



Utility Engineering Consultants, *LLC*

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130 Southcrest Drive, Suite 100
Homewood, AL 35209
P.O. Box 19218
Birmingham, Alabama 35219

April 23, 2024

City of Columbiana
107 Mildred Street
Columbiana, Al 35051

**RE: ADDENDUM NO. 1
 CITY OF COLUMBIANA
 WWTP UPGRADES
 CWSRF PROJECT NO. CS010923-01
 CONTRACT NO. CO22 093**

All Contractors shall acknowledge receipt of Addendum No. 1 for the above referenced job by signing and returning this statement by email: dbrown@uecllc.com or fax to (205) 951-3839.

Contractor: _____

Received by: _____

Date: _____



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City of Columbiana
107 Mildred Street
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**RE: ADDENDUM NO. 1
 CITY OF COLUMBIANA
 WWTP UPGRADES
 CWSRF PROJECT NO. CS010923-01
 CONTRACT NO. CO22 093**

The changes, modifications and/or additions covered by the set forth in this Addendum No. 1 shall become part of and be incorporated in the Specifications, Contract Documents and Bid Documents for the above referenced Project.

CLARIFICATION

- Time of Construction shall be 630 days.
- Section 00520 Agreement Part 4.02.A Number of days shall be 630 days substantially complete and 660 days for final payment.
- All buried fittings to be restrained joint, pipe can be push on pipe.
- PVC C900 piping to use DI restrained joint fittings.
- Sheet 4,6 show existing pipe conditions, sheet 18 shows the new 8” pipe to replace the existing 3” and 4” force mains.
- The PVC water lines shall b meet section 15050.2.2.B specifications.
- Plug valves are 100% port.
- Transition couplings shall be Romac 501 or equivalent.
- Air line gaskets to be Fluoroelastomer Fluorel Viton®³ . Gaskets for all other uses shall be EPDM.
- Underground pipe shall use fasttite type gaskets and fittings shall be T-head bolts.
- Alabama Power Cost will be taken out of the \$100,000.00 electrical modifications.
- All gate operators to be NEMA 4 weatherproof except the four located at the bottom of the bar screen they shall be NEMA 7

CONTRACT AND SPECIFICATIONS

- The attached **Section 00410** shall be replaced with the attached 004100 Addendum #1.
- The attached **Section 09900 Painting Addendum #1** shall be made part of the City of Columbiana WWTP Upgrades Contract Documents and Specifications.
- **Section 11001 Aqua Guard** Part 1.1.A the correct model number should be AGUC-MN.
- The attached **Section 11283 Fabricated Gates Addendum # 1** shall be made part of the City of Columbiana WWTP Upgrades Contract Documents and Specifications.
- The attached **Section 11601 HVAC Addendum #1** shall be made part of the City of Columbiana WWTP Upgrades Contract Documents and Specifications.
- The attached **Section 16624** shall be replaced with the attached 11624 Addendum #1.
- Delete the Building Wage Rate, it does not apply to this project.

PLANS

- Sheet 31 Extend divider wall between clarifier #1 & #2 to the aeration basin from the WAS box. The WAS line and scum line shall be 4"
- Sheet 32 Extend divider wall between clarifier #3 & #4 to the aeration basin from the WAS box. The WAS line and scum line shall be 4" diameter.
- Sheet 34 The WAS line and scum line shall be 4".
- Sheet 21 The 8" PVC line shall be C900 PVC
- Sheet 27 The 12" force main shall be DI pipe.
- Sheet 22 the 12" cap tapped for 4" pipe shall be changed to a 12" x 4" reducer.
- Sheet 41 Minisplit unit shall be added to the drawing.
- Sheet 46 all structural shown shall have #5 bars @ 8" o.c.w.e.f.
- Sheet 67 There shall be a Hydrolink Enclosure added next to bar screen control panel. All shielded cables shown shall land in the Hydrolink panel, also a circuit from the receptacles shall be linked to this panel.
- Sheet 68 There shall be a Hydrolink Enclosure added next to each pump control panel control panel. All shielded cables shown shall land in the Hydrolink panel, also a circuit from the receptacles shall be linked to this panel.
- Sheet 69 There shall be a Hydrolink Enclosure added next to grit removal control panel. All shielded cables shown shall land in the Hydrolink panel, also a circuit from the receptacles shall be linked to this panel.

- Sheet 72 There shall be a Hydrolink Enclosure added next to UV control panel. All shielded cables shown shall land in the Hydrolink panel, also a circuit from the receptacles shall be linked to this panel.
- Sheet 74 There shall be a Hydrolink Enclosure added next to septage receiving control panel. All shielded cables shown shall land in the Hydrolink panel, also a circuit from the receptacles shall be linked to this panel.
- Sheet 75 There shall be a Hydrolink Enclosure added next to Parkson control panel. All shielded cables shown shall land in the Hydrolink panel, also a circuit from the receptacles shall be linked to this panel.
- Sheet 75 There should be 13 type "B" fixtures.
- Sheet 75 all three 480V to 120/208V transformers should be 45kVA rated.
- Sheet 75 Minisplit shall be added to the drawing, service shall be 208 volt, single phase, 60 hz for indoor and outdoor units. Service is 30 amp, with #10 wiring.
- Sheet 79 all three 480V to 120/208V transformers should be 45kVA rated.

This Addendum No. 1 shall be made a part of your set of Construction Contract Documents and Specifications. Acknowledgment of receipt of Addendum No. 1 shall be noted in the Bid for Unit Price Contracts Section of this contract.

Sincerely,

UTILITY ENGINEERING CONSULTANTS, LLC



Dave Bechtel, P. E.

DB/djb

Attached: Section 00410
 Section 09900
 Section 11283
 Section 11601
 Section 16624

ADDENDUM NO 1
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SECTION 09900

PAINTING

PART 1 - GENERAL

PART 1 - 1 SECTION INCLUDES

Surface preparation and field application of paints and coatings.

PART 1 - 2 RELATED SECTIONS

- A. Section 15190 - Mechanical Identification.
- B. Section 16195 - Electrical Identification.

PART 1 - 3 REFERENCES

- A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. AWWA (American Water Works Association) - D102 - Painting Steel Water Storage Tanks.
- D. NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.
- E. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

PART 1 - 4 DEFINITIONS

Conform to ASTM D16 for interpretation of terms used in this Section.

PART 1 - 5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on all finishing products.
- C. Samples: Submit two samples, 2 x 2 inches in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Samples: Submit two samples, 2 x 2 inches in size illustrating selected colors and textures for each color selected.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention.

PART 1 - 6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience approved by manufacturer.
- B. Applicator: Company specializing in performing the work of this section with minimum 5 years documented experience waste coating.

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- C. Per Addendum No. 4, October 14, 2016 Part 1.6.C shall be added:
Building design shall be based on an essential design. Gauge shall be 24 gauge.

PART 1 - 7 REGULATORY REQUIREMENTS

Conform to applicable code for flame and smoke rating requirements for finishes.

PART 1 - 8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

PART 1 - 9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 1 - 10 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Provide 2 gallons of each color, type, and surface texture to Owner.
- C. Label each container with color, type, texture, room locations, and building in addition to the manufacturer's label.

PART 2 - PRODUCTS

PART 2 - 1 MANUFACTURERS

- A. Manufacturers - Paint
 - 1. **Tnemec Company, Inc.)**
 - 2. Or Equal

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- B. Manufacturers - Primer Sealers
 - 1. **Tnemec Company, Inc.)**
 - 2. Or Equal

- C. Manufacturers - Block Filler
 - 1. **Tnemec Company, Inc.)**
 - 2. Or Equal

- D. Manufacturers - Field Catalyzed Coatings
 - 1. **Tnemec Company, Inc.)**
 - 2. Or Equal

PART 2 - 2 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

- C. Patching Materials: Latex filler.

- D. Fastener Head Cover Materials: Latex filler

PART 2 - 3 FINISHES

Refer to schedule at end of section for surface finish schedule.

PART 3 - EXECUTION

PART 3 - 1 EXAMINATION

- A. Verify site conditions under provisions of Section 01039.

- B. Verify that surfaces & substrate conditions are ready to receive work as instructed by the product manufacturer.

- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

- D. Test shop applied primer for compatibility with subsequent cover materials.

- E. Measure moisture content of surfaces as recommended by the coatings manufacturer. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: As recommended by manufacturer.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: As recommended by manufacturer.
 - 3. Interior Wood: As recommended by manufacturer.
 - 4. Exterior Wood: As recommended by manufacturer.
 - 5. Concrete Floors: 3 lbs per 1,000 square feet (ASTM F 1869) or as directed by the manufacturer.

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PART 3 - 2 PREPARATION

- A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.
- C. Seal with shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Uniformly profile surfaces by abrasive blasting, sanding or other suitable means which will provide a 1.0 mil anchor profile.
- F. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- G. Concrete Floors: Allow new concrete surfaces to cure a minimum of 28 days. Verify dryness by testing for moisture with the "plastic film tape down test (ASTM D 4263)". Should moisture be detected perform "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride (Reference ASTM F 1869)". Moisture content not to exceed that as recommended by the manufacturer. Abrasive blast or mechanically abrade all surfaces to remove sealers, hardeners, coatings, as well as any other foreign matter (reference SSPC-SP 13 ICRI CSP 1 -9).
- H. Copper Surfaces Scheduled for a Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Scarify the surface to provide a uniform 1.0 mil anchor pattern.
- I. Copper Surfaces Scheduled for a Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.
- J. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- K. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Abrasive blast to remove all contamination, passivation and to provide a uniform profile of at least 1.0 mil.
- L. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- M. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- N. Shop Primed Steel Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Abrasive blast in accordance with SSPC-SP 10 Near White Blast Cleaning. Surface Profile shall be as specified for the coating system to be applied. All surface shall be coated prior to the formation of rust and no later than eight hours after surface preparation. Areas damaged during erection or field installation shall be repaired by abrasive blasting in accordance with SSPC-SP 10 Near White Blast Cleaning and spot priming with the primer specified in the appropriate Section.

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- O. Field Primed Steel Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Abrasive blast in accordance with SSPC-SP 10 Near White Blast Cleaning. Surface Profile shall be as specified for the coating system to be applied. All surface shall be coated prior to the formation of rust and no later than eight hours after surface preparation.
- P. Interior Wood Items Scheduled to Receive Paint Finish: Sand to a smooth finish. Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- Q. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- R. Exterior Wood Scheduled to Receive Paint Finish: Sand to a smooth finish. Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied.
- S. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied.
- T. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- U. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

PART 3 - 3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand wood and metal lightly between coats to achieve required finish.
- F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- G. Allow applied coat to dry before next coat is applied.
- H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface
- I.
- J. Prime concealed surfaces of interior and exterior woodwork with primer paint.
- K. Prime concealed surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

PART 3 - 4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Section 15190 and Section 16195 for schedule of color coding and identification banding of

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- equipment, duct work, piping, and conduit.
- B. Paint shop primed equipment. Paint shop prefinished items occurring at interior areas.
 - C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports except where items are refinished.
 - E. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers and grilles to match face panels.
 - F. Paint exposed conduit and electrical equipment occurring in finished areas.
 - G. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - H. Color code equipment, piping, conduit, and exposed duct work in accordance with owner's existing paint scheme. Color band and identify with flow arrows, names and numbering.
 - I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

PART 3 - 5 FIELD QUALITY CONTROL

Field inspection and testing will be performed under provisions of Section 01400.

PART 3 - 6 CLEANING

- A. Clean work under provisions of 01700.
- B. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

PART 3 - 7 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Metal Fabrications - Section 05500: Exposed surfaces of lintels, elevator pit ladders.
- B. Metal Stairs - Section 05510: Exposed surfaces of stringers, exposed vertical risers.

PART 3 - 8 PAINTING SCHEDULE

A. STEEL

1. Immersion, Potable or Non-Potable Water:

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast Near-White (SP10)	Primer	Series 91 H20 Hydro-Zinc or Equal	1 Coat, 2.5 – 3.5 mils
	Stripe	Series N140-1255 Pota-Pox Plus or Equal	1 Coat, 2.0 – 4.0 mils
	Intermediate	Series 21-1255 Epoxoline	1 Coat, 4.0 – 6.0 mil
	Finish	Series 21-WH16 Epoxoline Epoxoline or Equal	1 Coat, 10.0 to 12.0 mils

2. Immersion – Domestic Sewage:

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast Near White (SP 10)	Primer	Series 1 Omnithane or Equal	1 Coat, 2.5 to 3.5 mils
	Stripe	Series 66 Epoxoline (Brush Applied) or Equal	1 Coat, 2.0 – 4.0 mils
	Intermediate	Series 66 Epoxoline or Equal	1 Coat, 4.0 – 6.0 mils
	Finish	Series 142 Epoxoline or Equal	1Coat, 10 to 12 mils

3. Exterior, Non-immersion – Mildly Corrosive Atmosphere

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast (SP10)	Primer	Series 91 H20 Hydro-Zinc	1 Coat, 2.5 to 3.5 mils
	Intermediate	Series 66 Epoxoline	1 Coat, 3.0 to 5.0 mils
	Finish	Series 1094 Endura-Shield	1 Coat, 3.0 to 5.0 mils

4. Interior, Non-immersion:

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast (SP10)	Primer	Series 91 H20 Hydro-Zinc	1 Coat 2.5 to 3.5mils
	Intermediate	Series 66 Epoxoline	1 Coat, 3.0 – 5.0
	Finish	Series 1094 Endura-Shield	1 Coat, 3.0 to 5.0 mils

5. Immersion, Domestic Sewage – High levels of Hydrogen Sulfide:

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast (SP10)	Primer	Series 66 Epoxoline	1 Coat, 4.0 to 6.0 mils
	Stripe Coat	Series 66 Epoxoline (applied by brush)	1 Coat, 2.0 to 4.0 mils
	Finish	Series 435 Perma-Glaze	1 Coat, 20.0 to 30.0 mils

6. Miscellaneous Casting, Including Manhole Rings & Covers:

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast (SP10)	Prime & Finish	Series 46H-413 Tneme – Tar	2 Coats, 10.0 to 12.0 mils per coat

7. Metal Anchorage for Buried Piping:

Surface Prep.		Paint Material	Min. Coats, Cover
Clean & Dry or Power Tool (-SP3)	Prime & Finish	Series 46-465 Tnemecol	1 Coat, 8.0 to 12.0 mils per coat

8. Factory Primed:

Surface Prep.		Paint Material	Min. Coats, Cover
Clean & Dry	Primer	Series 135 Chembuild	1 Coat, 3.0 to 5.0 mils
	Finish	See topcoat exposure	See Exposure

B. STEEL PIPE

1. Exterior Pipe (Non-immersion):

Surface Prep.		Paint Material	Min. Coats, Cover
Clean & Dry	Primer	Series 91 H20 Hydro-Zinc`	1 Coat, 2.5 to 3.5 mils
	Stripe	Series 66 Epoxoline (Brush Applied)	1 Coat, 2.0 -4.0 mils
	Intermediate	Series 66 Epoxoline	1 Coat, 3.0 – 5.0 mils
	Finish	Series 1094 Endura-Shield	1 Coat, 3.0 to 5.0 mils

2. Immersion, Potable or Non-Potable Water:*

Surface Prep.		Paint Material	Min. Coats, Cover
Abrasive or Centrifugal Wheel Blast Near-White (-SP10)	Primer	Series 91 H20 Hydro-Zinc	1 Coat, 2.5 to 3.5 mils
	Stripe	Series N140-1255 Pota-Pox Plus (Brush Applied)	1 Coat, 2.0 – 4.0 mils
	Intermediate	Series 21-1255 Epoxoline	1 Coat, 4.0 – 6.0 mils
	Finish	Series 21-WH16 Epoxoline*	1 Coat, 10.0 to 12.0 mils

* Use Series 142 Epoxoline for Non-Potable Water at same DFT

C. GALVANIZED STEEL PIPE & MISCELLANEOUS FABRICATIONS

1. Interior Mild to Moderate Atmosphere:

Surface Prep.		Paint Material	Min. Coats, Cover
Solvent Clean (SP1) Followed by abrasive blasting to remove contaminants and to provide uniform 1.0 mils profile	Primer	Series 66 Epoxoline	1 Coat, 2.0 to 3.0 mils
	Finish	Series 1094 Endura-Shield	1 Coat, 2.0 – 3.0 mils

2. Exterior Mild to Moderate Atmosphere (Non-immersion):

Surface Prep.		Paint Material	Min. Coats, Cover
Solvent Clean (SP1) Followed by abrasive blasting to remove contaminants and to provide uniform 1.0 mils profile	Primer	Series 66 Epoxoline	1 Coat, 2.0 to 3.0 mils
	Finish	Series 1094 Endura-Shield	1 Coat, 2.0 to 3.0 mils

3. Immersion, Potable or Non-Potable Water:

Surface Prep.		Paint Material	Min. Coats, Cover
Solvent Clean (SP1) Followed by abrasive blasting to remove contaminants and to provide uniform 1.0 mils profile	Primer	Series 21 Epoxoline	1 Coat, 4.0 to 6.0 mils
	Finish	Series 21 Epoxoline	1 Coat, 4.0 to 6.0 mils

* Use Series 66 Epoxoline for wastewater

4. Galvanized Metal Repair:

Surface Prep.		Paint Material	Min. Coats, Cover
Solvent Clean (SP1) Followed by Mechanical Cleaning (-SP11)	Primer & Finish	Series 90-97 Tneme-Zinc	1 Coat, 2.5 to 3.5 mils

D. CHAIN LINE FENCES

Surface Prep.		Paint Material	Min. Coats, Cover
Clean & Dry	Finish	Series 43-36 Aluminum	1 Coat, 2.0 to 3.0 mils

E. CONCRETE, DENSE MASONRY

1. Immersion - Domestic Sewage:

Surface Prep.		Paint Material	Min. Coats, Cover
SSPC-SP 13 (ICRI CSP 5)	Surfacer	Series N218 MortarClad	1/16" minimum. Fill all voids and seal surface
	Finish	Series 436 Perma-Shield PL	1 Coat, 80.0 to 100.0 mils

2. Immersion - Water:

Surface Prep.		Paint Material	Min. Coats, Cover
SSPC-SP 13 (ICRI CSP 5)	Primer	Series N218 MortarClad	1/16" minimum. Fill all voids and seal surface
	Finish	Series 22 Epoxoline	1 Coat, 30.0 to 40.0 mils

3. Chemical Resistant Secondary Containment:

Surface Prep.		Paint Material	Min. Coats, Cover
SSPC-SP 13 (ICRI CSP 5)	Base Coat	Series 239SC (MCK) (embed fiberglass matt while material is still wet and rib roll)	1 Coat, 60 – 80 square feet per gallon
	Saturante	Series 239SC (RCK)Chembloc	1 Coat, 10.0 to 12.0 mils
	Finish	Series 239SC (RCK)Chembloc	1 Coat, 10.0 to 12.0 mils

4. Chemical-Resistant Wall, Heavy Duty-CMU:

Surface Prep.		Paint Material	Min. Coats, Cover
Per manufacturer's instructions	Primer	Series 130 Envirofill Masonry Filler (Sprayed or rolled then squeegee)	1 Coat, 60 to 80 sq. Ft./gal
	Finish	Series 282 Tneme-Glaze	2 Coats, 8.0 to 12.0 mils per coat

5. Exterior - Non-immersion:

Surface Prep.		Paint Material	Min. Coats, Cover
Dry & Clean / Rubbed finish free of bugholes and imperfections	Primer	Series 156 Enviro-Crete	1 Coat, 4.0 to 6.0 mils
	Finish	Series 156 Enviro-Crete	1 Coat, 4.0 to 6.0 mil

* Series 156 is a Flat, Smooth Finish; Series 157 a Flat, textured Finish

6. Exterior CMU

Surface Prep.		Paint Material	Min. Coats, Cover
Dry & Clean	Block Filler	Series 130 Envirofill	1 Coat, 60 to 80 square feet per gallon
	Finish	Series 156 Enviro-Crete	2 Coats, 4.0 to 6.0 mils per coat

F. CONCRETE FLOORS

1. Decorative

Surface Prep.		Paint Material	Min. Coats, Cover
Blastrac or Brush Blast (ICRI CSP 4 – 5)	Base Coat	Series 241 Ultra-Tread MTV (Broadcast to refusal with selected quartz)	1/16” Nominal
	1st Coat	Series 222 – Deco Tread (Broadcast to refusal with selected quartz)	20 mils
	Grout Coat	Series 222 Deco-Tread	8.0 to 10.0 mils
	Finish	Series 248 Everthane	2.0 to 3.0 mils

2. Pipe Gallery, Mechanical Rooms and Hallway

Surface Prep.		Paint Material	Min. Coats, Cover
Mechanically abrade (ICRI CSP 2 – 3)	Primer	Series 237 Power-Tread	6.0 - 8.0 mils
	Intermediate	Series 237 Power-Tread	6.0 – 8.0 mils
	Finish	Series 248 Everthane	2.0 -3.0 mils

G. CONCRETE STRUCTURES:

1. Below Grade:

Surface Prep.		Paint Material	Min. Coats, Cover
Brush Blast to Roughen Substrate and to Open Bugholes	1st Coat	Xypex Concentrate	1/16”
	2nd Coat	Xypex Mega-Mix I	1/8” minimum

H. PLASTER & WALLBOARD (GYPSUM BOARD)

Surface Prep.		Paint Material	Min. Coats, Cover
Dry & Clean	Primer	51 PVA Sealer	1 Coat, 1.0-2.0 mils
	Finish	Series 1026 Enduratone	2 Coats, 2.0-3.0 mils per coat

I. WOOD

1. Interior or Exterior:

Surface Prep.		Paint Material	Min. Coats, Cover
Dry & Clean	Primer	Series 10-99 W Tnemec Primer	1 Coat, 2.0 to 3.5 mils
	Finish	Series 1029 Enduratone	2 Coats, 2.0 to 3.0 per coat

J. INSULATED PIPE

1. Interior:

Surface Prep.		Paint Material	Min. Coats, Cover
Clean & Dry	Primer & Finish	Series 1026 Enduratone	2 Coats, 2.0 to 3.0 mils per coat

K. PVC PIPE

1. Interior and Exterior Fiberglass, PVC:

Surface Prep.		Paint Material	Min. Coats, Cover
Roughen by sanding or Brush Blasting	Prime	Series 66 Hi-Build Epoxoline	1 coat, 2.0 to 3.0 mils
	Finish	Series 1095 Endura-Shield	1 Coat, 2.0 to 3.0 mils

L. DUCTILE & CAST IRON

1. Interior-(O.D.):

Surface Prep.		Paint Material	Min. Coats, Cover
Solvent Clean (SP1) Followed by Abrasive blasting per NAPF Exterior Standard	Primer	Series N140-1211 Pota-Pox Plus	1 Coat, 6.0 to 8.0 mils
	Intermediate	Series 66 Epoxoline	1 Coat, 3.0 – 5.0 mils
	Finish	Series 1094 Endura-Shield	1 Coat, 3.0 – 5.0 mils

2. Exterior Exposed-(O.D.):

Surface Prep.		Paint Material	Min. Coats, Cover
Solvent Clean (SP1) Followed by Abrasive blasting per NAPF Exterior Standard	Primer	Series N140-1211 Pota-Pox Plus	1 Coat, 6.0 to 8.0 mils
	Intermediate	Series 66 Epoxoline	1 Coat, 3.0 – 5.0 mils
	Finish	Series 1094 Endura-Shield	1 Coat, 3.0 – 5.0 mils

PART 3 - 9 COLOR CODE FOR PROCESSING EQUIPMENT

- A. Prior to beginning of work verify color for new equipment with Owner.
- B. Systems - OSHA - Where Applicable on this Project.

Application	Generic Color	Color Identification
Water		
Raw Water	olive green	110GN Clover
Flocculated or Filtered	aqua	10GN Aqua Sky
Finished or Potable Water	dark blue	11SFSafety Blue
Waste Water		
Backwash Waste	light brown	68BR Twine
Sewage Plant Effluent (N/A)	clay**	21BR Earthenware
Sludge	dark brown	84BR Weathered Bark
Sewer (Sanitary or Other)	dark gray	34GR Deep Space
Chemical		
Alum or Primary Coagulant	orange	04SF Safety Orange
Caustic	green	09SF Safety Green band 06SF Safety Red band
Chlorine (Gas & Solution)	yellow with red band	02SF Safety Yellow
Fluoride	light blue with red band	25BL Fontainebleau with 06SF Safety Red Band
Potassium Permanganate	violet	14SF Safety Purple
Soda Ash	light green with orange band	37GN Irish Spring with 04SF Safety Orange band
Sulfuric Acid	yellow with red band	02SF Safety Yellow with 06SF Safety Red band
Sulfur Dioxide	light green with yellow band	37GN Irish Spring with 02SF Safety Yellow Band
Other		
Compressed Air	dark green	91GN Balsam
Gas	yellow	02SF Safety Yellow
Other Lines	light gray	32GR Light Gray
Hoists/Trolleys	yellow**	02FS Safety Yellow
Fire Protection	red**	06SF Safety Red

*These colors are in accordance with the Recommended Standards for Water Works.

ADDENDUM NO. 1

SECTION 11283

FABRICATED GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabricated Sluice Gates
- B. Operators
- C. Controls
- D. Appurtenances

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 03300 - Concrete: Grouting, reinforcing
- B. Section 15050 Piping: Pipe and Fittings

1.3 RELATED SECTIONS

- A. Section 15050 - Piping
- B. Section 15100 - Valves
- C. Division 16 - Electrical

1.4 SUMMARY

- A. Stainless steel sluice gates shall be rising stem, self-contained, or separate lift as indicated on the Drawings and specified in the Specifications.
 - 1. Gates shall be supplied with accessories, including lift and lift stem, extension stem, stem guide, stem covers, wall thimbles, brackets, and stop nuts.
 - 2. All fabricated gates supplied shall be of a single type and manufacturer.
 - 3. Fabricated gates designed for locations specified in the Gate Schedule.
 - 4. Sluice gates and accessories shall operate satisfactory under the conditions of installation, including operating frequency ranging from twice daily to period of prolonged idleness.
 - 5. The manufacturer shall certify inspection and acceptance of the gate installation and guarantee trouble-free operation for a period of two years when the gate is operated as recommended by the manufacturer written instructions.
- B. The manufacturer shall guarantee the following:
 - 1. Leakage shall be no more than that allowed by these Specifications.
 - 2. Slide and sealing system shall be free of sticking or binding during routine operation and after periods of prolonged idleness.
 - 3. A design safety factor of 5, on tensile, compression and shear based on AWWA C-201 standard.

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1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate dimensions, weights, and placement of anchor bolts.
- C. Product Data: Provide component sizes, rough-in requirements and installation requirements.
- D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Record actual locations of equipment and controls.
- C. The gate numbers as indicated on the Plans and in the gate schedule shall have corresponding material certifications that will be supplied and included in the O & M manual for this project.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Operation Data: Indicate frequency of lubrication and maintenance required.
- C. Maintenance Data: Include installation instructions, spare parts lists, lubrication to be used, and exploded assembly views.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Load and unload all gates, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Use sling, hooks, and pipe tongs in such a manner to prevent damage to products.
- C. Keep stored products safe from damage or deterioration. Keep the interior of gates, operators, and appurtenances free from dirt or foreign matter. Store gates in a manner that will protect gates from damage.
- D. Store gates, operators and appurtenances in accordance with manufacturer's recommendations.
- E. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

1.9 QUALITY ASSURANCE

- A. Manufacturer shall have experience in production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 25 installations, for a minimum of 10 years operation.

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- B. Manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirement of ANSI/AWS DI.1 of ASME Boiler and Pressure Vessel Code Section 9.
- C. Assembled gates shall be shop inspected and adjusted before shipping.
 - 1. There shall be no assembling nor adjusting required on jobsite except for the lifting mechanism.
- D. Quality Assurance
 - 1. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - a. ASTM A276, stainless and heat-resisting steel bars and shapes.
 - b. ASTM A480, stainless steel plate, sheet, and strip.
 - c. ASTM B584, copper alloy and sand castings for general application.
 - d. ASTM D4020, U.H.M.W. polyethylene molding and extrusion material.
 - e. ASTM D2000, standard classification system for rubber products in automotive applications.
 - f. ASTM B26, aluminum alloy sand castings.
- E. Leakage test report from the factory shall be supplied & approved before shipping. The leakage test data shall be furnished for one gate of each size.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All gates, operators and appurtenances shall be as shown on the drawings and specified in this section. All gates, operators and appurtenances shall be new and unused.
- B. The manufacturer is reminded that this job has a 1,000 day time of completion and that the scheduled equipment deliveries shall be coordinated with the Contractor. Prior to delivery of any equipment the manufacturer shall submit recommended storage requirements to the Engineer and Owner.
- C. Manufacturer shall be H. Fontaine, Ltd., Whipps, Rodney Hunt, and Waterman for fabricated gates with seating/unseating heads. **(Per Addendum No.1, 9/21/16 Golden Harvest shall be added as an approved manufacturer.) (Per Addendum No.2, 9/27/16 RW Gate and OBRINOX shall be added as acceptable manufacturers.)**

2.2 MATERIAL

- A. Wall thimble, gate frame, yoke, slide, side guides, and reinforcing.
Member's: Stainless steel, ASTM A-276 Type 316 or 304L.
- B. Stem: Stainless steel, ASTM A-276 Type 316 or 303 MX.
- C. Fasteners: Stainless steel, ASTM A-276 Type 316 or 304L.
- D. Stem guides liner. True Ultra High Molecular Weight Polyethylene (UHMWPE) ASTM-D-4020-96
- E. Side and top seals: True, Ultra high molecular weight polyethylene (UHMWPE) ASTM-D-4020-96 and be self-adjusting type. Mechanical seals are not acceptable.
- F. UHMWP clad neoprene seals are an acceptable alternative to UHMWP.

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- G. Bottom seal: Neoprene ASTM D-2000 Grade 2 BC 510.
- H. Lift nut: Manganese bronze ASTM B584 Alloy 432.

2.3 DESIGN REQUIREMENTS

- A. Gates shall be either self-contained or non self-contained of the rising stem type, as indicated on the Drawings. A design safety factor of 5, on tensile, compression and shear is required.
- B. Wall Thimble
 - 1. Wall thimble shall be fabricated 316L or 304L stainless steel of sufficient section to resist permanent distortion and shall be provided by the gate manufacturer.
 - 2. Wall thimbles shall be of F-section, as scheduled or indicated on the Drawings, and of a depth equal to the thickness of the structure wall upon which the gate is mounted, as indicated on the Drawings.
 - a. Joint between thimble and gate shall be sealed watertight, in accordance with AWWA C501.
- C. Frame
 - 1. Gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame, Flange Back design.
Flat Back design is not allowed. A safety factor 5, in tensile, compression and shear per AWWA C-501 must be followed in design and manufacturing.
 - 2. Frame for wall-mounted gates shall be of the Flange Back design and allow mounting without a box-out into the concrete opening.
 - 3. Frames of self-contained gates, with operator installed, shall have sufficient section strength to resist seismic and wind loading without need for external bracing.
 - 4. Guide slot shall be of ultra high molecular weight polyethylene (UHMWPE) and engage the slide plate a minimum of one inch.
 - 5. Frame configuration shall be of the type indicated in the schedule and shall allow replacement of top and side seals without removing the gate frame from concrete or wall thimble.
 - 6. Minimum material thickness shall be $\frac{3}{8}$ ".
 - 7. 15' x 15' gates - 1.50" thick mounting front flange after finish machining.
 - $\frac{1}{2}$ " thickness for the body of the thimble.
 - 8. Gates less than or equal to 12' x 12' - 1" thick mounting front flange after finished machining.
 - $\frac{3}{8}$ " thickness for the body of the thimble.
 - 9. The front flange shall be machined.
- D. Slide
 - 1. Slide shall consist of a flat plate reinforced with formed plates or structural members that shall limit its deflection to 1/720 of the span of the gate when under the design head.
 - 2. Slide shall have a minimum material thickness of $\frac{3}{8}$ ".
- E. Guides and Seals:
 - 1. Guides shall be made of ultra high molecular weight polyethylene (UHMWPE) and shall be of such length as to retain and support at least two thirds of the vertical heights of the slide in the full open position.
 - 2. Sides and top seals shall not be in contact with the environment and made of True, Ultra High Molecular Weight Polyethylene (UHMWPE), (ASTM-D-4020-96) self adjusting type and shall maintain an efficient sealing in any position of the slide. Mechanical type seals are not acceptable.
 - 3. Seals shall maintain the specified leakage rate in both seating and unseating conditions. Sealing system shall be integrated in the guides and shall not interfere with water flow.

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4. The bottom seal for flush bottom type gates shall be resilient neoprene attached to the bottom member of the frame and shall form a flush bottom.
 5. The bottom seal for downward opening gates shall be as in 2. above.
- F. Yoke
1. Self-contained gates shall be provided with a yoke made of structural members or formed plates.
 - a. Construction shall be such as to limit deflection to $1/360$ of the span of the gate.
 - b. The yoke arrangement shall allow the removal of the slide without the removal of the yoke.
 - c. Yoke design shall meet the requirements specified for the frame in D.4. above.
- G. Stems
- The operating stem will be a minimum 2" diameter and sized to safely withstand, in tension, a 200-lb. effort on the crank or handwheel, or a 250 ft. lb. effort on a wrench nut. In addition, the stem will be designed to withstand, in compression, without buckling, at least $2\frac{1}{2}$ times the rated output of the floorstand or bench-stand with a 40 lb. effort on the crank or handwheel, or a 100 ft. lb. torque on the wrench nut. Critical buckling load shall be determined using the Euler column formula with $C=2$. Where electrically driven actuators are used, the stem will withstand, in compression, not less than 1.25 times the output thrust of the actuator with the electric motor in the stalled condition. The threaded portion of the stem will have machine cut threads of the 29° Acme type. Stems of more than one section will be joined by stainless steel couplings, threaded and keyed to the stems and should be of greater strength than the stem. All couplings of the same size will be interchangeable. Manually operated rising stem gates will be provided with an adjustable stop collar on the stem above the floorstand lift unit.
- H. Stem Guides
- Stem guides will be UHMWPE bushing, mounted on stainless steel (type 304L or 316L) brackets. They will be adjustable in two directions and will be spaced at sufficient intervals to adequately support the stem. Stem guide spacing will not exceed an L/R ratio of 200.
- I. Manually Operated Floorstands or Benchstands
- Manual operation will be by handwheel or crank operated floorstand or benchstand as indicated on the plans and specified in the gate schedule. Handwheel operated type will be without gear reduction and crank operated type will have either single or double gear reduction depending upon the lifting capacity required. Each type will be provided with a threaded cast bronze lift nut to engage the operating stem. Ball or roller bearings will be provided above and below a flange on the operating nut to support both opening and closing thrusts. Floorstands or benchstands will operate the gates under the specified operating head with not greater than a 40 lb. pull on the crank or handwheel. Gears, where required, will be steel with machine-cut teeth designed for smooth operation. The stainless steel pinion shafts on crank operated floorstands, whether single or double ratio, shall be supported on tapered roller bearings or needle bearings. All components will be totally enclosed in a cast iron case and cover. Positive mechanical seals will be provided on the operating nut and the pinion shaft to exclude moisture and dirt and prevent leakage of lubricant out of the hoist. Lubricating fittings will be provided for the lubrication of all gears and bearings. Removable handwheel or crank will be designed for rough treatment and minimum weight. Floorstands will include a high strength steel pedestal designed to position the input shaft or handwheel approximately 36" above the operating floor. Benchstands will be provided with a rectangular cast iron base machined and drilled for mounting purposes. An arrow with the word "open" will be permanently attached or cast on the floorstand, benchstand or handwheel indicating the direction of rotation to open the gate.
- J. Thrust Nut
- Each gate shall be provided with a thrust nut for connecting the stem to the slide. It shall be of ample design to take the thrust developed during gate operation under the maximum operating head condition loads with a safety factor of five, in opening and closing direction. The thrust nut and slide shall be constructed to prevent turning of the thrust nut in the pocket in the slide. On rising-stem gates, the

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thrust nut shall be tapped, threaded and bolted to the stem. On nonrising stem gates, the thrust nut shall be threaded but not keyed or pinned to the stem, so that the nut and slide can move up and down the stem, as the stem turns. The thrust nut shall be as shown on the drawings.

K. Bolts, Nuts, and Fittings

Machine bolts, cap screws, and fittings for the gate proper and for the stem guides shall be stainless steel (type 304L or 316L).

L. Anchor Bolts

1. Anchor bolts and nuts not provided by the gate manufacture for the gate installation shall be of adhesive type and shall be of sufficient quantity and length to anchor the unit.

2.4 MANUAL OPERATORS

- A. Manual operators shall have crank-operated with either single or double gear type. Maximum force required to open or close the gate shall be 100-ft.-lbs. on the crank handle.
1. All gears and bearings shall be enclosed in housing. Fittings shall be provided so that all gears and bearings can be lubricated.
 2. Operators shall be equipped with pedestal, machined and drilled to receive the gear housing.
 3. Operator shall be geared to permit the slide operation with maximum force of 50 ft.-lbs. on the crank handle after slide is unseated.
 4. Operators shall be equipped with 1-3/4 inch standard nut assemble to be operated by portable motor apparatus.
 5. Crank handle shall be removable with maximum swing of 15 inches.
 6. Operators shall be equipped with galvanized stem cover with manual indicator on the rising stem.
 7. Crank handle shall be removable with 1-3/4 inch socket designed to fit a standard 1-3/4 inch nut.

2.5 FABRICATION

- A. Gate and wall thimble shall be (Crushed Glass) blasted after fabrication to remove weld splatter and to polish scratches.
- B. Blasting shall clean the entire surface and produce an even color and sheen.

2.6 FIELD QUALITY CONTROL

- A. Following the completion of each gate installation and checking by Contractor, each gate shall be operated through at least two complete open-close cycles by Contractor.
- B. Gates shall be leakage tested by the Contractor under supervision from the Supplier.
1. Under the design of 30 feet seating head, the leakage shall not exceed 0.05 gallons per minute per foot of seating perimeter.
 2. Under the design unseating head, the leakage shall not exceed 0.10 gallons per minute per foot of seating perimeter.
 3. Manufacturer shall certify in writing that the field leakage test does not exceed the specified leakage rate.

2.7 POWER OPERATORS

A. General

Electric actuator shall include the electric motor, reduction gearing, valve stem drive nut/bushing, position limit switches, mechanical overload torque switches, ductile iron gear case and automatic declutchable handwheel.

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- B. Gears
Motor speed reduction shall be by means of a gear train consisting of hardened steel spur gears and self-locking worm and worm gear set. The worm shall be heat treated alloy steel and have worm thread surface rolled or ground. The worm gear shall be bronze. Non-metallic gears in the power train are not acceptable.
- C. Rotating Components
All gearing and shafting shall be supported on anti-friction bearings. All thrust components shall be supported by use of tapered roller bearings.
- D. Handwheel Drive
The actuator shall be furnished with a handwheel located in a 90 degree plane from the actuator output drive, with a maximum rim pull requirement of 60 pounds for valve travel loads. An external manual declutch lever shall be included to place actuator in the manual mode. The lever shall not require more than a 10 pound force to engage even when the valve has been tightly seated. The lever is to be padlockable in either handwheel or motor mode. Operation by motor shall not cause the handwheel to rotate, or operation of the handwheel shall not cause the motor to rotate. Handwheel shall operate in the clockwise direction to close.
- E. Lubrication
All gearing and bearings shall be grease lubricated and suitable for year-round service based on prevailing ambient temperature conditions.
- F. Electric Motors
Electric motors shall be specifically designed for valve actuator service, and be totally enclosed, non-ventilated. The enclosure shall meet NEMA 4 (weatherproof), NEMA 6 (Submersible), or NEMA 7 (explosion-proof), as required for the project. Motor shall be capable of operation under maximum specified loads when voltage to the motor is $\pm 10\%$ of the nominal voltage. Motor shall have Class F insulation with thermal overload sensors imbedded in the motor windings.
- G. Limit Switches
Limit switches shall be geared to the drive mechanism and in step with actual valve position at all times, whether operation is by power or manual mode. Switches shall be activated by a rotor type design. Contacts shall be silver and have a rating of 10 amps at 120 VAC. A minimum of three (3) N.O. and three (3) N.C. contacts shall be provided for each direction of travel. The limit switch gear mechanism shall be enclosed to prevent entrance of foreign matter or wire entanglement. Use of cams or screws to set switches or designs requiring battery aback-up methods to ensure position control in the event of a power failure, are unacceptable.
- H. Torque Switches
The actuator shall include an adjustable torque switch to interrupt the motor power circuit when an obstruction is encountered in either direction of travel or when torque seating of valves is required for tight shut off. The torque switch shall have a calibrated dial for adjustment and have means to ensure maximum actuator rating is not exceeded. Contacts shall be same construction and rating as limit switch. Mechanical torque springs for load control shall be field replaceable without need of actuator dismantling or removal of the worm assembly.
- I. Position Indication
Local position indication for quarter valves shall be by indicator dial located on the gear operator and graduated in 25 percent increments. For rising stem multi-turn actuators a dial window indicator shall be located on the limit switch compartment cover and labeled 0 to 100% open and graduated in 5 percent increments. If remote position indication is specified, this shall be by means of a 1000 ohm potentiometer in step with valve position at all times whether operation is electrical or manual.

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J. Electrical Controls

As a minimum, the actuator shall be furnished with power and control terminal strips, space heater (25 watt), limit switches, torque switches, all housed in a control compartment meeting NEMA 4X (weatherproof) or as specified for the project. The rectangular enclosure shall have a bonded o-rig seal and a hinged cover. Cover bolting shall be captive stainless hex head screws.

1. When built-in controls are specified they shall be an integrated modular package, completely wired and be easily removable or replaceable, as a complete package, by removal of four (4) captive screws. Motor leads and power supply leads will be terminated to the terminal strips located on the modular package. Power supply terminals (5 points minimum) and control supply terminal (48 points minimum) shall be physically isolated from each other to protect against transient voltages. The terminal strips shall be completely shrouded with high impact resistant plastic to avoid accidental terminal contact by personnel. The module is to include a snubber circuit to provide control voltage protection for switches and electronic modules from voltage surges. All electrical components of the modular package, such as reversing contactor, transformer, etc., shall be unidirectional plug connected to provide easy removal and replacement without concerns for proper wiring connections. All optional control requirements such as modulating control, 2-wire control, interposing relays, etc. shall be plug-in printed circuit type boards having gold plated contact connectors. Unless otherwise specified, all PC boards must be temperature rated -40° to $+70^{\circ}\text{C}$. Ease of replacement or upgrading shall be of paramount consideration.

K. Open-close Service Controls shall include as a minimum: (refer to suggested Wiring Diagram M2CP-001).

1. Reversing Contactor

- a. Control voltage shall be 120 volts, 60 or 50 Hz.

- 1) N.O. Seal-in contacts for momentary contact pushbutton control and N.C. contacts for electrical interlock shall be supplied. When specified, additional auxiliary contacts (I N.O. and I N.C. for open and close coils) shall be supplied. The contactor shall be both electrically and mechanically interlocked. It shall be completely wired as an assembly and plug connected to the modular package.
- 2) Control Power Transformer
The transformer assembly shall provide 115, 18 and 12 Vac. It shall be epoxy impregnated and encapsulated to prevent moisture incursion and shall be completely wired as an assembly and plug connected to the modular package.
- 3) Pushbuttons
Each actuator shall be supplied with open-stop-close pushbuttons furnished integrally mounted. Pushbuttons shall be double o-ring sealed and include a protective silicon boot. Seal material shall be resistant to ozone and ultraviolet light. When integrally mounted pushbuttons are specified, the design shall permit operation of the button, when the electrical enclosure cover is open.
- 4) Indicating Lights
The actuator shall include a two (2) long life-high intensity LED type pilot lights to indicate open, closed and intermediate valve position (both lamps on). Red shall indicate valve open and green shall indicate valve closed. An additional LED pilot light shall be furnished to indicate power is on. A fourth LED pilot light shall be furnished to indicate torque switch trip.
- 5) Selector Switch
The actuator shall include a 3-position selector switch, for local (hand)-off-remote (auto) control. If specified the switch shall be padlockable in any position. A tumbler keylock option may be specified. Extra Switch contacts shall be available to provide remote indication of selector switch position.
- 6) Other Options (when specified), such as interposing relays, two wire control, positioning control, etc., shall be by means of plug-in type PC board modules designed for easy upgrading without need of changing existing equipment.

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- L. Positioning Control Service providing up to 600 starts per hour for 3 phase motors and up to 100 starts per hour for 1 phase motors with positioning accuracy to $\pm 1.0\%$ dependent on valve operating time, shall include, in addition to the Open-Close controls: (refer to suggested Wiring Diagram M2Cp-002).
1. Comparator Circuit
The comparator circuit shall be a solid state plug-in PC board to accept a 4-20mA input control signal from a position controller and have zero, span and deadband adjustments. The circuit shall provide, as standard, a 4-20mA output signal for remote position indications. Both input and output signals shall be optically isolated. The circuit shall include a jumper selectable setting to Remain-In-Last Position or Close on Loss of control signal. Failure of or removal of the positioning control card shall not prevent local pushbutton control of the actuator.
 2. Feedback Potentiometer
A valve position feedback potentiometer shall be included and shall be mechanically connected to the valve stem and in step with valve position at all times whether the unit is being operated electrically or by handwheel. The potentiometer shall be self-balancing upon setting of the actuators limit switch.
 3. Calibration of the Positioner
The Positioner shall be easily calibrated with the use of a volt meter. Special Signal generators shall not be required for calibration.
- M. Continuous Duty Modulation Service when specified, shall provide up to 1200 starts per hour for both 1 and 3 phase power. 1 phase service actuators shall utilize a 2100 rpm, DC current, Class H insulated motor. The DC motor voltage shall be rectified to 1 phase AC within the actuator control system. All reversing mechanisms shall be of the solid state type. 1 phase, units shall be EIM Futronic III and 3 phase units shall be EIM Futronic IV. 1 phase units shall be EIM Futronic III or Auma SAR Matic 9 (single phase), and 3 phase units Futronic IV or Auma SAR Matic S (three phase).
- N. General
All actuators on project shall be by the same manufacturer, for control circuit consistency, ease of maintenance and availability or stocking of spare or replacement parts.
- O. Acceptable Actuator manufacturers shall be limited to the following:
1. EIM Company, Missouri City, Texas Series 2000/M2CP.
Per Addendum No.2, 9/27/16 AUMA shall be added as an acceptable manufacturer.)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Erect sluice and stainless steel slide gates in accordance with the manufacturer's instructions.
- B. Erect structural aluminum items in accordance with the Aluminum Association Specifications.
- C. All field adjustment shall be in accordance with manufacturer's instructions.
- D. Where dissimilar metals are in contact, or when aluminum is in contact with concrete, mortar, masonry, or pressure treated wood, protect dissimilar surfaces as specified in section on Coating.
- E. Field assembly shall meet the following requirements:
 1. Frames and wall thimbles shall be accurately assembled to the lines and elevations indicated.
 2. The various members forming parts of a complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.

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- F. Wall thimbles shall be accurately positioned and supported to prevent shifting during placement of surrounding concrete. Square or rectangular thimbles shall be carefully braced both horizontally and vertically to prevent distortion.
- G. Each gate shall be carefully installed and adjusted for proper operation. Care shall be taken to avoid warping the gate frames and to maintain tolerances between seating faces.
- H. Each operator shall be accurately set and plumbed and shall be in proper alignment with the gate and stem before the operator is grouted in place. Operating stems shall be installed in proper alignment and shall not bind in the lift nut or stem guides.
- I. All bolts shall be tightened and all items requiring lubrication shall be lubricated.

3.2 CONSTRUCTION PROTECTION

The Contractor shall use all precautions necessary to protect finishes from scratches, nicks, gouges, dents, etc., during assembly and installation. Damaged material shall be replaced at no additional cost to the Owner.

3.3 FIELD PAINTING

- A. Abraded and corroded areas shall be cleaned and touched up with the same type of paint used in shop painting.
- B. Touch up galvanized surfaces with galvanized repair paint applied in accordance with these Specifications.

3.4 PRIME COAT TOUCHUP

Immediately after erection, areas where prime coat has been damaged shall be sanded smooth and touched up with same primer as applied at shop. Remove rust before above specified touchup is applied. Touchup shall not be obvious.

3.5 PROTECTION

Protect installed gates and frames against damage from other construction work.

3.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle gates, stems and frames in a manner to prevent damage and deterioration. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings to protect metal items.
- B. Store gates, stems and wall thimbles in a protected dry area, at least 1 inch off the ground or floor and at least ¼ inch between individual pieces. Follow special storage and handling requirements of manufacturer. Protect exposed finish surfaces of prefinished items with masking tape.

3.7 FIELD QUALITY CONTROL

- A. Following the completion of each gate installation and checking by Contractor, each gate shall be operated through at least two complete open-close cycles by Contractor.
- B. Gates shall be leakage tested by the Contractor.

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1. Under the design seating and unseating heads, the leakage shall not exceed 0.05 gallons per minute per foot of seating perimeter.
2. Under the design unseating head, the leakage shall not exceed 0.10 gallons per minute per foot of seating perimeter.
3. Manufacturer shall certify in writing that the field leakage test does not exceed the specified leakage rate.

3.8 SERVICE

- A. The Contractor will include in his Bid the services of the Equipment Manufacturer's field service technician for a period of five (5) trips and a total of ten (10) working days. This service will be for the purpose of acceptance testing, certification and instruction of plant personnel. The trips and days shall cover sluice gates, tilting weir gates, and slide gates.
- B. A written report covering the technician's findings and installation approval shall be submitted to the Engineer, covering the inspections and outlining in detail any deficiencies noted.

**SECTION 11601
HVAC MINI SPLIT**

PART 1 – GENERAL

1.01 SYSTEM DESCRIPTION

The single-zone mini-split heat pump system shall be the Lennox Mini-Split System. The system shall be capable of providing heating and cooling in a one-to-one configuration.

1.02 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and shall bear the Listed mark.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. The System shall be rated in accordance with Air Conditioning Refrigeration Institute (AHRI) Standard 210/240-2008 Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment and bear the AHRI label.
- D. The System shall be rated in accordance to the U.S. Department of Energy (DOE) test procedures.
- E. The units and components within bonded for grounding shall meet safety standards for servicing required by Underwriters Laboratories Inc. (UL), in accordance with Standard for Safety UL 1995 Heating and Cooling Equipment, and that of the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI).
- F. Units shall be Intertek (ETL) certified for the U.S. and Canada.

1.03 DELIVERY, STORAGE, AND HANDLING

Equipment shall be stored and handled according to the manufacturer's recommendation.

PART 2 – WARRANTY

2.01 EXTENDED LIMITED WARRANTY

Warranty commences on the date of initial installation. For the compressors, parts shall be covered by the manufacturer's extended limited warranty for a period of 12 years. Other covered components shall also be covered by the manufacturer's extended limited warranty for a period of 12 years. Online product registration is required where applicable or a standard 7 year compressor / 5 year covered parts warranty applies.

2.01 INSTALLATION REQUIREMENTS

The system shall be installed per manufacturer's recommendation.

PART 3 – PERFORMANCE

3.01 PERFORMANCE

The system performance shall be rated in accordance with AHRI 210/240-2008 Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment test conditions. The system efficiency shall meet or exceed the following performance criteria stated in 3.01 subsections [A](#) and [B](#).

3.02 COOLING OPERATING RANGE

The operating range in the cooling mode shall be -13°F – 122°F.

3.03 HEATING OPERATING RANGE

The operating range in the heating mode shall be -13°F – 86°F.

3.04 REFRIGERANT PIPING

All refrigerant piping shall be installed in accordance with manufacturer's recommendations. No additional sight glasses or filter/dryers shall be required. All field installed refrigerant piping shall be applied using nitrogen ACR copper tubing and shall be meet ASTM B280. All branch piping joints necessary for Multi-Zone system installation shall be approved by the manufacturer.

Fully serviceable brass service valve shall prevent corrosion and provide access to refrigerant system. Flare connection lines shall be located on side of unit cabinet. Shut-off valve and 2-way service valve (with service port) may be accessed to manage refrigerant charge while servicing system. Refrigerant lines shall be individually insulated to prevent sweating and bundled in line set with UV-rated tape.

The system shall be capable of the following refrigerant piping lengths as stated in 3.04 subsections **A** and **B**.

A. Single-Zone Mini-Split System

1. Maximum line set length: 213 ft (65 m)*
2. Maximum line set elevation from outdoor unit to indoor unit, when outdoor unit is above: 98 ft (30 m)*
3. Maximum line set elevation from outdoor unit to indoor unit, when outdoor unit is below: 98 ft (30 m)*

B. Furnish model no 3WMB036 for indoor unit, Model No. 3PB036 for outdoor unit.

PART 4 – PRODUCTS

4.01 MPB SINGLE-ZONE OUTDOOR UNIT

A. General

1. The MPB single-zone outdoor unit shall be factory assembled and pre-wired with all controls necessary for operation.
2. All refrigerant piping lines shall be insulated separately in accordance with the adopted state or local energy code requirements.
3. Outdoor unit sound pressure level for an individual condensing unit module shall not exceed 63 dB(A).
4. The system shall be capable of automatically restarting operation when power is restored after a power failure.
5. The unit shall have a terminal strip furnished for easy wiring connections.
6. The unit shall have an automatically enabled function to defrost the unit when frost

build-up is detected. Outdoor and indoor blower operations terminate and status is displayed on the indoor unit panel.

7. The unit shall be equipped with a 4-way interchange reversing valve to implement rapid changes in direction of refrigerant flow to result in quick changeover from heating to cooling and vice versa. Valve operates on pressure differential between outdoor unit and indoor unit.
8. The unit shall be equipped with a base pan heater.

B. Unit Cabinet

1. The outdoor unit cabinet shall be constructed of heavy gauge steel and shall be finished with a weatherproof and corrosion resistant baked enamel finish.
2. The unit shall have access covers for power and control wiring connections.
3. The unit shall have access covers for service valves.
4. The outdoor unit shall utilize a base pan heater to prevent build-up of ice during heating operation.
5. The unit shall feature tabs on base to allow secure mounting to slab.
6. Condensate drain outlets shall be furnished on unit base. Drain shall be field furnished.

C. Fan

1. The outdoor unit direct fan drive moves large air volumes uniformly through entire outdoor coil for high refrigeration capacity.
2. The outdoor unit fan motor shall be powered by an inverter drive capable of 5 steps of fan speed control.
3. An outdoor unit fan guard shall be provided.

D. Condenser Coil

1. The condenser coil shall be manufactured from copper tubes with aluminum fins.
2. A wire grille guard shall be provided.
3. The condenser coil shall be factory coated with a hydrophilic treatment for increased corrosion resistance.

E. Compressor

1. The unit shall have a compressor that features high-efficiency operation.
2. The compressor shall be balanced to reduce vibration and promote quiet operation.
3. The brushless DC motor shall use powerful Neodymium magnets, 15-20 times stronger than the ferrite magnets within conventional AC compressors.
4. The unit shall utilize a compressor crankcase heater to protect against refrigerant migration that can occur during low ambient operation.

F. Controls

1. The system utilizes DC inverter control to provide continuous operation while adjusting capacity according to room temperature. The system's accurate sensing of heating and cooling loads prevents frequent changes in capacity and ensures efficient, economical operation.
2. The microprocessor shall control the electronic expansion valve. It shall also assist the automatic compressor timed-off protection feature, indoor fan-on delay in heating mode after coil is warm, and 4-way reversing valve.

G. Electrical

1. The power supply to the outdoor unit shall be 208-230 volts, single phase, 60 Hz, ~~or 115 volts, single phase, 60 Hz.~~
2. Dedicated communication cables will be required by the 3 and 4 ton units. The control

wiring to the indoor unit requires 18 gauge, 2 core, stranded, and shielded wire. Unshielded communication wire shall not be accepted. Control wire shielding shall be grounded in accordance with manufacturer's recommendations.

H. Refrigerant

1. Refrigerant shall be non-chlorine, ozone friendly R-410A.
2. Each unit shall be pre-charged from the factory with a holding charge. Additional refrigerant shall be added in the field in accordance with manufacturer's recommendations.
3. Flare refrigerant connection lines shall be located on side of unit cabinet.
4. The unit shall have a fully serviceable brass service valve to prevent corrosion and provide access to refrigerant system. Shut-off valve may be fully shut off while 2-way service valve with port may be accessed to manage refrigerant charge while servicing system.
5. The refrigerant oil shall be VG74 ester oil or VG74 Polyolester (POE).

4.02 MWMA/MWMB WALL-MOUNTED NON-DUCTED INDOOR UNIT

A. General

1. The Lennox MWMA wall-mounted non-ducted indoor unit shall be completely factory assembled and tested. The unit shall include all wiring, piping, electronic expansion valve, and printed circuit boards necessary for operation.
2. The unit shall be capable of a heating set temperature of 46°F to prevent space from freezing.
3. The unit shall have a pre-heat function to delay fan operation until the indoor coil has reached a field-adjustable temperature.
4. The unit will allow compensation for temperature due to installation height and ground height differentials.
5. The unit shall allow use of remote controller temperature sensor rather than indoor unit temperature sensor.
6. The unit will have a turbo mode to allow unit to initially operate at maximum output to reach set temp as quickly as possible.
7. The unit shall utilize a large diameter cross flow fan and evaporator temperature to minimize the sound level by lowering fan speed.
8. The unit shall have a self-cleaning function to allow drying and cleaning of unit interior to prevent mold and bacteria growth.
9. The unit will have a sleep mode to allow a slow increase or decrease in temperature before shutting off after a delay.
10. The unit shall have a low charge detection function to alert the user when refrigerant leakage is detected.
11. The unit will have an intelligent defrost mode that can vary the defrosting time according to the current system state.
12. The unit must allow continuation of operation in the event of a temperature sensor error.
13. The unit shall allow for restriction to heating operation only.

14. The unit shall restart automatically after power failure after 3 minutes with prior settings.
 15. The unit will be paired with a wireless remote controller; a wired controller may be purchased separately.
 16. The unit must be compatible with primary VRF provider's product line.
 17. The unit shall have a timer that allows the user to automatically turn on or turn off the unit up to 24 hours later.
 18. The indoor unit shall include motor-driven louvers and shall support automatic vertical swing functionality.
 19. The unit shall include a factory-provided LED readout display and infrared receiver panel. The LED display shall indicate the current operational set point of the indoor unit, operation status, and codes for maintenance and servicing.
- B. Unit Cabinet
1. The front panel of the unit may be raised for wiring and maintenance accessibility.
- C. Fan
1. The fan motor shall be a DC motor capable of operating at 3 fan grades: low, medium, and high.
 2. The fan motor shall be thermally protected.
- D. Connections
1. The unit shall be equipped with liquid and gas flare fittings for quick and secure piping.
 2. The unit shall have refrigerant piping and drainage hose connections on the right and left side.
 3. The unit shall offer 3 access points for refrigerant outlet pipes in the right, left, or rear sides.
 4. The indoor unit coil shall be rifled copper tubing with hydrophilic coated aluminum fins.
 5. The coil shall have a design pressure of 550 psi.
- E. Filter
1. The unit shall be equipped with a cold catalyst filter to reduce odors and presence of volatile organic compounds.
 2. The unit shall include an easily removable, washable mesh filter.
- F. Electrical
1. The power supply to the indoor unit shall be 115 volts, single phase, 60 Hz, or 208-230 volts, single phase, 60 Hz.

PART 5-- CONTROLS

5.01 LENNOX MINI-SPLIT LOCAL CONTROLLERS

- A. Wireless Remote Controller (MOSTAT60Q-1)
1. The Wireless Remote Controller shall be provided with Wall-Mounted Indoor Units, Cassette Indoor Units, and Ceiling/Floor Indoor Units. The wireless remote controller may be ordered separately for ducted indoor units.
 2. The Wireless Remote Controller shall have a maximum operating range of 25 feet.
 3. The wireless remote controller shall control the following options: On/Off, Operation Mode (auto, cool, dry, heat and fan), fan speed setting, and louver swing setting. The wireless remote controller shall be capable of sensing the temperature of the room at the remote control location. The wireless remote controller shall be capable of

increasing cooling or decreasing heating in 2°F increments per hour with a sleep function. The wireless remote controller shall be capable of setting indoor unit on or off via a timer function.

4. The wireless remote controller shall have a backlit LCD display for easy visibility.

B. Non-Programmable Wired Remote Controller (M0STAT61Q-1)

1. The non-programmable wired remote controller shall be provided with ducted indoor units. The wired remote controller may be separately ordered for non-ducted indoor units.
2. The wired remote controller shall control the following options: On/Off, Operation Mode (auto, cool, dry, heat and fan), and fan speed setting (auto, low, medium, high). The wireless remote controller shall be capable of setting indoor unit on or off via a timer function.
3. The wired remote controller shall have LCD backlight for easier visibility
4. The wired remote controller shall be connected with 5-wire shielded cable

C. Programmable Wired Remote Controller (M0STAT64Q-1)

1. The programmable local controller shall be approximately 4-7/8" x 4-3/4" in size and white in color with an auto-timeout touch screen LCD display. LCD display of the programmable local controller shall be a minimum of 6.2 inches. The programmable local controller shall have a USB port for saving settings, loading settings, and loading software changes.
2. The programmable local controller shall support temperature display of Fahrenheit or Celsius. The programmable local controller shall control the following operations: On/Off, Operation Mode (cool, heat, auto, dry, and fan, temperature set point, fan speed setting, and louver swing setting. The programmable local controller shall be capable of setting temperature setpoint in the range of 62°F - 86°F.
3. The programmable local controller shall support scheduling up to 8 times in a day.
4. The programmable local controller shall be capable of locking the following user functions: ON/OFF, temperature settings, operation mode, swing, and scheduling.
5. The programmable local controller shall connect using four-wire, stranded and shielded conductor cable.

SECTION 16624

DIESEL ENGINE DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Controls and Instrumentation, System commissioning and General Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes packaged engine-generator sets for Standby power with the following features:

1. Diesel engine
2. Cooling system
3. Control and monitoring with connections to building BMS
4. Performance requirements for sensitive loads
5. Fuel system
6. Alternator, exciter, and voltage regulator
7. Battery and battery charger
8. Outdoor enclosure
9. Exhaust
10. Mounting
11. Air make-up system
12. Vibration isolation devices

- B. Related Requirements:

The list of related requirements is for informational purposes only. The purpose is to help identify by cross-reference the location of certain requirements that are not specified in this section.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Acronyms for names of standard-setting organizations are listed under the article 'References'.

- B. Other abbreviations and acronyms:

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1. AHJ: Authority having jurisdiction.
2. bhp: Brake horse power
3. CFR: U.S. Code of Federal Regulations.
4. DN: Diameter nominal.
5. DVR: Digital voltage regulator.
6. ECM: Engine Control Module
7. EPA: U.S. Environmental Protection Agency.
8. EPS: Emergency power supply (see article 'Definitions' below).
9. EPSS: Emergency power supply system (see article 'Definitions' below).
10. Genset: Generator set, packaged generator set, engine generator
11. HVAC: Heating, ventilation, and air conditioning
12. LCD: Liquid-crystal display
13. NETA: InterNational Electrical Testing Association
14. NRTL: Nationally Recognized Testing Laboratory
15. NSPS: New Source Performance Standards (40 CFR Part 60)
16. OSHA: Occupational Safety & Health Administration, U.S. Department of Labor
17. p.f.: Power factor.
18. PME: Permanent magnet excitation
19. PMG: Permanent magnet generator
20. RTD: Resistance temperature detector
21. SCAC: Separate circuit aftercooler (aftercooler second stage cooling)
22. UPS: Uninterruptible power supply

1.4 **DEFINITIONS**

A. Definitions Related to NFPA 110

1. Emergency Power Supply (EPS): This section utilizes the definition provided by NFPA 110 as follows: 'Emergency Power Supply (EPS). The source of electric power of the required capacity and quality for an emergency power supply system (EPSS)'. For purposes of this section, the EPS is the packaged generator set that is being specified here.
2. Emergency Power Supply System (EPSS): This section utilizes the definition provided by NFPA 110 as follows: 'Emergency Power Supply System (EPSS). A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power.' For purposes of this section, the complete EPSS is not specified here.
3. EPPS Level 1: This section utilizes the definition provided by NFPA 110 as follows: 'Level 1 systems shall be installed where failure of the equipment to perform could result in loss of human life or serious injuries.' Also, 'For new Level 1 installations, the EPSS shall not be considered as meeting this standard until the acceptance tests have been conducted and test requirements met'.

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4. EPPS Type: This section utilizes the definition provided by NFPA 110 as follows: ‘The type defines the maximum time, in seconds, that the EPSS will permit the load terminals of the transfer switch to be without acceptable electrical power’
5. Integral Fuel Tank in EPS Systems: This section utilizes the definition provided by NFPA 110 as follows: ‘A fuel tank furnished by the EPS supplier and mounted on the engine or under as a subbase.’
6. Prime mover: engine

B. Other Definitions

1. Hot Engine: An engine that has been previously loaded or fully heat soaked.
2. Cold Engine: An engine that has not been loaded recently. Typical for the initial loading of an engine in a standby/emergency application. Jacket water heater is typically continuously on for an emergency genset.
3. Genset: A generator set, a packaged engine generator, engine generator, energy converter
4. Generator: Main rotating piece of equipment attached to the engine and responsible for the conversion of rotational mechanical energy into electrical energy. Sometimes referred also as ‘Main Generator’, ‘Main Alternator’, or ‘Alternator’.

1.5 REFERENCES

- A. The following codes and standards are referenced throughout this section. Specific items of required compliance are listed within each article.
- B. International Electrotechnical Commission (IEC)
 1. IEC 60034 – Rotating electrical machines.
 - a. Part 1: Rating and performance
- C. International Organization for Standardization (ISO)
 1. ISO 3046 - Reciprocating Internal Combustion Engines – Performance
 2. ISO 8528 - Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets
- D. National Electrical Manufacturers Association (NEMA)
 1. NEMA MG1 – Motors and Generators
- E. National Fire Protection Association (NFPA)
 1. NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
 2. NFPA 70 – National Electrical Code.

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3. NFPA 99 – Health Care Facilities Code.
 4. NFPA 110 – Standard for Emergency and Standby Power Systems.
- F. Underwriters Laboratories, Inc. (UL)
1. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 2. UL 2200 – Standard for Stationary Engine Generator Assemblies.

1.6 **WORK INCLUDED**

- A. Installation: The work includes supplying and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories.
- B. Fuel System: The contractor shall provide a full tank of diesel fuel for the completion of all testing.
- C. System Test: A complete system load test shall be performed after all equipment is installed.
- D. Requirements, Codes and Regulations: The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.7 **ACTION SUBMITTALS**

- A. Bill of Materials: A listing shall include all panels, racks, instruments, components, and devices provided under this section.
- B. Product Data: For each type of package engine generator indicated. Drawings and descriptive (catalog) data and brochures of each item of equipment including technical data sheets for the engine and generator.
 1. Diesel engine data:
 - a. Manufacturer and model
 - b. Revolutions per minute (rpm)
 - c. Rated capacity brake horsepower (bhp)
 - d. Make and model of governor
 - e. Engine displacement (cubic inches)
 - f. Fuel consumption rate in gallons per hour at: full load, 3/4 load, 1/2 load
 2. Generator Data (Main Alternator): Submit generator manufacturer's data sheet for the exact generator arrangement included in this scope. Generator data shall include:
 - a. Generator specifications
 - b. Kilowatt and kVA ratings, line and phase voltages, and rated current
 - c. Generator efficiency at 25%, 50%, 75%, and 100% of kilowatt rating
 - d. Generator reactance and time constants
 - e. Stator and field resistances

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- f. Short circuit ratio
 - g. Voltage regulation performance
 - h. Excitation voltage and current, at no-load and full-load conditions
 - i. Generator center of gravity XYZ locations
 - j. Generator, rotor, and stator weights
 - k. Rotor balance deflection, in mm
 - l. Overspeed capacity, expressed as % of synchronous speed
 - m. Generator torsional data for coupling and fan, rotor, exciter end, and shaft
Stiffness
 - n. Insulation class
 - o. Generator thermal limits in kVA for:
Class B, F, and H temperature rises over 40°C ambient in continuous duty (BR - base rating): B BR 80/40, F BR 105/40, H BR 125/40
Class F and H temperature rises over 40°C ambient in standby duty (PR - peak rating): F PR 130/40, H PR 150/40
Class H temperature rise over 27°C ambient in standby duty (PR - peak rating): H PR27
 - p. Motor starting capability chart at 0.4 p.f. (% voltage dip v. skVA)
 - q. Instantaneous fault currents (3-phase, line-line, and line-neutral)
 - r. Current decrement data curve (instantaneous 3-phase fault current v. E time cycle)
 - s. Generator output characteristic curves:
 - 1) Open circuit curve (line-line voltage v. field current)
 - 2) Short circuit curve (armature current v. field current)
 - 3) Zero power factor curve (line-line voltage v. field current)
 - 4) Air gap curve (line-line voltage v. field current)
 - 5) Reactive capability curve
3. Package data:
- a. Overall length, width, and height
 - b. Weight of complete skid mounted unit
 - c. Exhaust pipe size
 - d. Air flow (in cubic feet per minute) of air required for combustion and ventilation
 - e. Heat rejection to the atmosphere of the engine and generator in BTU/hr
 - f. Cooling air volume required
 - g. Emissions certification
 - h. Sound data
4. Engine-generator unit and accessories to include:
- a. Enclosure
 - b. Accessory sub-panel & transformer
 - c. Control panels
 - d. Voltage regulator
 - e. Fuel system
 - f. Exhaust system
 - g. Batteries
 - h. Battery charger
 - i. Jacket water heater

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5. Generator circuit breaker:
 - a. Catalog data
 - b. Recommended trip settings for all adjustable settings
 - c. Short circuit interrupt ratings
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and vibration isolation bases.
 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.

1.8 **INFORMATIONAL SUBMITTALS**

- A. Sizing calculation: Generator supplier to submit a project specific sizing calculation for engineering review and approval. Loading as shown on the electrical drawings.
- B. Qualification Data: For installer, manufacturer, and testing agency
- C. Source quality-control test reports:
 1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 4. Report of sound generation.
 5. Factory EPA Certificate showing compliance with applicable federal regulations.
 6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- D. Field quality control test report
- E. Warranty: Special warranty specified in this Section

1.9 **CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section "Operation and Maintenance Data," include the following:
 1. Recommended service intervals, fluid sampling, and inspections.

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2. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
3. Operator training plan

1.10 MAINTENANCE MATERIAL

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: One set each of lubricating oil, fuel, and combustion air filters

1.11 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
4. Manufacturer Qualifications: A qualified manufacturer with a minimum of 25 years' experience building the generator sets. The manufacture shall actively maintain a 24-hour parts and service organization regularly engaged in maintenance contract programs to perform preventive maintenance and service on equipment like that specified.
 1. Maintenance Proximity: Not more than 4 hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
5. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
7. Comply with ASME B15.1.
8. Comply with NFPA 37.
9. Comply with NFPA 70.
10. Comply with NFPA 99.
11. Comply with NFPA 110 requirements for Level 1 and Level 2 emergency / legally required power supply systems.
12. Listed to UL 2200 (600V generator output and below)
13. Exhaust Emissions: Comply with applicable federal, state, and local emissions requirements at the time of installation and commissioning
14. Sound emissions: Comply with applicable local sound requirements

15.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.13 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: - 13°F to + 77°F
 - 2. Altitude: Sea level to 650.0 feet.

1.14 WARRANTY

- A. Two Year Standby / Mission Critical Generator Set Warranty
 - 1. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor. Warranty coverage of less than 500 hours a year operation will not be accepted. Submittals received without written warranties as specified will be rejected in their entirety.
 - 2. Warranty shall include a temporary generator set in the event a warrantable repair will take more than 48 hours. Selling dealer must have a minimum of 100 units in its rental fleet to assure a temporary unit is available if needed. Provide documentation as such.

1.15 MAINTENANCE SERVICE

- A. The engine generator supplier shall maintain 24 hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The distributor shall carry sufficient inventory to cover no less than 80% of the parts service within 24 hours and 95% within 48 hours.
- B. Initial Maintenance Service: Beginning at Acceptance, provide 12 months' full maintenance by certified employees of manufacturer's designated service organization. Include semi-annual exercising to check for proper starting, load transfer, and running under load. Include routine

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preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

- C. Inspection App: Equipment manufacturer to provide complementary app to inspect and document inspection data. The app shall include the following:
1. Access to standard inspections forms like Preventative Maintenance, Checklists and Daily Walk Arouns
 2. Create custom check lists and inspection forms
 3. Document asset condition with photos, videos and inspector comments
 4. Red, Yellow, Green ratings allow for quick identification of actionable items
 5. Web interface for viewing inspection data and managing inspection forms
 6. Conduct Equipment, Site and fluid Inspections
 7. Assign inspections to team members and evaluate the results from online at anytime
 8. View Inspection Results - Inspect integrates with other Equipment Management applications
 9. Optimized for mixed fleet owners – secure inspection results for assets all in one place
 10. Inspection Data Integration – Completed inspection data made available for analysis through Partner API (Application Program Interface)
 11. Real-Time Information – digital inspections provide real-time information for review and retention.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
1. Caterpillar Inc.
 2. Cummins.
 3. Taylor
- B. Basis-of-Design Product: Subject to compliance with requirements, provide a Cat 650 kW diesel generator set. The power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around Caterpillar supplied equipment. Should any substitutions be made, the CONTRACTOR shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result from such substitutions.

3.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 37, NFPA 70, NFPA 99, NFPA 110 (Level 1 EPSS)
- B. UL Compliance: Comply with UL2200
- D. Engine exhaust emissions: Comply with U.S. EPA requirements and applicable state and local regulations.
- E. Noise emission: Comply with applicable state and local regulations

3.2 ENGINE-GENERATOR SET

- A. New, factory assembled and tested engine-generator set.
- B. The electric power generating system shall consist of 650 kW, 0.8 power factor, 480 volts, Wye connected, Three Phase, 4 wire, 60 hertz generator systems.

Motor starting at 90% rated sustained voltage will not be accepted. Generator set shall be rated for Standby applications with typical usage of 500 hours per year.
- C. Engine shall be capable of providing 650/812.5 kW/kVA, at 77°F and altitude of 650.0 feet.
- D. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation, with provisions for lifting attachments.
 - 1. Rigging diagram shall be permanently attached to the generator set package to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity
- E. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
 - 2. Output Connections: 480 volt three-phase, four wire
- F. Nameplates: For each major system component, identify manufacturer's name, model, and serial number of component
- G. Generator set performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3% of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20% variation for 50% step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5% of rated frequency from no load to full load.

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4. **Steady-State Frequency Stability:** When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. **Transient Frequency Performance:** Less than 5% variation for 50% step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. **Output Waveform:** At no load, harmonic content measured line to line or line to neutral shall not exceed 5% total and 3% for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50%.
7. **Sustained Short-Circuit Current:** For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250% of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. **Start Time:** Comply with NFPA 110, Type 10, system requirements.

3.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2 ULS type

B. Rated engine speed: 1800 RPM

C. Lubrication system: The following items are mounted on engine or base rails:

1. Filter and strainer: Oil filters rated to remove 90% of particles 5 micrometers and smaller while passing full flow
2. Lube oil pump
3. Oil level regulator
4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassemble and without use of pumps, siphons, special tools, or appliances

D. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. Provide water separator and fuel filters. Fuel filters shall have isolation valve for changing of filters during engine operation.

E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

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F. Governor: Shall provide isochronous control, with provisions to interface with load share modules and / or remote switchgear. The engine governor shall be an electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. The ECM shall adjust fuel delivery per exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame, radiator duct flange and integral engine-driven coolant pump.

1. Coolant: As recommended by engine manufacturer.
2. Size of Radiator: The cooling system shall be sized to operate at full load conditions and 104°F ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equipped with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
6. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
7. Integral fuel oil cooler shall be provided as required by the OEM.

H. Muffler / Silencer:

- C. The silencer/muffler, companion flanges, and flexible stainless-steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor as shown on the drawings.
- D. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine.
- E. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

I. Air Intake Filter: Heavy duty dual element, engine mounted air cleaners with replaceable dry-filter elements, "blocked filter" visual indicator.

J. Starting System: 24 VDC electric with negative ground

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1. Starting motor: A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.
2. Battery: A lead-acid storage battery set shall be provided. Battery voltage shall be compatible with the starting system.
3. Battery Charger: A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float and equalize charge settings, with provisions to automatically switch between the two modes. It shall maintain its rated output voltage within $\pm 0.2\%$ with AC input variation of $\pm 10\%$. Operational monitors shall provide with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of battery charger malfunction, low battery voltage, and high battery voltage. Charger shall include an Analog DC voltmeter and ammeter and fused AC input and DC output, and shall be wall mount type in a NEMA 1 enclosure.

3.4 FUEL OIL STORAGE

- A. As required for specific installation per all local codes and regulations.

2.6 CONTROLS AND MONITORING

- A. Provides a fully solid-state, microprocessor based, auto start / stop generator set control module which is fully configurable via PC using USB and RS485 ModBus communication. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to engine ECU/ECM via CAN SAE J1939.
- B. Environmental: The generator set control shall be tested and certified to the following environmental conditions:
 1. -22°F to $+158^{\circ}\text{F}$ Operating Range
 2. 68°F to $+131^{\circ}\text{F}$ at 95% relative humidity for 48 hours (BS EN 60068-2-30, BS EN 60068-2-78)
 3. IP65 for front of module when installed in the control panel using sealing gasket
 4. Vibration at 2G, 8-500 Hz (BS EN 60068-2-6)
 5. Electromagnetic capability (BS EN 61000-6-2, BS EN 61000-6-4)
 6. Shock: withstand 15G (BS EN 60068-2-27)
- C. Functional Requirements: The following functionality shall be integral to the control panel:
 1. The control shall include 132 x 64-pixel, 2.9 inch x 1.8 inch, 4-line LCD display
 2. LCD alarm with text-based alarm/event descriptions and an alarm mute button in controller
 3. 3-phase generator sensing and protection
 4. Unbalanced load protection
 5. Breaker control via fascia buttons
 6. BMS (building management system) integration using MODBUS RTU

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7. Standard ISO labeling
8. Multiple language capability
9. Remote start/stop control
10. Local run/off/auto control integral to system microprocessor
11. Cooldown timer
12. Speed adjust
13. Lamp test
14. Emergency stop push button
15. Front panel configuration with PIN protection

D. Digital Monitoring Capability:

The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

1. Engine:

- a. Engine status
- b. Engine oil pressure
- c. Engine oil temperature
- d. Engine coolant temperature
- e. Engine crankcase pressure
- f. Engine boost pressure
- g. Engine turbo inlet pressure
- h. Engine Speed (RPM)
- i. Engine battery voltage
- j. Engine run time
- k. Engine fuel level
- l. Engine crank attempt counter
- m. Engine successful start counter
- n. Service maintenance interval
- o. Real time clock
- p. Engine exhaust stack temperature
- q. Engine main bearing temperature

2. Generator:

- a. Generator AC volts (Line to Line, Line to Neutral)
- b. Generator AC current (Avg and Per Phase)
- c. Generator AC Frequency
- d. Generator kW (Total and Per Phase)
- e. Generator kVA (Total and Per Phase)
- f. Generator kVAR (Total and Per Phase)
- g. Power Factor (Avg and Per Phase)
- h. Total kW-hr
- i. Total kVAR-hr
- j. % kW

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- k. % kVA
- l. % kVAR
- m. Generator bearing temperature protection
- n. Generator stator winding temperature protection

E. Alarms and Shutdowns:

The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for multiple past and recent events.

1. Engine Alarm/Shutdown:

- a. Low oil pressure alarm/shutdown
- b. High engine temperature alarm/shutdown
- c. Loss of coolant shutdown
- d. Overspeed shutdown
- e. Over crank shutdown
- f. Emergency stop shutdown
- g. Low coolant temperature alarm
- h. Low battery voltage alarm
- i. High battery voltage alarm
- j. Control switch not in auto position alarm
- k. Battery charger failure alarm

2. Generator Alarm/Shutdown:

- a. Generator phase sequence
- b. Generator over voltage
- c. Generator under voltage
- d. Generator over frequency
- e. Generator under frequency
- f. Generator reverse power (real and reactive)
- g. Generator overcurrent

F. Inputs and Outputs:

1. Programmable Digital & Analog Inputs: The Controller shall include the ability to accept total twelve (12) programmable digital and analog input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts. Additional I/O add-on capability available through expansion modules.
2. Programmable Digital Outputs: The control shall include the ability to operate programmable digital DC output signals, integral to the controller. The DC outputs (2) for fuel and start shall be rated for 10 A resistive for 10 seconds, 5 A resistance continuous at module supply & other configurable DC outputs (6) are 2 A resistive at module supply. Additional I/O add-on capability available through expansion modules.

G. Maintenance:

All engine and control panel shall be accessible through electronic service tool for engine and configuration suit software using Type A to Type B USB data cable for generator. The following maintenance functionality shall be integral to the generator set control.

1. Engine running hours display
2. Service maintenance interval (running hours or calendar days)
3. Engine crank attempt counter
4. Engine successful starts counter
5. Last 250 events are stored in control panel memory
6. Programmable cycle timer that starts and runs the generator for a predetermined time.

H. Remote Communications:

1. Remote Communications: The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates up to 115.2 kbaud rates.
2. Remote Monitoring Software: The control shall provide Monitoring Software with the following functionality:
 - a. Monitor up to 20 expansion modules
 - b. Provide access to all data and events on generator set communications network
 - c. Provide remote control capability for the generator set(s)
 - d. Ability to communicate via Modbus RTU or remote modem

I. Local Indicator and Remote Annunciation:

1. Local indicator: The control shall include following local LED indicators on the control panel:
 - a. A lamp mute & lamp test
 - b. Selection mode
 - c. Manual mode indicator
 - d. Auto mode indicator
 - e. Generator Breaker indicator
 - f. Generator Available indicator
2. Remote annunciators: The controller shall include ability to connect with five (5) remote annunciator modules each consisting of two (2) LED expansion modules. Remote annunciator has functionality of 16 channel fault annunciation when two (2) LED expansion modules are used. It includes an alarm sound that is triggered when host controller detects an alarm condition which can be muted using front push button. The panel will be fitted with removable label cards which can be used to identify the standard NFPA alarms if desired.

F. Telematics and Data Monitoring:

1. Asset Health and Data Monitoring:

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- a. There shall be a monitoring and data management system available on a 24/7/365 basis, which interfaces with the asset (generator set, switchgear, etc.) via a cellular or Ethernet connection.
 - b. It shall provide automated alert notification via text message and/or e-mail. These alerts shall also be displayed by a web-based system which will be updated automatically.
 - c. Asset functions being monitored will be displayed by a web-based system which will be updated automatically.
 - d. Provide remote start/stop operation of generator set and scheduled generator set exercising option.
 - e. Asset monitoring allows for remote troubleshooting to upkeep asset health and performance.
2. Analytics and Data Reporting:
- a. The telematics shall provide data analytics for insights and status updates through pre-defined reports.
 - b. Continual monitoring provides to offer status updates including basic engine / electrical parameters and historical performance.
 - c. Provide insights to asset status and potential maintenance issues.
3. Telematics and Data Security:
- a. The web-based software shall be secure, requiring a registered user name and password structure for access.
 - b. Data Privacy Principles of the remote monitoring system are as follows:
 - 1) The manufacturer shall be transparent about data collection
 - 2) The manufacturer shall protect the data collected
 - 3) The manufacturer shall respect the data rights of others
4. The telematics hardware and remote monitoring user interface shall be an end-to-end system designed with multi-layer security controls and safeguards, to protect against unauthorized access and disclosure.
- a. High level security safeguards include, but not limited to:
 - 1) Cryptographic security controls to protect against unauthorized device software changes.
 - 2) Encrypted and authenticated remote connection.
 - 3) Only an outbound remote connection, initiated by the device, is allowed. Device shall not participate in or responds to general internet traffic.
 - 4) Manufacturer's corporate IT infrastructure secured utilizing generally accepted information security principles and practices.

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- 5) Secure web application connection with user login authentication and role based access controls.
- b. Security Principles of the remote monitoring system shall be as follows:
 - 1) Dedicated cybersecurity program and team
 - 2) Risk-based approach to multi-layers cybersecurity
 - 3) Proactively about cybersecurity
 - 4) Response and Remediation to Cyber incidence
 - 5) Training and awareness
5. The system will offer the user the option of having alarms and/or events handled by an expert advisor trained by the manufacturer. The advisor shall follow a user-defined procedure for handling alarms and/or events.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Provide a generator mounted 100% rated circuit breaker, molded case, NEMA 1/IP22. Breaker shall utilize a solid state trip unit. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns.
- B. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.
- C. Features to include:
 1. Molded case thermal magnetic trip breaker sized for full unit output rating
 2. Neutral connection sized for full product ratings.
 3. Ground connection in the customer power wiring section.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H insulation. Windings shall be of the random wound type. Temperature rise shall not exceed] over 40°C ambient temperature. Alternator shall be model
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

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- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125% of rating, and heat during operation at 110% of rated capacity.
- F. Enclosure: Drip proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Voltage adjustment on control and monitoring panel shall provide plus or minus 5% adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12.5 % or less.

2.9 VIBRATION ISOLATION DEVICES

- A. Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer. Provide owner color selection chart.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Reference system Commissioning Specifications for additional requirements. Include, at a minimum, the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Transient and steady-state governing.
 - 6. Single-step load pickup.
 - 7. Safety shutdown.

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8. Provide 30 days' advanced notice of tests and for observation of tests by Owner's representative.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions, NFPA 110 and all local codes
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch.
- D. Install black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Section "Hydronic Piping."
 - 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section "Hydronic Piping."
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Electrical wiring includes but is not limited to battery chargers, heaters, control power, load bank, grounding, remote annunciator panels, paralleling gear, remote control panels, etc. Contractor to include as part of their scope of work, wall wiring and empty conduit indicated on contract drawings, specified herein, indicated/noted on approved manufacturers shop drawings and as required to provide a fully functional system.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section "Hydronic Piping." Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect cooling-system water piping to engine-generator set and with single braid corrosion resistant type 302 stainless steel wire braid and compression fittings.
- D. Connect engine exhaust pipe to engine with stainless steel flexible connector.

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- E. Connect fuel piping to engines with a gate valve and union and stainless steel flexible connector. Provide all required fire safe-off and solenoid valves.
- F. Connect to BMS, coordinate with controls contractor.
- G. Ground equipment according to Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Section "Identification for HVAC Piping and Equipment" and Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Field Testing: If factory service technicians cannot provide the field testing specified as part of manufacturer's start-up, the contractor shall engage a qualified factory certified and authorized testing agency to perform tests and inspections and prepare test reports required by manufacturer.
- B. Manufacturer's Field Service: Contractor to include field services of factory-authorized service representatives to provide start-up testing as well as to assist in 3rd party system commissioning as specified under the system commissioning specifications. Testing will not be concurrent so multiple travel days shall be included as per the approved schedule.
- C. Perform tests and inspections and prepare test reports.
- D. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters. Generators shall be tested individually and in parallel.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

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5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 6. Exhaust Emissions Test: Comply with applicable government test criteria to confirm adherence to EPA Tier rating.
 7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50% and 100% step-load increases and decreases, and verify that performance is as specified.
 8. Harmonic-Content Tests: Measure harmonic content of output voltage under 25% and at 100% of rated linear load. Verify that harmonic content is within specified limits.
 9. "Pull the Plug Test": Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and retest as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators, load bank and associated paralleling gear operations. Refer to Section "Demonstration and Training."