - d. D924, Standard Test Methods for A-Class Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
 - e. D971, Standard Test Method for Interfacial Tension of 0.1 Against Water by the Ring Method.
 - f. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - g. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - h. D1500, Standard Test Method for ASTM Color of Petroleum Products.
 - i. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
 - j. D1533, Standard Test Methods for Water in Insulating Liquids.
 - k. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
 - l. D2285, Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop-Weight Method.

3. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
 - b. 48, Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminators.
 - c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - d. 95, Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage.
 - e. 118, Standard Test Code for Resistance Measurement.
 - f. 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.
4. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guideline for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
 - c. WC 7, Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - d. WC 8, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
5. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety Requirements for Employee Workplaces.

1.02 SUBMITTALS

- A. Administrative Submittals: Submit 30 days prior to performing inspections or tests:
 1. Schedule for performing inspection and tests.
 2. List of references to be used for each test.
 3. Sample copy of equipment and materials inspection form(s).
 4. Sample copy of individual device test form.
 5. Sample copy of individual system test form.
- B. Quality Control Submittals: Submit within 30 days after completion of test:
Test or inspection reports and certificates for each electrical item tested.

1.03 OPERATION AND MAINTENANCE DATA

- A. As per Section 01 78 23, Operation and Maintenance Manuals and Data.

1.04 SEQUENCING AND SCHEDULING

- A. Perform inspection and electrical tests after equipment has been installed.
- B. Perform tests with apparatus de-energized whenever feasible.
- C. Inspection and Electrical Tests on Energized Equipment are to be:
 - 1. Scheduled with Engineer prior to de-energization.
 - 2. Minimized to avoid extended period of interruption to the operating plant equipment.
- D. Notify Engineer at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Tests specified in this section are to be performed in accordance with the requirements of Division 1, General Requirements.
- B. Tests and Inspection shall establish that:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, and ANSI C2.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Adjust mechanisms and moving parts for free mechanical movement.
- E. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- F. Verify nameplate data for conformance to Contract Documents.
- G. Realign equipment not properly aligned and correct unlevelness.

- H. Properly anchor electrical equipment found to be inadequately anchored.
- I. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.
- J. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- K. Provide proper lubrication of applicable moving parts.
- L. Inform Engineer of working clearances not in accordance with NFPA 70.
- M. Investigate and Repair or Replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- N. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by Engineer, door and panel sections having dented surfaces.
 - 5. Repair or replace, as determined by Engineer, poor fitting doors and panel sections.
 - 6. Repair or replace improperly operating latching, locking, or interlocking devices.
 - 7. Replace missing or damaged hardware.
 - 8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required due to extensive damage, as determined by Engineer, refinish the entire assembly.
- O. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents.

3.02 CHECKOUT AND STARTUP

- A. Voltage Field Test:
 - 1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
 - 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.

3. Record supply voltage (all three phases simultaneously on same graph) for 24 hours during normal working day.
 - a. Submit Voltage Field Test Report within 5 days of test.
 4. Unbalance Corrections:
 - a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
 - b. Obtain a written certification from a responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.
- B. Equipment Line Current Tests:
1. Check line current in each phase for each piece of equipment.
 2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
 3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 PANELBOARDS

- A. Visual and Mechanical Inspection: Include the following inspections and related work:
1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 3. Check panelboard mounting, area clearances, and alignment and fit of components.
 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 5. Perform visual and mechanical inspection for overcurrent protective devices.
- B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:
1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.

- d. With breakers open.
 - e. With breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Ground continuity test ground bus to system ground.

3.04 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
 - d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 - e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.05 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact-to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Proper phase barrier material and installation.
7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Phase-to-phase and phase-to-ground for 1 minute on each pole.
 - c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each switch blade and fuse holder.
 - b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.06 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 3 horsepower and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionality and proper operation.

e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.

5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:

a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:

1) Motors above 200 horsepower for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.

2) Motors 200 horsepower and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.

b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.

2. Calculate polarization index ratios for motors above 200 horsepower. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.

3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.

4. Measure running current and voltage and evaluate relative to load conditions and nameplate full-load amperes.

5. Overpotential Tests:

a. Applied dc voltage in accordance with IEEE 95.

b. Limited to 2,300-volt motors rated 1,000 horsepower and greater.

c. Test results evaluated on pass/fail basis.

3.07 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection:

1. Check doors and panels for proper interlocking.

2. Check connections for high resistance by low-resistance ohm meter calibrated torque wrench applied to bolted joints.

3. Check positive mechanical and electrical interlock between normal and alternate sources.

4. Check for proper operation:

a. Manual transfer function switch.

b. Generator under load and nonload conditions.

c. Auto-exerciser of generator under load and no-load conditions.

5. Verify settings and operation of control devices.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1, for each phase with switch CLOSED in both source positions.
 - b. Phase-to-phase and phase-to-ground for 1 minute.
 - c. Test values in accordance with manufacturer's published data.
2. Contact Resistance Test:
 - a. Contact resistance in microhms across each switch blade for both source positions.
 - b. Investigate values exceeding 500 micro-ohms.
 - c. Investigate values deviating from adjacent pole by more than 50 percent.
3. Set and calibrate in accordance with Specifications, manufacturer's recommendations, and Coordination Study.
 - a. Voltage and frequency sensing relays.
 - b. Time delay relays.
 - c. Engine start and shutdown relays.
4. Perform automatic transfer tests by:
 - a. Simulating loss of normal power.
 - b. Return to normal power.
 - c. Simulating loss of alternate power.
 - d. Simulating single-phase conditions for normal and alternate sources.
5. Monitor and verify operation and timing of:
 - a. Normal and alternate voltage sensing relays.
 - b. Engine-start sequence.
 - c. Timing delay upon transfer and retransfer.
 - d. Engine cool down and shutdown.
 - e. Interlocks and limit switch functions.
 - f. Engine cool down and shutdown feature.

3.08 BATTERY SYSTEM

A. Visual and Mechanical Inspection:

1. Physical damage and electrolyte leakage.
2. Evidence of corrosion.
3. Intercell bus link integrity.
4. Battery cable insulation damage and contaminated surfaces.
5. Operating conditions of ventilating equipment.
6. Visual check of electrolyte level.

B. Electrical Tests:

1. Measure:
 - a. Bank charging voltage.
 - b. Individual cell voltage.
 - c. Electrolyte specific gravity in each cell.
 - d. Measured test values to be in accordance with manufacturer's published data.
2. Verify during recharge mode:
 - a. Charging rates from charger.
 - b. Individual cell acceptance of charge.
3. Load tests for integrity and capacity; test values in accordance with IEEE 450.

3.09 LOW VOLTAGE SURGE PROTECTING DEVICE

A. Visual and Mechanical Inspection:

1. Adequate clearances between arrestors and enclosures.
2. Ground connections to ground bus electrode.

B. Electrical Tests:

1. Varistor Type Arrestors:
 - a. Clamping voltage test.
 - b. Rated RMS voltage test.
 - c. Rated dc voltage test.
 - d. Varistor arrestor test values in accordance with IEEE C62.33, Section 4.4 and Section 4.9.

3.10 STANDBY EMERGENCY GENERATOR SYSTEMS

A. Visual and Mechanical Inspection:

1. Proper grounding.
2. Blockage of ventilating passageways.
3. Proper operation of jack water heaters.
4. Integrity of engine cooling and fuel supply systems.
5. Excessive mechanical and electrical noise.
6. Overheating of engine or generator.
7. Proper installation of vibration isolators.
8. Proper cooling liquid type and level.
9. Operate engine-generator and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.

- d. Check resistance temperature detectors or generator inherent thermal protectors for functionality and proper operation.
 - e. Excessive vibration.
10. Verify voltage regulator and governor operation will cause unit speed and output voltage to stabilize at proper values within reasonable length of time.
 11. Proper operation of meters and instruments.
 12. Compare generator nameplate rating and connection with one-line diagram or approved Submittal.
 13. Verify engine-generator operation with adjustable frequency drives energized and operating under normal load conditions.
- B. Electrical and Mechanical Tests:
1. Cold start test by interrupting normal power source with test load consisting of connected building load to verify:
 - a. Transfer switch operation.
 - b. Automatic starting operation.
 - c. Operating ability of engine-generator.
 - d. Overcurrent devices capability to withstand inrush currents.
 2. Phase rotation tests.
 3. Test engine protective shutdown features for:
 - a. Low oil pressure.
 - b. Overtemperature.
 - c. Overspeed.
 4. Vibration baseline test on generator sets rated above 300 kW; levels in accordance with manufacturer's recommendations.
 5. Load bank test with reactors and resistors adjusted to 80 percent power factor for each load step. Record voltage, frequency, load current, oil pressure, and engine coolant temperature at 15-minute intervals:
 - a. 25 percent applied load for 30 minutes.
 - b. 50 percent applied load for 30 minutes.
 - c. 75 percent applied load for 30 minutes.
 - d. 100 percent applied load for 3 hours.
 - e. Load test results to demonstrate ability of unit to deliver rated load for test period.
 6. One-Step Rated kW Load Pickup Test:
 - a. Perform test immediately after performing load bank test.
 - b. Apply rated load, minus largest rated hp motor, to generator.
 - c. Start largest rated horsepower motor and record voltage drop for 20 cycles minimum with high-speed chart recorder or digital storage oscilloscope.
- C. Compare voltage drop with maximum allowable voltage dip for specified starting situation.

3.11 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect Each Individual Exposed Power Cable for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with Specifications.
 - e. Proper circuit identification.
2. Mechanical Connections for:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables for:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
4. Control Cables for:
 - a. Proper termination.
 - b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors:

1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
 - b. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.
 - c. Evaluate ohmic values by comparison with conductors of same length and type.
 - d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

3.12 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

A. General: Inspection and testing limited to circuit breakers and to motor circuit protector breakers rated.

B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.

3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 10.1.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480- and 600-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 10.2.
2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - f. Trip times shall be within limits established by NEMA AB 4, Table 5-3.
 - g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4.

3.13 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually Check Current, Potential, and Control Transformers For:
 - a. Cracked insulation.
 - b. Broken leads or defective wiring.
 - c. Proper connections.
 - d. Adequate clearances between primary and secondary circuit wiring.

2. Verify Mechanically That:
 - a. Grounding and shorting connections have good contact.
 - b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
 - a. Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.
 - b. Polarity test.
2. Potential Transformer Tests:
 - a. Insulation Resistance Test at Test Voltages in Accordance with NETA ATS, Table 7.1.1 for 1 Minute On:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 7.1.1.

3.14 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center, panelboard, switchboard, and assemblies for proper connection and tightness.
2. Ground bus connections in motor control center, panelboard, and switchboard assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-Of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 5 ohms.

2. Two-Point Direct Method Test:
 - a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
 - b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.

3.15 THERMOGRAPHIC SURVEY

- A. Provide thermographic survey per NETA ATS Table 100.18 of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 4 and larger at each:
 1. Service Entrance Rated Main Breaker.
 2. Main Distribution Panelboard
 3. Lighting Panelboard.
- B. Provide thermographic survey of feeder conductors No. 4 and larger terminating at:
 1. Low voltage disconnect switches.
 2. Transfer switches.
 3. Engine-generators.
- C. Remove necessary enclosure metal panels and covers prior to performing survey.
- D. Perform with equipment energized during periods of maximum possible loading per NFPA 70B, Section 20.17.
- E. Do not perform survey on equipment operating at less than 40 percent of rated load. If plant load is insufficient, perform test with supplemental load bank producing rated load on item being measured.
- F. Utilize thermographic equipment capable of:
 1. Detecting emitted radiation.
 2. Converting detected radiation to visual signal.
 3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.
- G. Temperature Gradients:
 1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.
 2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.

3. 16 degrees C and above indicates deficiency that is to be corrected immediately.

H. Provide written report of:

1. Areas surveyed and the resultant temperature gradients.
2. Locations of areas having temperature gradients of 3 degrees C or greater.
3. Cause of heat rise and actions taken to correct cause of heat rise.
4. Detected phase unbalance.

END OF SECTION

**SECTION 26 50 00
LIGHTING****PART 1 GENERAL**

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi [345 MPa] Minimum Yield Point to 4-inch [100-mm] Thick.
 - e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 - f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - g. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
 - i. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
 2. American Wood Protection Association (AWPA): M6, Brands Used on Forest Products.
 3. Canadian Standards Association (CSA).
 4. Certified Ballast Manufacturer (CBM).
 5. Federal Communications Commission (FCC).
 6. Illuminating Engineering Society of North America (IESNA).
 - a. HB-9, Lighting Handbook.
 - b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.
 - c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - d. RP (Recommended Practices) Series.
 - e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.

7. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
8. National Electrical Manufacturers Association (NEMA):
9. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
10. ICS 6, Industrial Control and Systems: Enclosures.
11. National Energy Policy Act.
12. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
13. Rural Utilities Service (RUS): 1728F-700, Specification for Wood Poles, Stubs and Anchor Logs.
14. Underwriters Laboratories, Inc. (UL):
 - a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting - Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
 - b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 - c. 924, Emergency Lighting and Power Equipment.
 - d. 1598, UL Standard for Safety Luminaires.
 - e. 2108, UL Standard for Safety Low Voltage Lighting Systems - First Edition; Reprint with Revisions through and Including February 24, 2014.
 - f. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
15. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. General:
 - 1) Provide catalog data sheets and pictures for all products listed below.
 - 2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard '.ies' file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution not identified on the project Luminaire Schedule. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the project Luminaire Schedule.

- b. Interior Luminaires:
 - 1) Catalog data sheets with pictures.
 - 2) Luminaire material, finish, dimensions, and metal gauge.
 - 3) Lens material, pattern, and thickness.
 - 4) Candle power distribution curves in two or more planes.
 - 5) Candle power chart 0 degree to 90 degrees.
 - 6) Lumen output chart.
 - 7) Average maximum brightness data in foot lamberts.
 - 8) Coefficients of utilization for zonal cavity calculations.
 - 9) Mounting or suspension details.
 - 10) Heat exchange and air handling data.
- c. Exterior Luminaires:
 - 1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
 - 2) Lens material, pattern, and thickness. Filters.
 - 3) IESNA lighting classification (BUG rating).
 - 4) Isolux diagram.
 - 5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
 - 6) Fastening details to wall, pendant, or pole.
 - 7) Ballast type, location, and method of fastening.
 - 8) For light poles, submit catalog sheet, wind loading, pole deflection with fixture attached, total weight, all accessories, complete dimensions, and finish.
 - 9) For concrete poles, include section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes, initial prestressing steel tension, and concrete strengths at release and at 28 days.
 - 10) Documentation for Energy Star qualifications for equipment provided under this section.
 - 11) Brackets and supports.
 - 12) Pole foundations.
- d. LED Source Systems:
 - 1) General:
 - a) IESNA LM-80 test reports.
 - b) IESNA TM-21 ratings.
 - c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
 - d) Warranty: Light engine and driver.
 - e) Rated life.
 - f) Surge protection.
 - g) Thermal control device, heat sink.
 - h) Enclosure and wiring information.
 - i) Operating voltage range.

- 2) Electronic Module/Light Engine:
 - a) Correlated Color Temperature (CCT).
 - b) Color Rendering Index (CRI).
- 3) Drivers:
 - a) Input Current Total Harmonic Distortion.
 - b) Power factor.
 - c) Sound rating.
 - d) Dimming system information.
- e. Time Switches:
 - 1) Wiring diagram.
 - 2) Contact ratings.
 - 3) Functional features.
 - 4) Programmable capabilities.
 - 5) Enclosure type, dimensions.
- f. Lighting Contactor:
 - 1) Type (mechanically or electrically held).
 - 2) Enclosure.
 - 3) Contact ratings and configuration.
 - 4) Coil operating voltage.
- g. Photoelectric Switches (Photocells):
 - 1) Voltage.
 - 2) Power consumption.
 - 3) Load capacity (watts).
 - 4) Contact ratings and configuration.
 - 5) Time delay.
 - 6) Light operating level controls.
 - 7) Enclosure type and dimensions.
 - 8) Mounting type.
 - 9) Temperature range.
 - 10) Features and options.
- h. Photo Sensors/Controls for Daylight Harvesting Control:
 - 1) System description, overall functionality.
 - 2) Each component.
 - 3) Electrical ratings (voltage, amperage, watts).
 - 4) Wiring diagrams.
 - 5) Programming.
 - 6) Testing.
- i. Wall box dimmers.
- j. Dimming systems.
- k. Occupancy Sensors:
 - 1) Type.
 - 2) Switching capacity.
 - 3) Coverage.
 - 4) Time delay AUTO/OFF adjustment.

- l. Low Voltage Remote Control Wiring System:
 - 1) Type.
 - 2) Switching capacity.
 - 3) Voltage rating.
 - 4) Wiring diagrams.
- m. Outdoor Motion Sensors.
- n. Emergency Shunt Relay.
- o. High mast lighting.
- p. Standby lighting panel.
- q. Luminaire lowering device.
- r. Landscape Lighting:
 - 1) Luminaires.
 - 2) Controls.
 - 3) Transformers.
 - 4) Wiring.
- s. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
- 2. Manufacturer's printed installation instructions.
- 3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Manuals and Data.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

- 1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
- 2. Provide materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. in conformance with those standards and with an applied UL listing mark.

B. Standard Products:

- 1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.

2. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to Bid opening in similar applications under similar circumstances and of similar size. Provide products that have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.

C. Preinstallation Meeting:

1. Occupancy Sensors: Arrange preinstallation meeting with manufacturer's factory authorized representative at Owner's facility, to verify placement of sensors and installation criteria.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Concrete Poles:

1. Do not store poles on ground.
2. Support poles so they are at least 1 foot above ground level and growing vegetation.
3. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

B. Aluminum or Steel Poles:

1. Provide manufacturer's standard protection for the finish during shipment and installation. At minimum, spirally wrap each pole shaft with protective paper secured with tape, and ship small parts in boxes.
2. Do not store poles on ground.
3. Support poles so they are at least 1 foot above ground level and growing vegetation.
4. Do not remove factory-applied pole wrappings until just before installing pole.
5. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

1.05 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts.

Item	Quantity
LED drivers	Two complete set per unit
LED arrays	Two complete set

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule.
- B. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.
- C. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, “.ies” format, certified by the luminaire manufacturer for use with lighting software.
- D. Luminaire Labels:
 - 1. External label per ANSI C136.15.
 - 2. Internal label per ANSI C136.22.
- E. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.
- F. Feed-through type, or separate junction box.
- G. Wire Leads: Minimum 18 AWG.
- H. Component Access: Accessible and replaceable without removing luminaire from ceiling.
- I. Soffit Installations (Interior or Exterior Damp Locations):
 - 1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
 - 2. Ballast: Removable, prewired.
- J. Exterior Installations:
 - 1. UL Labeled: SUITABLE FOR WET LOCATIONS.
 - 2. Ballast: Removable, prewired.
 - 3. When factory-installed photocells are provided, entire assembly shall have UL label.
- K. Illuminated Exit Signs:
 - 1. Body: As scheduled.

2. Face: Stencil.
 - a. Letters:
 - 1) 6-inch high by 3/4-inch stroke.
 - 2) Color: Red.
3. Mounting: As schedule.
4. Directional Arrows: As indicated on Drawings.

L. Emergency Lighting Units:

1. Power Pack: Self-contained, 120/277-volt dual voltage selectable input transformer, inverter/charger, sealed nickel cadmium battery, and indicator switch in accordance with UL 924.
2. Lighted, push-to-test indicator.
3. Capable of providing full illumination for 1-1/2 hours in emergency mode.
4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.
5. Capable of protecting against excess charging and discharging.

M. Hazardous Classified Areas:

1. UL Labeled: As indicated in the Luminaire Schedule.
2. Fixture Enclosure and Fittings: Copper-free, cast aluminum in accordance with UL 844.

2.02 LED SOURCE SYSTEMS

A. General:

1. Provide IESNA LM-80 test reports.
2. Provide Energy Star compliance for solid state luminaires.
3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
4. Provide RoHS compliant LED light source(s) and driver(s).
5. Rated operating temperature range as indicated on the Luminaire Schedule.
6. Warranty: 5 years minimum.

B. Electronic Module/Light Engine:

1. Mount all components to a single plate and factory prewired with quick-disconnect plugs.
2. Include a driver, thermal control device, thermal protector device, and surge protector device. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.

4. Light engine rating per TM-21: 60,000 at 65 degrees C, L84.
5. Correlated Color Temperature (CCT): As indicated on the Luminaire Schedule.
6. Color Rendering Index (CRI): Minimum of 80.

C. Drivers:

1. Expected life of 60,000 hours at 65 degrees C.
2. Provide drivers mounted in an all metal can.
3. Operating Voltage Range: 50/60-Hz input source of 120V – 250V with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.
6. Sound rating: Class A.
7. Comply with NEMA 410 for inrush current limits.
8. Dimming:
 - a. Continuously dimmable from 10 percent to 100 percent.
 - b. Provide driver compatible with standalone dimming controls and/or dimming systems used.

2.03 LIGHTING CONTROL

A. Time Switch, Electronic Programmable Type:

1. Provide digital electronic time switch with number of channels indicated on Drawings.
2. Programming: Each channel shall be independently programmable and include:
 - a. A Form C dry contact, output rated for 20 amps at 120V to 208V ac for operation on inductive, LED driver loads.
 - b. Provide channels with 8 ON/OFF set points in a 24-hour period for each day or the week.
 - c. 365-day capability.
 - d. Holiday override capability.
 - e. Four seasonal schedule capabilities.
 - f. User-programmable daylight savings time adjustment option.
 - g. Automatic daylight savings changeover.
 - h. Automatic leap year compensation.
3. Time Switch Minimum Features:
 - a. Selectable am/pm or 24-hour format.
 - b. 1-minute time resolution.
 - c. Control Inputs: Up to 8 control inputs capable of connection to input devices including photoelectric relays, discrete input devices, etc. for use in programming output channels.

- d. Battery backup with rechargeable batteries and 72 hour.
 - e. Individual manual ON/OFF override control for each channel.
 - 4. Manufacturers:
 - a. Tork.
 - b. Intermatic.
 - c. Paragon Electric Company.
- B. Lighting Contactor:
- 1. Features:
 - a. Electrically held contactor.
 - b. Contacts Rating: 600 volts, 30 amperes.
 - c. Enclosure: NEMA 4 conforming to NEMA ICS 6.
 - d. Provide contactor with HAND-OFF-AUTOMATIC.
- C. Photoelectric Switch (Photocell):
- 1. Automatic Solid State ON/OFF Switching Photo Control:
 - a. Dry Contacts:
 - 1) Configuration: DPST.
 - 2) Rating: 1,000VA inductive.
 - 3) Compatible with connected load device indicated on Drawings.
 - 2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
 - 3. Setting: ON at dusk and OFF at dawn.
 - 4. Time delay feature to prevent false switching.
 - 5. Field adjustable to control operating light levels.
 - 6. Integral surge protection.
 - 7. Manufacturers:
 - a. Tork.
 - b. Intermatic.
 - c. Paragon Electric Company.
- D. Photo Sensors/Controls for Daylight Harvesting Control:
- 1. General.
 - a. Operating Temperature: 32 degrees F to 120 degrees F.
 - b. Environment: Indoor dry.
 - c. Illumination Sensing Levels:
 - 1) 10 Foot-candles to 200 Foot-candles: General interior spaces.
 - 2) 100 Foot-candles to 1,000 Foot-candles: Atriums, light shelves.
 - 3) 1,000 Foot-candles to 10,000 Foot-candles: Light wells, skylights.
 - d. Output: Compatible with individual lighting load characteristics controlled.

2. Switching Control:
 - a. Sensor shall sense relative lighting levels in interior spaces as daylight contribution varies throughout the day and shall convey changes to a control unit/power pack switching device. Switching device shall open and close load contacts based on field programmable set points.
 - b. Power Pack:
 - 1) Dry contacts rated 20A at 120V – 208V ac.
 - 2) Adjustable Time Delay: 5 seconds to 300 seconds.
 - 3) Set point adjustment for both on and off operation.
 3. Dimming Control:
 - a. Sensor shall sense relative lighting levels in interior spaces as daylight contribution varies throughout the day and modulate electric luminaire lighting output to maintain a fixed lighting level in the space.
 - b. Controller Unit:
 - 1) 120V - 208V ac input.
 - 2) 24V dc output to power the sensor.
 - c. Sensor Output: 0V dc to 10V dc.
 - d. Light level set point adjustment performed by separate hand held remote control device.
- E. Wall Box Dimmers:
1. General:
 - a. Modular gangable design.
 - b. Solid-state circuitry.
 - c. Voltage: As required on Drawings.
 - d. ON/OFF switch integral to the unit. ON/OFF switch shall be independent of dimming level function.
 - e. Single-pole or three-way as indicated on Drawings.
 - f. Operator:
 - 1) Continuous adjustability throughout the dimming range.
 - 2) Slider.
 - g. Integral suppression for audible frequency and EMI/RFI.
 - h. Comply with UL 1472.
 2. LED System Dimmers: Certified by manufacturer to operate on dimming drivers provided with luminaires in this Project.
- F. Dimming System:
1. Fluorescent dimmer capable of dimming from one to ten 40-watt rapid-start lamps.
 2. Size: Fit in a single gang wall box.
 3. Positive OFF switching and low intensity trim adjustment without removing dimmer from box.

4. Manufacturers:
 - a. Lutron Electronics Co., Inc.
 - b. Pass and Seymour/LeGrand.
 - c. Lithonia Lighting Co.

G. Low Voltage Remote Control Wiring System:

1. Provide a complete low-voltage, remote control wiring system for control of lighting fixtures as indicated on Drawings and Schedules. Provide complete system including transformers, rectifiers, relays, switches, master switches, electronic controls, enclosures, wall plates, and wiring of same manufacturer.
2. Remote Control Wiring: In accordance with Article 725, Class 2 of NFPA 70.
3. Provide for Direct-Wired Connection of:
 - a. Standard of pilot light switches for individual control of relays.
 - b. Two independent master override inputs which allow ON/OFF control of all relays while still supporting individual control of each relay.
4. Provide relay panels configured to allow future addition of up to two master controls of programmable control of all relays.

H. Occupancy Sensors:

1. General:
 - a. Capable of operating normally with any electronic ballast and PL lamp systems.
 - b. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to cycling of air conditioner or heating fans.
 - c. Provide sensors with readily accessible, user adjustable controls for time delay and sensitivity.
 - d. Provide a bypass manual OVERRIDE ON key on each sensor to allow operation in the event of sensor failure. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. Recess bypass control to prevent tampering.
 - e. Provide an extra Form C (1-NO-1-NC) contact for each unit to interface with building system. Provide units mountable in standard electrical box.
2. Sensor Technology:
 - a. Passive Infrared (PIR):
 - 1) Provide sensors that respond to human heat and movement to detect occupants in the coverage area.
 - 2) Temperature compensated pyroelectric sensor.

- 3) High immunity to false triggering due to RFI and EMI noise.
- 4) Provide passive infrared sensors with a multiple segmented lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue buildup.
- 5) Detection Range (IR Range) on Axis: 1,200 square feet.
- b. Ultrasonic:
 - 1) Provide sensors which respond to ultrasonic disturbances within as well as outside the line of sight to detect occupants in the coverage area.
 - 2) Use advanced signal processing technology to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and airflow throughout the controlled space.
 - 3) Detection Range (IR Range) on Axis: 500 square feet to 2,000 square feet.
- c. Dual Technology:
 - 1) Sensors use a combination of passive infrared and ultrasonic technologies to detect occupants in coverage area.
 - 2) Provide technology mode selection to allow installer to configure the operation mode between dual technology, passive infrared only, or ultrasonic only functionality.
 - 3) Detection Range (IR Range) on Axis: 2,000 square feet.
 - 4) No audio dual technology units will be accepted.
3. Sensor Mounting:
 - a. Ceiling:
 - 1) Directional Coverage: 360 degrees.
 - b. Wall:
 - 1) Directional Coverage: 180 degrees.
 - c. Corner:
 - 1) Coverage: 90 degrees.
 - d. Switch Box:
 - 1) Directional Coverage: 180 degrees.
 - 2) Coverage Area: At desk top level up to 300 square feet and gross motion up to 1,000 square feet.
 - 3) Switch Types:
 - a) Single circuit switches shall control a single switched circuit.
 - b) Bi-level switches shall accommodate up to two switched circuits.
 - 4) Loads:
 - a) Wall box switches shall include an integral power supply.
 - b) Switches shall accommodate loads from 0 watt to 800 watts at 120 volts; 0 watt to 1,200 watts at 277 volts.

- e. High-Bay:
 - 1) Directional Coverage: 360 degrees.
 - 2) Mounting Height: 12 feet to 50 feet.
 - 3) Mounting: Conduit threads.
 - 4) Bi-level switches turn lights on when an occupant enters the coverage area and turns lights either off or to a preset dimmed level after the coverage area is vacated for a preset time delay.
 - 5) Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.
- 4. Circuit Control Hardware—CU Power Packs:
 - a. Control Units: Able to mount through a 1/2-inch knockout in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer shall provide power to a minimum of two sensors.
 - b. Relay Contact Ratings:
 - 1) 13A, 120V ac tungsten.
 - 2) 20A, 120V ac ballast.
- 5. Wiring: Control wiring between sensors and control units shall be Class II, 14 AWG, stranded, UL Classified, PVC insulated or Teflon jacketed cable approved for use in plenums, where applicable.
- 6. Manufacturers:
 - a. Unenco, Inc.
 - b. Watt Stopper, Inc.
 - c. Or approved equal.

2.04 EQUIPMENT IDENTIFICATION

- A. Manufacturer's Nameplate: Provide each item of equipment with a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.
- B. Provide clear markings located to be readily visible to service personnel.

2.05 FACTORY FINISH

- A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.01 LUMINAIRES

A. General:

1. Install in accordance with manufacturer's recommendations.
2. Provide proper hangers, pendants, and canopies as necessary for complete installation
3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.
4. Install plumb and level.
5. Install each luminaire outlet box with galvanized stud.

B. Mounting:

1. General:

- a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 01, Electrical.
- b. Refer to Fastener Schedule in Section 05 50 00, Metal Fabrications.

2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.

3. Pendant Mounted:

- a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
- b. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
- c. Provide twin-stem hangers on single luminaires.
- d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.

4. Pole Mounted: Provide precast concrete base.

C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.

D. Finished Areas:

1. Install symmetrically with tile pattern.
2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.

5. Junction Boxes:
 - a. Flush and Recessed Luminaires: Locate minimum 1 foot from luminaire.
 - b. In concealed locations, install junction boxes to be accessible by removing luminaire.
 6. Wiring and Conduit:
 - a. Provide wiring of temperature rating required by luminaire.
 - b. Provide flexible steel conduit.
 7. Provide plaster frames when required by ceiling construction.
 8. Independent Supports:
 - a. Provide each recessed fluorescent luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
 - b. Select chain or wire with tensile strength and method of fastening to structure adequate to support luminaire weight.
 - c. Fasten chain or wire to each end of luminaire.
- E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
 2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.
- F. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.

3.02 LIGHTING CONTROL

- A. Outdoor Luminaires: Photocells switch lights ON at dusk and OFF at dawn.
- B. Dimming Systems:
1. Install in accordance with manufacturer's recommendations.
 2. Do not connect ballasts or equipment to dimming system unless acceptable to dimming system manufacturer.
- C. Occupancy Sensors: Locate and aim sensors in correct location required for complete and proper volumetric coverage within range of coverage(s) of controlled areas per manufacturer's recommendations. Provide 90 percent to 100 percent room coverage to accommodate all occupancy habits of single or multiple occupants at any location within room(s). Locations and quantities of sensors shown on Drawings are diagrammatic and only indicate which rooms are to be provided with sensors. Provide additional sensors if required to properly and completely cover respective room.

3.03 EMERGENCY LIGHTING UNIT

- A. Install in accordance with manufacturer's recommendations.
- B. Provide permanent circuit connections with conduit and wire.
- C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.
- D. Provide separate circuit wiring to luminaire.

3.04 FIELD FINISHES

- A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Paint as specified in Section 09 90 00, Painting and Protective Coatings.

3.05 FIELD QUALITY CONTROL

- A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.
- B. Coordinate lighting and controls installation and testing with commissioning as specified in Section 01 91 14, Equipment Testing and Facility Startup.

3.06 MANUFACTURER'S SERVICES

- A. Occupancy Sensors:
 - 1. Furnish manufacturer's representative at Job Site in accordance with Section 01 43 33, Manufacturers' Services, to inspect installation, test unit, and put into service.
 - 2. Provide, at Owner's facility, training necessary to familiarize Owner's personnel with operation, use, adjustment, and problem solving diagnosis of occupancy sensing devices and systems.
- B. Standby Lighting Panel: Furnish manufacturer's representative at Job Site in accordance with Section 01 43 33, Manufacturers' Services, to inspect installation, test unit, and put into service.

3.07 CLEANING

- A. Remove labels and markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.
- C. Clean luminaire plastic lenses with antistatic cleaners only.

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- D. Touchup painted surfaces of luminaires and poles with matching paint ordered from manufacturer.
- E. Replace defective lamps at time of Substantial Completion.

END OF SECTION