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ADDENDUM 2

Via E-Mail

DATE: July 21, 2023

Contract: 23-C-00002; Prescott Pump Station Rehabilitation

Bidders on the above referenced project are hereby notified that the following addendum is made to the Contract Documents. BIDS TO BE SUBMITTED SHALL CONFORM TO THIS NOTICE.

Item 1: Add the following: Section 16421 MINI POWER-ZONE

Item 2: Replace the following: W-46 with the one attached
W-49 with the one attached
W-76 with the one attached
W-16216 with the one attached

Item 3: Delete the entirety of Section 51 (Automatic Transfer Switch)

All other provisions of the Contract Documents and Specifications not in conflict with this Addendum shall remain in full force and effect. Questions are to be e-mailed to ContractAdministration@tampagov.net.

Jim Greiner

Jim Greiner, P.E., Contract Management Supervisor

SECTION 16421

MINI POWER-ZONE

PART 1 GENERAL

1.1 INCLUDED

- A. Mini Power-Zone

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Install complete grounding system in accordance with the National Electrical Code.

1.3 REFERENCE STANDARDS

- A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.

1. National Electrical Manufacturer's Association (NEMA) Publications:
2. Underwriter's Laboratories, Inc., (UL) Publications:

1.4 SHOP DRAWINGS

- A. Mini Power-Zone shop drawings shall contain layout of equipment, nameplate, schedule, electrical characteristics of components, overall weight and dimensions, conduit space in top, voltage rating, ampacity of all bus bracing, and information that indicates that function requirements of the specification have been met.

PART 2 - PRODUCTS

2.1 MINI POWER-ZONE

- A. Transformer/Panelboard
 1. The Distribution Panelboard shall be dead-front type, metal enclosed. Panelboard shall be installed in a NEMA 3R stainless steel, powder coated enclosure for operation at 120/240V, single-phase. A minimum of 10 single-pole spaces shall be provided. All circuit breakers shall be bolt-on type.

2. Unit shall be provided with a 40 Ampere main breaker installed on the primary side of the transformer. An 80 Ampere secondary breaker shall be provided for the 120/240V, single-phase distribution panelboard.
3. The transformer section shall convert 480V, single-phase power into 120/240V, single-phase power. The transformer shall be 15 KVA single-phase.

2.2 APPROVED MANUFACTURERS

- A. Mini Power-Zone
 1. Schneider Electric
 2. Eaton
 3. General Electric (GE)

PART 3 - EXECUTION

3.1 INSTALLATION OF MINI POWER-ZONE

- A. Install the Mini Power-Zone per manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
 1. Close and open each circuit breaker to test operation.

END OF SECTION

SECTION 46 – CONTROLS (480 VOLT)

W-46.01 General

Control components shall comply with the latest ANSI, IEEE, and NEMA standards where applicable.

Maximum control voltage shall be 120 VAC, 60 Hz.

Control devices shall be of industrial grade, heavy-duty design, utilizing modular construction to increase flexibility.

W-46.02 Control Enclosures and Panels

The control enclosures shall be rated NEMA 4X, gasketed, and be constructed of minimum 14 gauge, 304 stainless steel. The door shall have a handle with padlock provisions and three-point latch mechanism. The door shall be provided with a positive stop mechanism to prevent it from closing while controls are being serviced. Stiffeners shall be provided on the enclosure and door as necessary to provide rigidity. The closing surfaces shall have rolled lips. The outside of enclosure shall be finished with a durable RAL 9003 white powder coat to reduce solar heat gain. All hardware shall be heavy-duty, stainless steel. A print pocket shall be provided on the inside of the door. The enclosure dimensions shall be as shown or required.

The panel shall be 12-gauge steel and sized to be accommodated by the enclosure. The periphery of the panel shall be formed to provide a 0.75 inch stiffener frame. The panel shall be primed, painted with white enamel and baked, after forming.

The enclosure and panel shall be as manufactured by Quality Metals, Hoffman Engineering, or equal.

Motor Control Panel

The motor control panel shall be as defined in Sections W-46.01 General, W-46.02 Control Enclosures and Panels and shall contain, but not limited to the components listed in the sections W-46.03 thru W-46.10:

W-46.03 Motor Starter

A. Full Voltage Starter

The motor starter shall be 3-pole polyphase, and have a NEMA rated contactor with a minimum Size 1 rating. It shall be designed for full voltage, non-reversing service.

Motor starter contacts shall be silver alloy, double break; and shall be easily replaceable, with standard tools, without removing the starter from the enclosure; or removing the line, load, or control wiring from the starter.

Contactor coil shall be of the encapsulated type; and shall be easily replaceable, with

standard tools, without removing the starter from the enclosure, or removing the line or load wiring from the starter.

The motor starter shall be provided with a Trip Class 20, bimetallic, ambient compensated, overload relay adjustable over a range of 85% to 115% of the nominal heater rating. The current in all 3-poles shall be sensed. The overload relays shall be field convertible from hand reset to automatic reset and vice-versa. When in automatic reset -- after tripping the relay -- the contacts will automatically reclose when the relay has cooled down. A manual "trip-to-test" feature shall be provided to facilitate a quick test of the mechanical and electrical operation of the overload relay. The overload relays shall include a "visible trip indicator" to easily identify a tripped overload block.

The motor starter shall have a 120VAC, 60Hz contactor coil and control circuit.

A minimum of one (1) N.O. holding contact shall be provided. The capability shall exist to install additional contacts in the field.

The motor starter shall be as manufactured by Square D, Cutler-Hammer, General Electric, Allen Bradley, or equal.

B. Reduced Voltage Solid State Starter

See Section W-49 Reduced Voltage Solid State Starter

W-46.04 Circuit Breakers

Circuit breakers shall be of the molded case, air-break type designed for 600 volt, 60 Hz service or as shown on the Drawings. They shall have both thermal and magnetic elements on all three poles. These elements will actuate a common tripping bar to open all poles when an overload or short circuit occurs.

The circuit breakers shall have an AIC rating greater than the available fault current at the panel.

The equipment shall be as manufactured by Square D, General Electric, or equal.

W-46.05 Three Phase Surge Protective Device (SPD-1)

The SPD shall be able to suppress lightning induced voltage surges three times greater than the industry standards. The rated line voltage for SPD shall be 277/480 VAC 3-phase, 4-wire. The maximum single impulse current shall be 200kA per phase.

1. The SPD shall have a 10-YEAR warranty. Under that warranty, the SPD shall be replaced if it is destroyed by lightning or other impulses.
2. The SPD shall have an LED failure indicator on all three phases.

3. The clamp voltages for the SPD shall be the following:

Line to neutral – 1200 volts
Line to ground – 1200 volts
Neutral to ground – 1200 volts
Line to line – 2000 volts

The Surge Protection Device shall be as shown on the Drawing Parts Schedule, or equal.

W-46.06 Seal Leak Detector

The seal leak detector shall be compatible with the submersible pump supplied and be Underwriters Laboratories (U.L) listed for use in sewage pumping applications. The Contractor shall coordinate with pump manufacturer to determine specific hardware required for stator temperature and seal-leak detection. The detector shall have the following features:

- 1.) The unit shall employ low voltage, low current, conductivity probe type liquid level detection.
- 2.) 120 VAC, 60 Hz, operating voltage.
- 3.) The alarm output shall be an SPDT 10-amp, 250 VAC relay contact with a minimum 2000 VAC isolation to probe.
- 4.) Probe supply characteristics - sensitivity, 4.7K to 100K OHM, adjustable; voltage, 24 VAC, 60 Hz; current, 2mA maximum.
- 5.) Eight pin octal-type plug (provide matching screw terminal sockets).
- 6.) The unit shall be housed in a high-impact plastic dust cover.

The seal leak detector shall be MINI-CAS for Flygt pumps and Crouzet model PNRU110A or equal for other manufactures.

W-46.07 Panel Mount Fuse Holder and Fuse

Panel mount fuse holders shall be rated for a minimum of 15 amps, 250 VAC. They shall accommodate 0.25 by 1.25-inch glass fuses and have a bayonet type knob. Terminations shall be by 0.25-inch Quick-Connect. Fuse holders shall be Bussman HKP, or equal.

Fuses shall be 0.25 by 1.25-inch slow blow, dual element, glass body with ratings as shown or required. Fuses shall be Bussman MDL series, or equal.

W-46.08 Power Phase Monitors

Phase Monitors shall be provided and installed as shown on the Drawings and specified herein. The unit shall have the following features:

- 1.) Adjustable in voltage
- 2.) input— 480 volt, 3-phase, 60Hz, 4-wire, utility service
- 3.) adjustable voltage range control
- 4.) SPDT relay operation and LED indication shall be triggered by phase loss, low

- voltage, power failure, or improper phase sequence.
- 5.) LED indication shall be on when voltage is normal— off with fault
 - 6.) relay shall operate if fault lasts more than 2.0 seconds.
 - 7.) relay shall release after voltage is normal for 5.0 seconds
 - 8.) relay contact rating— 10 Amps
 - 9.) mounting— 8-pin plug-in— provide socket for DIN rail

Phase Monitors **PM2, PM3, PM4, and PM5** shall be model SUA-440-ASA as manufactured by ATC Diversified Electronics, or equal.

W-46.09 Phase Monitor Fuse Holders and Fuses

The Fuse Holders shall be three-pole, 600V rated units suitable for use with Class CC, rejection type fuses. They shall be UL listed for branch circuit protection, and have a fuse withstand rating of 200 kA. The handle shall isolate the fuse from the circuit when installing or removing fuses— no special tools shall be required to insert or remove fuses. The fuse holder shall be provided with a blown fuse indicator to allow for easy troubleshooting. The fuse holder shall mount on a standard DIN rail.

The Fuse Holder shall be model 1492-FB3C30-L as manufactured by Allen Bradley, or equal. The fuses shall be Bussmann Limitron fast acting model KTK-R or equal, with the ampacity shown on the Drawings.

W-46.10 AC Current Sensor

The AC Current Sensor shall be a split core transducer used to convert a monitored AC current to a proportional 4-20mA output. The sensor shall comprise a current transformer, power circuit, precision rectifier, high-gain servo amplifier, and span and zero adjustments in one UL listed package. The sensor shall have three user selectable ranges. The two-wire loop powered 4-20mA output shall be available on two 6-32 screw terminals. The sensor shall meet the following performance parameters:

- 1.) operating temperature— -55 to +65°C.
- 2.) accuracy— +/- 0.5% of full scale
- 3.) repeatability— +/- 0.1% of full scale
- 4.) frequency— flat from 20-100 Hz
- 5.) response time— 100 msec (10 to 90%)
- 6.) ripple— less than 10 millivolts
- 7.) voltage supply— 21 to 40VDC

The AC Current Sensor shall be model SC200-2 as manufactured by Enercorp Instrument Ltd, or equal.

Pump Control Panel

The pump control panel shall be as defined in Sections W-46.01 General, W-46.02 Control Enclosures and Panels and shall contain, but not limited to the components listed in the sections W-46.11 thru W-46.25:

W-46.11 Switches and Push Buttons

Switches and push buttons shall be heavy-duty, oil-tight, watertight, NEMA Type 4X, corrosion resistant units intended for industrial applications. The operator shall mount in a 1.20-inch diameter opening and be provided with the proper legend plate.

Switches and push buttons shall be as manufactured by Square D, General Electric, Allen Bradley, or equal.

W-46.12 Pilot Lights

Pilot lights shall be heavy-duty, oil-tight, NEMA Type 4X, corrosion resistant, push to test, light emitting diode (LED) type, rated for 120VAC, and intended for industrial applications. The operator shall mount in a 1.20-inch diameter opening and be provided with the proper legend plate and lens color.

Pilot lights shall be as manufactured by Square D, General Electric, Allen Bradley, or equal.

W-46.13 Control Relays

- a. Multicontact- Unless otherwise noted, relays shall have a minimum of two (2) form C contacts rated at 10 amps, 120 VAC. They shall be of the type, which utilizes the circular plug system with hold down springs. Each relay shall be provided with an indicator lamp to show its status. The covers shall be dustproof, and manufactured of a clear polycarbonate material. The relays shall be Model KRPA as manufactured by Potter & Brumfield, Struthers Dunn, Square D, or equal.
- b. Timing relays shall have DPDT, 10 amp, 120 VAC contacts. Timers shall be solid-state and adjustable as required. They shall utilize a plug in base mounting system. Timing relays shall be Model 328 as manufactured by ATC, Potter & Brumfield or equal.
- c. NEMA Type Relays shall have two (2) normally open, 10-amp, 600 VAC, convertible instantaneous contacts. They shall have plug-in contact cartridges for easy contact conversion and replacement. Contact conversion shall be capable without removing terminal screws or wires. Coil voltage shall be as shown on the drawings or as required. NEMA Type Relays shall be Model X as manufactured Square D or equal.

W-46.14 Instrumentation Signal Multicontact Relays

Relays for switching instrumentation level signals shall have the following features: 120VAC coil; 4PDT Ag-Pd alloy bifurcated crossbar contacts; socket mount; sealed plastic cover; and hold-down spring.

The contact ratings shall exceed the requirements for the application, and shall be no less than 1 Amp at 120VAC. The expected life shall be a minimum of 200,000 operations at rated load.

The socket shall be of the surface or rail-mount design with screw terminals to facilitate circuit connections.

The relay shall be Idec model RY42, with model SY4S-05 socket, or equal.

W-46.15 Sewage Pump Controller / SCADA / Radio (PCSR)

The Sewage Pump Controller / SCADA / Radio subassembly comprises a programmable logic controller (PLC) based system engineered to provide duplex pump control, supervisory control and data acquisition (SCADA), and radio telemetry in one assembled package. The components shall be mounted on an aluminum sub-panel and be fully wired, tested, and ready for field connections via conveniently located interface terminals. The subassembly shall operate on a 120 Volt, 60 Hz, single-phase power supply and shall have integral transient voltage protection.

The PCSR shall be a Motorola ACE3600 package as distributed by Star Controls, Revere Control Systems, Automated Controls, Curry Controls, Rocha Controls or Cayzo Consulting Inc. The Contractor shall coordinate his efforts with Star Controls, Revere Control Systems, Automated Controls, Curry Controls, Rocha Controls or Cayzo Consulting Inc. to ensure system compatibility, performance, and security. The Contractor shall provide and install a complete control system package as programmed Star Controls, Revere Control Systems, Automated Controls, Curry Controls, Rocha Controls or Cayzo Consulting Inc. The existing Pump Station DCR controls shall revert to the City as a spare.

The following is a partial list of PCSR features:

1. Motorola ACE3600 remote terminal unit (RTU) with surge / lightning protection for power line and antenna shall be provided.
2. One Mixed I/O modules shall be provided.
3. A MOTOTRBO XPR5350 radio UHF R1 (430-470) MHz, shall be provided.
4. Provide one mixed signal auxiliary input/output interface board # ACE-V245-AUX-I/O with DC to DC plug in power supply# ACE-AUX-DCPS.
5. The pump controller shall operate independently of the SCADA / telemetry system in the event of communications loss.
6. DC power circuits derived from the RTU and feeding external loads shall be individually fused as required. Fuses shall have indicator LEDs to indicate fuse has blown.
7. A back-up pump controller shall be provided to facilitate emergency overflow protection in the event of RTU failure.
8. Interposing control relays shall be provided as required.
9. Terminal blocks shall be arranged, and separated as follows: main power distribution block; 120VAC power; 24VDC power; RTU DC power bus.
10. All wires shall be permanently identified using a computer generated labeling system. All terminal numbers and identifying nomenclature shall correspond to and be shown on the electrical diagrams and schematics.
11. All external wiring shall terminate on terminal blocks.
12. The RTU shall provide both digital and analog inputs for use in monitoring and control. Simultaneous monitoring of analog and digital level sensing devices shall be supported

where the analog level sensing device shall be primary. The RTU shall contain routines for detecting sensor failures and utilize the alternate level sensing device(s).

13. Battery back-up power shall be provided for the RTU so that monitoring is maintained during Utility power failures. The battery shall have the capacity of operating the RTU for a minimum of four hours. The power supply shall keep the batteries at float charge. The RTU shall contain a low battery cutout circuit, and the batteries shall not be damaged by deep discharges.
14. Local manual pump control is provided by Hand-Off-Auto (HOA) switches located in the pump control panel. In the absence of RTU power or in the case of RTU failure, the pump motor starters shall remain operational in the HAND position. In no case shall the RTU have the capability to operate or override the pumps in the HAND or OFF positions.
15. The capability to remotely override or disable individual pumps shall be provided (local switches must be in the AUTO position).
16. The RTU shall have the capability to test the back-up pump controller by creating a high level condition and verifying that the back-up controller functions properly. In the event of a controller failure, the RTU will send an alarm to the Central HMI.
17. Capability shall be provided to configure from two to four pumps.
18. Individual pump run status shall be reported to the Central HMI.
19. The following pump failures shall be reported to the Central HMI: fail to start; fail to stop; premature stop; drive fault; and stator over temperature.
20. RTU configuration parameters shall be adjustable locally and remotely from the Central HMI.
21. A fail-safe input shall be provided indicating cabinet intrusion.
22. The RTU shall have the latest RTU SCADA application license compatible with the existing Central HMI configuration.
23. The following spare shall be provided:
 1. One (1) Motorola ACE 3600 RTU
 2. One (1) AC Power Supply
 3. Two (2) Mixed I/O
 4. Two (2) SCADA Interface Boards

W-46.16 Wet Well Level Monitoring System

The wet well level monitoring system shall be of the ultrasonic type. It shall consist of a transducer element and a transmitter/electronics package.

The transducer shall use a PZT ceramic element with a nominal operating frequency of 50kHz. The transducer shall have a range of 1 to 32.8 ft. The transducer shall convert a 24-volt input from the electronics package to a 3,000-volt peak-to-peak echo pulse. The transducer shall be Factory Mutual (FM) approved for use in a Class I, Div.1, group A, B, C, & D location. The transducer shall be rated intrinsically safe for zone 0. The transducer cable length shall be as required to provide a splice-free mechanization.

The transmitter/electronics package shall operate from 115Vac, 60Hz or 10 to 28Vdc power source. The unit will automatically switch to the dc source when Utility power is lost. The

transmitter shall be compatible with a full line of transducers. The unit shall be simple to program via a hand-held programmer or laptop computer. Basic set-up and advanced echo analysis and diagnostics software shall be provided. A 4-20 mA output and two alarm relays shall be provided. A flashing LED shall indicate healthy status. An integral keypad and LCD display shall be provided. The accuracy shall be 0.25% of measured range and the resolution 0.1% of measured range. The unit shall be tropicalized and be housed in a NEMA 4X enclosure.

The wet well monitoring system shall be as manufactured by Pulsar, Inc., or equal (Transducer— dB10; Transmitter— Ultra-4).

W-46.17 Single-Phase Surge Protection Device

The SPD shall be able to suppress lightning induced voltage surges three times greater than the industry standards. The rated line voltage for SPD shall be 120 VAC single-phase, 3-wire (line, neutral, and ground). The maximum single impulse current shall be 2.5 kA.

- 1.) The clamp voltages for the SPD shall be the following:
 - Line to neutral – 620 volts
 - Line to ground – 850 volts
 - Neutral to ground- 850 volts

The Surge Protection Device shall be as shown on the Drawing Parts Schedule, or equal.

W-46.18 Panel Mount Terminal Blocks

Control terminal blocks shall be single pole units constructed of a polyamide plastic base with wire clamp terminals attached. The terminals shall be rated for 30 amps, 600 volts. The terminals shall accommodate #24 to #10 AWG conductors. The block shall mount on an aluminum DIN rail.

The terminal blocks shall be style UK5N, as manufactured by Phoenix Contact, or equal.

W-46.19 Control Panel Intrusion Sensors

The control panel intrusion sensors shall be of the inductive proximity type, with an 18mm diameter cylindrical, short barrel body. The supply voltage rating shall be 12-24 VDC. The interface circuitry shall be standard 3-wire, PNP, shielded, and rated for a maximum load of 200mA, 600Hz. The output shall be normally open (N.O.) with short circuit protection. The unit shall have a temperature range of –13 to 158 degrees F. The detecting distance shall be 5mm, with a LED indicator.

The proximity sensor shall be Omron, model E2F-X5F1 (Grainger # 1EA77) with Square D mounting hardware model XSZB118 (Grainger 5B233), or equal.

W-46.20 Control Transformers

The control transformer shall be an individual output type for primary and secondary voltages as shown. The secondary shall be grounded and circuit breaker protected. The control transformer shall have sufficient capacity to provide the energy demands for all connected control components

including relays, solenoids, and other indicated items.

The electrical performance shall exceed the requirements of ANSI/NEMA ST-1. The transformers shall be as manufactured by Square D, General Electric, Westinghouse, or equal.

W-46.21 Back-Up Pump Controller and Float Switch

The Back-Up Pump Controller shall be designed to run one or two pumps for a fixed time interval, set by the user, when the primary wet well level controls fail. The unit shall monitor a backup level alarm in the wet well and start up to two pumps when the high alarm float switch closes. When the high-level float switch closes, the back-up unit closes a relay that starts Pump #1 and starts an internal Timer #1. When Timer #1 reaches its set time, and the level-alarm float switch is still closed, Pump #2 is started. Pump #1 and Pump #2 will run until the level-alarm float switch opens. When the level-alarm float switch opens, Timer #2 is started and both pumps continue to run until Timer #2 reaches its set time.

The Back-Up Pump Controller shall be Wilkerson model DR1920, or equal.

The float shall be SPDT mercury switch with polypropylene casing, built in weight, and 30' cord length, as manufactured by Anchor Scientific Roto-Float, Type S, or equal.

W-46.22 Level Monitor Backup

The Level Monitor Backup shall consist of output connections to the Auxiliary inputs of the PCSR ACE Power Supply.

W-46.23 Process Meter

The Process Meter shall indicate the wet well level (in feet) as received from the station's proposed level detection system.

The process meter shall include 4-20 mA input and a 4-20 mA output with the following:

- 1.) 4-Digit 1.20" (30.5 mm) display
- 2.) Max/Min display
- 3.) Type 4X, NEMA 4X, IP65 front
- 4.) Universal power supply 85-265 VAC
- 5.) 24 VDC @ 200 mA transmitter power supply
- 6.) Shallow depth case 3.6" behind panel
- 7.) Sunlight readable display

W-46.24 Area Light Switch

General: Provide toggle switch of specification grade rated 20-amperes, 120-277 volts ac conforming to Fed. Spec. WS 896 and UL Standard 20. Switch shall be provided with back and side wired binding screw type terminals, one-piece spring contact arm and terminal plate with silver alloy contacts, one-piece steel mounting strap with an assured grounding clip. Provide ivory toggle.

The Area Light Switch shall be single-pole switch, Hubbel model HBL1221, or equal.

Miscellaneous

An emergency receptacle, lightning arrester, meter socket, and line-side phase monitor shall be installed and as defined in sections W-46.25 Emergency Receptacle, W-46.26 Lightning Arrester, W-46.27 Meter Socket, W-46.28 Line-Side Phase Monitor, W-46.29 Junction Boxes, and W-46.30 SCADA Antenna.

W-46.25 Emergency Receptacle

The emergency receptacle shall be of the heavy-duty, circuit breaking type with a weatherproof aluminum housing. The current rating shall be as shown with an operating voltage of 600 VAC. The receptacle assembly shall include a wiring box and angle adapter. The receptacle shall be equipped with a 4-pole exposed contact interior (reversed contacts). The receptacle shall be provided with a spring-loaded cap to cover the contacts when the receptacle is not in use.

The emergency receptacle shall be Crouse-Hinds Arktite w/ AJA6 angle adapter, model as shown on the Drawing Parts Schedule, or equal.

W-46.26 Lightning Arrester

The lightning arrester shall be suitable for use in a 480 Volt, 3-phase, 4-wire, Wye service and have the following characteristics:

- a) Type 1 SPD, UL 1449, 4th Edition approval
- b) UL96A Lightning Protection approval
- c) NEMA 4X enclosure for outdoor use
- d) LED status indicator (ON=good, OFF = replace)
- e) Incorporate thermally protected MOVs
- f) Fits 3/4" knockout with 3' leads
- g) 2 years
- h) Nominal Discharge Current Rating: 10 kA
- i) Maximum Continuous L-N / HL-N Voltage: 1800
- j) Maximum Continuous L-G / HL-G Voltage: N/A
- k) Maximum Continuous L-L / HL-L Voltage: 3000

The lightning arrester shall be as manufactured by Mersen, Square D, General Electric, or equal

W-46.27 Meter Socket

The meter socket shall be of aluminum construction with a large closing plate and

quadplex ground. The meter socket shall contain a 3-phase, 4 wire and a lever bypass.

The meter socket shall be Milbank, model ~~UAP3566-X-HSP~~ UAP9701-X-QG-HSP.

W-46.28 Line-Side Phase Monitor

A Phase Monitor, PM1, shall be provided and installed on the line-side of the utility main as shown on the Drawings and specified herein. See section W-46.08 Power Phase Monitors for features.

W-46.29 Junction Boxes

A pump motor junction box and instrumentation junction box shall be provided and installed as shown on the drawings and specified herein. Junction boxes shall be NEMA 4X, stainless steel with hinged doors and a stainless-steel louver plate kit.

The junction box shall be Hammond Manufacturing, or equal.

W-46.30 SCADA Antenna

The SCADA antenna shall be UHF and 360 fully welded gold. The antenna frequency shall be 450-470 MHz, 3 elements, 7.1 dBd gain, 17 dB front-back ratio with 20-3/16" boom length and 7/8" boom diameter.

The SCADA Antenna shall be Laird Technologies, model Y4503, or equal.

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SECTION 49- REDUCED VOLTAGE SOLID STATE STARTER

W-49.01 General

This section includes the requirements for the Reduced Voltage Solid-state Starter (RVSS) equipment.

The RVSS shall be designed for use with a standard three-phase, three-wire, squirrel cage, induction motor.

The unit shall be microprocessor based and programmed to slowly increase the voltage to the motor over an adjustable acceleration time, providing a shock free, smooth acceleration, while drawing the minimum current necessary to start the motor.

The RVSS shall be equipped with an internal by-pass contactor that will close at the end of acceleration time, thus reducing heating and saving power.

W-49.02 Acceptable Manufacturers

The Reduced Voltage Solid-state starter shall be a Solcon Industries Ltd. with Conformal Coated control boards, **Model Number: RVS-DX-44-180-115-8-US.**

W-49.03 General Provisions

The RVSS shall be designed to meet the following specifications:

1. General
 - a. Supply Voltage (Vn): V +10%-15%
 - b. Frequency: 45 – 65 Hz
 - c. Control Supply: 115 V +10% -15%
 - d. Load: **25HP**, 3-phase, three-wire, induction motors.
 - e. Standard display along with a remote keypad

2. Start-Stop Parameters
 - a. Starter FLC: Per Drawings Parts Schedule
 - b. Motor FLA: Per Drawings Parts Schedule
 - c. Start/Stop Profile: Field Programmable
 - d. Kick Start: A pulse of 80% Vn, adjustable range 0.1-1 Sec.
 - e. Initial Voltage: 10-50% VN
 - f. Initial Current: 100-400% of Motor FLA
 - g. Current Limit: 100-400% of Motor FLA
 - h. Acceleration Time: 1-30 Sec
 - i. Deceleration Time: 1-30 Sec

3. Motor Protection

- a. Too Many Starts: Maximum number of starts, range: OFF or 1-10, during a time period of 1-60 min.
- b. Starts inhibit: Period of 1-60 min, during which starting is prevented, after too Many Starts Fault.
- c. Long Start Time: Maximum allowable starting time 1-30 sec.
- d. Over Current (Instant): Two operation functions: during starting trips the starter at 850% and during running at 100-850% In, both within one Cycle (after internal delay).
- e. Overload Class: Overload Class shall be selectable between NEMA Class 10, NEMA Class 20, or NEMA Class 30. The cool down time after an overload shall be non-adjustable, fixed time setpoint.
- f. Under Current: Trips when current drops below 20-90% In, time delay 1-40 sec.
- g. Under Voltage: Trips when main voltage drops below 50-90%, time delay 1-10 Sec. w/ optional automatic reset.
- h. Over Voltage: Trips when main voltage increase above 110-125%, time delay 1-10 sec.
- i. Phase Loss, U/O Freq: Trips when one or two phases are missing and frequency is below 45Hz. or above 65Hz w/ optional automatic reset.
- j. Phase Sequence: Trips when phase sequence is wrong
- k. Shorted SCR: Prevents starting / trips if motor is not connected or incorrectly connected to the starter, or in case one or more SCRs have been shorted
- l. Heat Sink Over temp: Trips when heat-sink temperature rises above 85°C.
- m. External fault: Trips when an External Contact closes for 2 sec.

4. Control

- a. Displays: LCD (2-lines of 16 characters) and 4 LEDs.
- b. Keypad: 6 keys for easy setting
- c. Fault Contact: 2 Contacts, 8A, 250VAC, 2000VA
- d. Aux. Contact: 2 Contacts, 8A, 250VAC, 2000VA

5. Temperature/Humidity

- a. Operating Temp.: -10° to 40°C
- b. Storage Temp.: -20° to 70°C
- c. Humidity: 95% at 50°C or 98% at 45°C.

6. Standards

- a. Dielectric Test: 2500VAC
- b. EMC Emissions: EN 55011 CISPR 11 Class A
- c. EMC Immunity: EN 55082-2 ESD 8KV air, IEC 801-2 Electric RF field 10 V/m, 20-1000MHz, IEC 801-3 Fast transients 2KV, IEC 801-4
- d. Safety EN 600947-1 Related to safety requirements. Designed and assembled to conform with UL508C

SECTION 76 - CONDUIT, WIRE, AND GROUNDING

W-76.01 General

Conduit, wire, and grounding includes furnishing and installing all conduits, underground ducts, bus ducts, wires, cables, and grounding systems as shown, specified, and required for a complete installation. The work includes the furnishing and installation of wires and cables in flexible and rigid conduits, underground ducts, all as required, shown, and specified.

Descriptive literature and technical information relative to conduits, wires, and grounding shall be submitted by the Contractor in conformance with the requirements of the General Provisions.

The Contractor shall, with reference to approved drawings of equipment being installed, prepare detailed plans showing the layout and size of all conduits, ducts, bus ducts, cables and wires, connections between the point of service connection and all utilizing equipment. These plans shall be in sufficient detail to serve as working drawings for the installing electricians. The drawings shall be to scale not less than the Plans and be prepared as the work develops with approval by the Engineer before major steps of work are undertaken.

During construction, careful notes shall be kept of all deviations or changes in the layout or connection diagrams. Upon completion of the work, all working drawings shall be corrected and then marked "Record Drawings". Four sets of final prints, along with an equal number of bound instruction manuals and parts lists shall be given to the Engineer at the end of the job.

Excavation, backfill, form work, concrete, and reinforcing shall be in accordance with the applicable Workmanship and Materials sections.

W-76.02 Underground Ducts

In general, underground ducts for feeders and control wiring shall be plastic conduit. The plastic conduit shall be PVC, Schedule 80, and U.L. Inc. listed for direct burial, as manufactured by Carlon, Triangle, Allied Tube, or equal. The conduit shall be buried a minimum of 18 inches below grade. Manufactured fitted plastic duct spacers shall be used for installation spacing.

Ducts installed under streets, roads, alleys, driveways, and parking lots; and conduits leading from the wet well to junction boxes; shall be rigid aluminum conduit covered with no less than 40 mils of PVC, as manufactured by Plasti-Bond, Perma-Cote, KorKap, or equal. The PVC material shall conform to the applicable ASTM standards and UL 6A. The conduit shall be buried a minimum of 24 inches below grade unless otherwise noted or allowed by the NEC.

Each duct shall be carefully cleaned before and after installation. All inside surfaces shall be free from imperfections likely to injure the cable. After installation of complete duct runs in sizes 2 inches and larger, ducts shall be snaked with an approved tube cleaner equipped with an approved cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the

duct. Ducts through which the mandrel will not pass shall not be incorporated in the work. After snaking, the ends of dead-ended ducts shall be protected with standard conduit caps to prevent the entrance of water or other foreign matter.

Where ducts enter buildings or at stub-ups to equipment, transitions to aluminum conduits shall be made as noted and detailed. Where it is not otherwise shown, all ducts entering buildings and structures shall have transitions to aluminum conduit at least 5 feet from the outermost edge of the pile cap or footing supporting the outermost vertical wall of the building or structure.

Transitions from above-grade rigid aluminum conduit to nonmetallic conduit shall be accomplished with a threaded adapter. Rigid aluminum conduit installed above grade and extending below grade shall include the first 90° elbow. All rigid aluminum conduits extending below grade shall be coated with two coats of an asphaltum-type paint along its entire length below grade and extending 6" above grade or above the top of the finished slab. The asphaltum-type paint shall conform to Fed. Spec. TT-V-51 and equivalent to Koppers Bitumastic Super Service Black.

W-76.03 Liquidtight Flexible Conduit

Liquidtight Flexible Nonmetallic Conduit (LFNC)

All flexible conduits size 2-inch or less in non-classified areas shall be nonmetallic, liquidtight, and have a circular cross section. The conduit shall be resistant to oil, water, heat, sunlight, corrosion, most acids, ozone, alkali, strains, abrasions, and crushing. The conduit shall be rated for continuous use at 140°F and be U.L. Inc. listed. Compatible liquidtight nonmetallic fittings shall be used for conduit installation. The flexible conduit and fittings shall be as manufactured by Carlon, Kellems, K-Flex, or equal.

Liquidtight Flexible Metallic Conduit (LFMC)

All flexible conduits greater than 2-inch in non-classified areas shall be metallic, liquidtight, and have a circular cross section. The conduit shall be of a light-weight aluminum core, coupled with a PVC jacket. The conduit shall be resistant to sunlight, acid, and oil. The conduit shall be rated for a working temperature between -20°C to 80°C and U.L. Inc. listed. Compatible liquidtight metallic fittings **with aluminum locknuts** shall be used for conduit installation. The flexible conduit and fittings shall be as manufactured by Thomas & Betts or equal.

W-76.04 Metallic Conduit and Boxes

All conduit shall comply with the requirements of the U.L. Inc. Standards. Conduit shall be delivered to the job site in standard bundles having each length suitably marked with the manufacturer's name or trademark and bearing the label of the U.L. Inc. inspection service. The minimum size conduit service shall be 3/4 inch.

All exposed conduit within buildings and exposed on outdoor structures shall be rigid heavy wall, 6063 alloy, T-1 temper, aluminum conduit. Aluminum conduit shall conform to Fed. Spec. WW-C-540 and ANSI C80.5.

All conduit encased in building structures, exposed in the screen room/wet well area, or otherwise noted, shall be rigid aluminum covered with not less than 40 mils of PVC outside, and 2 mils of urethane inside, as manufactured by Plasti-Bond, Perma-Cote, KorKap, or equal. The physical properties of the PVC and urethane materials shall conform to the applicable ASTM standards and UL 6A.

Cast copper-free aluminum shall be used for outlet boxes and fittings in aluminum conduit systems. Outlet and junction boxes shall be of proper dimensions for each application. Cast metal boxes shall have watertight gaskets and covers secured with stainless steel screws. Outlet boxes shall be Crouse-Hinds type FS, FD, or equal.

PVC coated boxes and fittings shall be used in PVC coated conduit systems.

Conduit fittings, such as elbows, tees, couplings, caps, bushings, nipples, and locknuts shall be constructed of the same material as the conduit and be threaded to provide watertight connections. Conduit bodies shall be copper-free cast aluminum with gasketed aluminum covers secured with stainless steel screws and be type Form 7 or Mark 9 as manufactured by Crouse-Hinds, or equal.

Where it is necessary to use electrical unions, Universal, Erikson, or equal conduit couplings shall be used.

W-76.05 Conduit Installation

All conduits shall be installed as required. The conduit system shall be installed complete with all accessories, fittings, and boxes, in an approved and workmanlike manner to provide proper raceways for electrical conductors.

The Contractor shall note that conduit runs shown are for the purpose of outlining the general method of routing the conduits to avoid interferences.

All other conduits shall be run exposed, except where shown otherwise.

Sizes not shown shall be one size larger than indicated in Tables 1 and 4, Chapter 9, of the NEC. Exposed conduit shall be run parallel to or at right angles from walls or beams and plumb on columns and on walls. Conduit shall not be run through beams except where approved by the Engineer or specifically detailed. Where possible, conduit shall be pitched slightly to drain to the outlet boxes or otherwise installed to avoid trapping of condensate. Where necessary to ensure drainage, Appleton Type ECD, Crouse-Hinds, or equal, 1/4-inch drain fitting shall be installed in the trapped conduit at low points.

Factory made bends or elbows shall be used wherever possible. Field bends shall be carefully made to prevent conduit damage or reduction in the internal area. The bending radius shall be not less than six times the nominal diameters of the conduit with carefully matched bends on parallel runs to present a neat appearance. The number of crossovers shall be kept to a

minimum.

All conduit shall be reamed to remove burrs before installation. Aluminum conduit shall be cut with a saw to prevent reduction in internal area. To seal out air and moisture, lower electrical resistances, and prevent seizing and galling; aluminum conduit threads shall be given a coat of Aluma-Shield surface compound, as manufactured by Thomas & Betts, prior to assembly. All connections and joints in all conduit runs shall be watertight and ensure a low resistance ground path in the conduit system. All conduit runs shall be swabbed to remove foreign matter before wires are pulled in. Conduit terminations in boxes, panels, switchboards, motor control centers, and other sheet metal enclosures shall be bonded together for grounding and be fitted with insulating bushings, O.Z./Gedney Type A, Thomas and Betts, or equal. Where grounding bushings are required by code or shown, O.Z./Gedney Type SBLG, Thomas and Betts, or equal shall be furnished.

Conduit shall be neatly grouped where several lines follow a parallel course, and shall be well supported, using stainless steel clips or hangers of the ring or trapeze type. Clips, hangers, and support rods shall be held by self-drilling anchors, power-driven fasteners, or stainless-steel channel insets in the concrete ceilings or walls. Perforated strap hangers will not be accepted.

Conduit runs that enter the building from outdoors, or that pass through refrigerated or air-conditioned areas, are subject to moisture accumulation due to condensation. A pull box shall be provided in the conduit run near the point of temperature change to prevent trapping of moisture within the conduit system. A 1/4-inch weep hole shall be drilled in the bottom of the pull box. After the wires and cables are installed, the end of the conduit continuing into the warmer area shall be packed with a nonsetting sealing compound.

All PVC coated aluminum conduit shall be installed using specialized tools and equipment as recommended by manufacturer. The Contractor shall ensure those installing PVC coated aluminum conduit are certified by the manufacturer prior to beginning installation. Installation of PVC coated aluminum conduit shall not begin until a copy of an unexpired Certified Installer Card for each installer is submitted and approved by Engineer.

All conduit shall be securely fastened in place and supported at maximum 5 feet intervals.

W-76.06 Conduit Connections to Equipment

The conduit system shall terminate at the terminal box or at the conduit connection point of electric motors, devices, and equipment. Terminations of conduits at such locations shall permit direct wire connections to the motors, devices, or equipment.

Conduit connections shall be made with rigid conduit if the equipment is fixed and not subject to adjustment, mechanical movement, or vibration. Myers water-tight /dust-tight hubs shall be used for outdoor, below grade, or wash down areas. Rigid conduit connections shall have union fittings to permit removal of equipment without cutting or breaking the conduit.

If equipment is subject to adjustment, mechanical movement, or vibration, conduit

connections shall be made with approved flexible conduit and conduit connections shall be watertight. Flexible conduit shall not be installed in lengths longer than 3 feet. Flexible conduit shall transition to rigid aluminum conduit using an approved conduit fitting.

W-76.07 Expansion Fittings

Expansion fittings shall be installed at all expansion joints and where required by codes. Conduit expansion fittings shall be Crouse-Hinds Type XD, O.Z./Gedney Type DX, or equal.

W-76.08 Terminal, Junction, and Pull Boxes

Junction and pull boxes shall be installed as shown and as required.

Surface-mounted junction and pull boxes, unless specified otherwise herein, shall be of cast aluminum complete with mounting lugs, threaded entry bosses and flange or rabbeted gasketed covers.

Surface-mounted junction and pull boxes which would exceed 50 pounds weight if cast or which are shown as fabricated sheet metal boxes shall be made of 1/8-inch sheet aluminum, or equivalent stainless steel, with sides return channel flanged around the cover opening or with approved welded angle or channel supporting frames. Sheet aluminum boxes shall be provided with mounting lugs or channels and with conduit termination hubs. All seams in sheet aluminum boxes shall be continuously welded and ground smooth. All surface boxes larger than 6 inches square shall be mounted a minimum of 3/4 inch clear of the mounting surface by means of offset lugs or support channels.

Fabricated junction and pull boxes which are partially or fully encased in concrete shall be made of 10-gauge sheet stainless steel and fabricated in a similar manner to the sheet aluminum pull boxes specified herein, complete with mounting lugs or channels and conduit termination hubs. Cast aluminum boxes shall be provided in smaller sizes where required for full or partial encasement in concrete.

All junction and pull boxes shall be provided with covers or doors as shown or required. Covers and doors shall be fabricated of materials equal in weight, gauge, structure, and metallic composition as the basic box. All covers shall be gasketed and held in place with stainless steel captive knurled head screw slot bolts. All pull and junction boxes shall be provided with hinged doors. Doors shall have continuous hinges, and 3-point catches with external handles and hasps for padlocks. All doors shall be gasketed.

All boxes shall be provided with partitions as shown and as required.

Fabricated boxes shall be rated NEMA 12 for indoor, above grade areas; rated NEMA 4X for outdoor areas; and manufactured by Hoffman, Hope, or equal.

W-76.09 Hazardous Areas

All conduit and equipment installed in or routed through hazardous areas, as well as other electrical appurtenances installed therein, shall be installed to conform in every respect to Chapter 5 of the NEC for Class I, Division 1, Group D hazardous locations, unless noted otherwise. All material installed in hazardous areas shall be listed as complying with the requirements of the U.L. Inc. for use in Class I, Group D atmospheres. Terminal Boxes and Enclosures mounted in Hazardous Areas shall be NEMA 7, cast aluminum.

Sealing shall be provided for all conduits within and leaving hazardous areas as required.

W-76.10 Grounding System

A complete grounding system shall be in accordance with applicable ANSI, IEEE, and NEC Standards and local codes.

All noncurrent-carrying metal parts of the electrical wiring system shall be grounded. The grounding system shall include, but not be limited to, the following:

1. Motor control center controllers, ground bus, and enclosures.
2. All motor frames.
3. All conduit systems.
4. All mechanical equipment and structures.
5. Distribution and lighting panelboards.
6. Control, relay, and instrumentation panels.
7. Lighting fixtures and receptacles.
8. Fans, blowers, pumps, and similar equipment.
9. Hoist beams, cranes, and similar items.

A grounding connection from the transformer to the City water pipe shall be provided. The wire and conduit shall be attached to the City water pipe with a U.L. Inc. listed cast bronze U-bolt connector with silicon bronze bolts and nuts.

Motor frames shall be grounded by means of stranded, 600-volt insulated copper cables installed within the motor feeder conduit system. The cable shall be lug bolted to the motor terminal box and the ground bus of the motor control center serving the motor.

An equipment grounding conductor shall be installed in all electrical raceways and shall be sized in accordance with Article 250.95 of the National Electrical Code (NEC).

Exposed or buried ground conductors shall be bare copper wires or bars of the proper sizes.

All exposed ground cables or bars shall be firmly and neatly supported in place at proper intervals. Where subjected to mechanical abuse, protective enclosures shall be provided.

Grounding conductors run in conduits with circuit conductors shall be stranded cable with 600-volt green XHHW, TW, THW, or RHW Code insulation.

Stainless steel ground rods shall be 5/8-inch diameter with the length as required and made up of a 10-foot section with 5-foot sections added as required. Rods shall be driven to permanently moist soil.

Connections to ground rods, transformer case ground bus bars, case grounds, bare ground grid conductors, and the like, shall be made by an exothermic welding process or by clamps specifically designed for this application.

Ground conductor connections to ground bus bars in motor control centers, and the like, shall be cable lug bolted terminations equal to line conductor terminations specified hereinafter.

Welds embedded in the ground or concrete shall be cleaned and painted with an asphaltum base paint.

Tests shall be conducted by the Contractor and witnessed by the Engineer to determine the ground impedance for the entire system. The test shall be accomplished by using a ground loop impedance tester. The result shall not exceed 2 ohms at any point of test. If necessary, additional ground rods shall be installed at locations approved by the Engineer.

Care shall be exercised to ensure good electrical connections between the conduits and metallic enclosures of switchgear, control centers, and the like. Grounding jumpers shall be installed where necessary to accomplish this purpose.

W-76.11 Wires and Cables - General

Wires and cables required for all systems shall be complete, connecting all equipment and control components. Conductors shall be of ample size, with suitable insulation as specified hereinafter.

W-76.12 600-Volt Wire and Cable - Conductors

All ground conductors and power, control, and lighting conductors shall be soft-drawn or annealed stranded copper wire meeting the requirements of ASTM B 3 or B 33. For lighting fixture and convenience outlet wiring only, conductors No. 10 AWG and smaller may be solid conductor. Conductors shall be sized to limit the maximum conductor temperature to less than 75°C, except where specifically stated otherwise. Table 310.16 of the NEC shall be the guide in determining 600-volt conductor sizes. The minimum size of conductor for power and lighting

wiring shall be No. 12 AWG.

W-76.13 600-Volt Power and Control Cable - Insulation

Low voltage circuits shall be wired with 600-volt insulated conductors, sized as shown, or as required by the actual load to be served, whichever is larger.

Single Conductor: Insulation for single 600-volt copper conductors shall be cross-linked polyethylene compound, U.L. Inc. listed, NEC Type XHHW-2, with surface print cable identification; as manufactured by Okonite, American, Southwire or equal.

Multiconductor Cables: Individual conductors shall be insulated with 15 mils of polyethylene or PVC and 4-mil nylon jacket. The bundle of conductors shall be wrapped with tape binder and an outer jacket of not less than 45 mils of PVC. Use ICEA Method 1 for color coding wires.

W-76.14 Instrumentation / Data Cables - Insulation

4-20 mA Analog: Shielded two-conductor No. 16 AWG cables for instrumentation shall be properly stranded 600-volt insulated copper wire twisted cables as shown. Conductor insulation shall be polyethylene. Shields shall be overlapped metalized tape providing 100% coverage with tinned copper drain wire. Cable outer jacketing shall be of polyvinyl chloride. Cables shall be Belden #8719, or equal.

Three Conductor: Stranded No. 16 wire, 600-volt polyethylene insulation, twisted conductors, tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and outer jacket of PVC. Belden Cat. No. 8618.

Category 5: Provide cable having third party verification to TIA/EIA 568-A Category 5 requirements and constructed of four pair of stranded No. 24 AWG solid copper wire, polyethylene or polypropylene insulation, stranded No. 24 AWG tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and outer jacket of gray PVC. Belden Cat. No. 1624R.

Twinaxial (Data Highway): Provide stranded No. 20 AWG tinned copper wire (9.5 ohms/mile), 78 ohm nominal impedance, 300 volt polyethylene insulation, tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and 55 percent tinned copper braid shield (4.1 ohms/mile) and outer jacket of blue PVC. Belden Cat. No. 9463.

1-1/2 Pair (RS-485): Provide three stranded No. 22 AWG tinned copper wires with 300-volt FHDPE insulation, a tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage, 90 percent tinned copper braid shield and a PVC outer jacket. Insulated wires shall be configured as one twisted pair and one reference conductor— 120 Ohms characteristic impedance. Belden Cat. No. 3106A.

W-76.15 600-Volt Wire and Cable - Installation

The 600-volt wires and cables pulled into ducts and conduit shall be installed without the use of lubricants, except where such use is necessary and approved by the cable manufacturers and the Engineer. Wires and cables shall be carefully handled to avoid twists and kinks in the conductors or damage to the insulation. All trapped conduit and duct lines shall be swabbed to remove any accumulated moisture or debris before wires or cables are pulled in.

Cable reels shall be stored on concrete or other hard surface or shall be lagged with 2 x 4 wood laggings providing 100% coverage.

No splicing will be permitted, except in junction boxes.

Lug bolting at devices, bus bars or motors shall be made up with a flat washer, a Belleville washer, and a locknut. The length of the bolt shall not extend more than a couple of threads past the end of the locknut. Lugs shall have holes that match the size of the bolt. The minimum size for feeder lugs shall match the bolt size of lugs on motor wiring. If motor lugs don't match, lugs shall be changed to match size of bolt, using a proper crimping tool.

Lines of nylon or polypropylene, propelled by carbon dioxide or compressed air, shall be used to snake or pull wire and cable into conduits. Flat steel tapes or steel cables shall not be used.

W-76.16 600-Volt Wire and Cable - Splices and Terminations

Splices between copper conductors, size no. 10 AWG and smaller, shall be made up with compression type butt connections. Splices between copper conductors, size no. 8 AWG and larger, shall be made up with U.L. Inc. listed compression type tube connectors.

Lug bolting at devices, bus bars or motors shall be made up with a flat washer, a Belleville washer, and a locknut. The length of the bolt shall not extend more than a couple of threads past the end of the locknut. Lugs shall have holes that match the size of the bolt. The minimum size for feeder lugs shall match the bolt size of lugs on motor wiring. If motor lugs don't match, lugs shall be changed to match size of bolt, using a proper crimping tool.

Splices and pigtail connections for lighting and receptacle wiring inside the buildings, no. 10 AWG and smaller, shall be made with a pre-insulated, spring connectors, or equal.

Stranded copper wire size no. 8 AWG and smaller for terminal block connections, shall be made with a ferrule to wire termination. The ferrule shall be insulated and extend from the stripped insulation, then compressed with a properly sized crimping tool. The ferrule shall be manufactured by Phoenix Contact, or equal.

Splices and lug terminations in 600-volt insulated cables shall be carefully taped and covered, using materials recommended by the cable manufacturer, to provide watertight insulation equal to that of the conductors.

Lug terminations at motor connections shall be insulated using three layers of tape. The first layer shall have a wrap of varnished cambric tape (Scotch 2520 or equal). As an alternative to varnished cambric tape, self-fusing silicon rubber tape (Scotch 70 or equal) or vinyl electrical tape (Scotch 33, 88 or equal) may be used. If vinyl electrical tape is used, the wrap shall be installed upside down. The second layer shall have a wrap of rubber splicing tape (Scotch 23, 130C, or equal). The third layer shall have a wrap of vinyl electrical tape (Scotch 33, 88, or equal).

Splices shall not be made within manholes unless specifically approved by the Engineer.

W-76.17 600-Volt Wire and Cable - Tests

The 600-volt insulated cables shall be factory tested prior to shipment in accordance with IPCEA standards for the insulation specified.

The following 600-volt wires and cable shall be tested after installation but before final connections are made up:

1. All feeders from motor control centers to motors 30 horsepower and larger.
2. All feeders from variable speed drive units.
3. All feeders from motor control centers to lighting panels and dry-type transformers.

For the above listed cables, a test voltage of 1,500 volts AC shall be applied for a period of 1 minute between all conductors in the same conduit, and between each conductor and ground.

All tests shall be made at the Contractor's expense, and certification of the tests shall be submitted to the Engineer. If any failures occur during the tests, the Contractor shall replace the cable.

W-76.18 Identification of Circuits

All wires and cables shall be banded with an identifying number and color code at each end termination and at each splice point in junction boxes. The identifying number of each wire shall be determined at the point of circuit origin and shall continue unchanged to the point of circuit termination. In each conduit system, the wire identifying numbers shall include the conduit designation with a numeral suffix. The numeral suffix shall start with No. 1 and continue as required.

Where conduits enter motor control centers, switchgear terminal cabinets, and the like, the identification tag shall be fastened to the wire bundle near the conduit termination. The tag shall be held by an adjustable, self-locking nylon "Ty-Rap" as manufactured by Thomas and Betts Co., or equal. The identifying tag shall be of aluminum, brass, rigid fiber, and shall be engraved, stamped, or painted with the scheduled conduit number.

The wire identifying numbers and color code shall be applied as PVC slip-on sleeves,

properly fitted to the wire diameter. The sleeves shall be as manufactured by Brady Co., Thomas and Betts Co., or equal.

Color Coding:

PHASE	208/120 VOLTS	240/120 VOLTS	480Y/277 VOLTS
A	Black	Black	Brown
B	Red	Orange (High-Leg)	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Gray or White
Ground	Green	Green	Green

W-76.19 Wire and Cable Connections to Equipment

Electrical connections shall be made to all equipment in strict accordance with the manufacturer's approved wiring diagrams, the Plans, or as approved by the Engineer. The Contractor shall be responsible for the accuracy of his work and shall repair any damage and replace any damaged equipment resulting from erroneous connections.

W-76.20 Painting

Conduit and boxes shall be painted in accordance with the Workmanship and Materials section headed "Painting."

Where aluminum surfaces such as boxes, conduit, or structural supports come in contact with incompatible metals, lime, mortar, concrete, or other masonry materials, the contact areas shall be given one field coat of Koppers Metal Passivator No. 40 and one coat of Koppers Bitumastic Super Service Black or two coats of asphalt varnish conforming to Fed. Spec. TT-V-51.

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SECTION 16216

DIESEL ENGINE DRIVEN GENERATOR WITH WEATHERPROOF ENCLOSURE

W-16216.01 Scope of Electrical Work

1. Furnish all materials, equipment and incidentals required to delivery, and field test the weatherproof diesel engine driven generator unit, automatic transfer switch, and appurtenances as shown on the Drawings and specified herein.
2. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, the shop testing, and delivery and field testing, of required generator and appurtenances for the complete unit as herein specified, whether specifically mentioned in these Specifications or not.
3. The Generator Supplier is responsible for field testing of the entire installation and instruction of the regular operating personnel in the care, operation and maintenance of all equipment.

W-16216.01 Description of System

1. The engine-generator sets shall be mounted as shown on the Drawings and shall be arranged for automatic starting and stopping, and load transfer upon failure of the normal source of power. The unit controls shall provide for automatic exercising on a weekly basis.

W-16216.01 Qualifications

1. The generator sets shall be listed to UL 2200.
2. The generator shall be Caterpillar. A Letter of Standardization has been executed for this generator. No other generator shall be considered an "or equal" in accordance with the City's standardization program. The "or equal" clause applies to all other equipment, unless specifically excluded by a Single Source Certificate or Letter of Standardization.
3. The enclosure and fuel tank shall be by Phoenix Products.
4. Automatic Transfer Switch shall be Eaton or approved equal, UL 1008 Listed, Service Entrance Rated, Molded Case Circuit Breaker Type, 400-amp, 480 Volt, 3 pole, ATC-900 controller, with stainless steel enclosure.

W-16216.01 Submittals

1. Submittals shall include test certification and specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams,

dimension drawings, and interconnection diagrams identifying by terminal number each required for interconnection between the generator set and the transfer switch included elsewhere in these specifications.

- A. Submit to the Engineer operating and maintenance data.
- B. Submit to the Engineer the equipment MANUFACTURER'S Certificate of Proper Installation, Testing, and Instruction.
- C. Submit to the Engineer the written warranty as required below.

W-16216.02 Ratings

1. The standby rating of the generator sets shall not exceed the MANUFACTURER's published prime rating by more than 10%. The gross engine horsepower required to produce the standby ratings shall not exceed the MANUFACTURER's published continuous duty rating by more than 150 percent. Continuous duty rating shall be as defined in BS649 or DIN6270 but in no case shall it exceed the MANUFACTURER's published continuous duty rating for the engines as used in continuous rated pump drive applications. The gross engine horsepower required for the generator set standby ratings described above shall include all parasitic demands such as generator inefficiencies, fuel pumps, water pumps, radiator fan (for fan cooled models) and all accessories necessary to the unit's proper operation while operating at rated load and at a rotative speed not to exceed 1800 rpm.

W-16216.02 Engines

1. The engine shall be full compression ignition, four cycle, single acting, solid injection engine, either vertical or "V" type. Speed shall not exceed 1800 revolutions per minute at normal full load operation. Multi block engines are not allowed. The engine governor shall be electronic type with a +/- 0.5 percent accuracy.
2. The engine shall be capable of satisfactory performance on No. 2 fuel oil (ASTM Designation D396). Diesel engines requiring a premium fuel will not be considered.
3. The engine shall be capable of operating at light loads for extended periods of time and shall provide a means to reduce carbonization. Periodic cleaning of exhaust ports shall not be required.
4. The engine shall be equipped with fuel filters, lube oil filters, intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter, engine driven water pump, and unit mounted instruments. Unit mounted instruments shall include a fuel pressure gauge, water temperature gauge, and lubrication oil pressure gauge. The engine shall be provided with low oil pressure, high water temperature, low coolant level and overspeed safety shutdowns of the manual reset type. Additional instruments and safety shutdowns shall be provided as noted herein.
5. Injection pumps and injection valves shall be a type not requiring adjustment in service and shall be of a design allowing quick replacement by ordinary mechanics

without special diesel experience. The engine shall have an individual mechanical injection pump and injection valve for each cylinder, any one of which may be removed and replaced from parts stock. Fuel injection pumps shall be positive action, constant-stroke pumps, activated by a cam driven by gears from the engine crankshaft. Fuel lines between injection pumps and valves shall be of heavy seamless tubing.

6. The fuel system shall be equipped with fuel filters having replaceable elements. Filter elements shall be easily removable from their housing for replacing without breaking any fuel line connections, or disturbing the fuel pump, or any other part of the engine. All fuel filters shall be conveniently located in one accessible housing, ahead of the injection pumps so that the fuel will have been thoroughly filtered before it reaches the pump. No screens or filters requiring cleaning or replacement shall be used in the injection pump or injection valve assemblies. The engine shall be equipped with a built-in gear-type, engine-driven fuel transfer pump, capable of supplying fuel through the filters to the injection pump at constant pressure.
7. In addition to the standard fuel filters provided by the engine MANUFACTURER, there shall also be installed a primary fuel filter and a water separator in the fuel inlet line to the engine.
8. The engine shall be provided with removable wet-type cylinder liners of close grained alloy iron, heat treated for proper hardness as required for maximum liner life. The cylinder block shall be a one piece stress relieved gray iron casting.
9. The engine shall have a gear-type lubricating oil pump for supplying oil under pressure to main bearings, crank pin bearings, pistons, piston pins, timing gears, camshaft bearings, valve rocker mechanism and governor. Effective lubricating oil filters shall be provided and so located and connected that all oil being circulated is continuously filtered and cleaned. Filters shall be accessible, easily removed and cleaned and shall be equipped with a spring-loaded by-pass valve as an insurance against stopping of lubricating oil circulation in the event the filters become clogged. The engines shall have a suitable water cooled lubricating oil cooler.
10. The engine shall be provided with one or more engine mounted dry type air cleaners of sufficient capacity to protect effectively the working parts of the engine from dust and grit.
11. During the initial start of the engine, a system shall be provided to pre-lube at low idle speed. When the internal oil pressure reaches a predetermined safe value, the engine will then increase to generator set operation speed.
12. Mounting: The unit shall be mounted on a structural steel sub-base and shall be provided with vibration isolators.
13. The engine shall be EPA Tier 2 certified.

W-16216.02 Cooling Systems

1. The engine shall be furnished with a unit mounted radiator-type cooling system having sufficient capacity for cooling the engine when the diesel generator set is delivering full rated load in an ambient temperature not to exceed 110 degrees F. The engines shall be provided with a thermostatic valve placed in the jacket water outlet between the engine and the cooling source. This valve shall maintain the proper jacket water temperature under all load conditions. Total air restriction from the radiator shall not exceed 0.5 inches of water at both inlet and outlet. A flexible connecting section shall be provided between the radiator and discharge louver frame.
2. Closed circuit jacket water system shall be treated with a rust inhibitor as recommended by the engine MANUFACTURER.
3. The expansion tank of the radiator shall be fitted with a low water level switch and wired into the safety shutdown system of the unit.

W-16216.02 Generator, Exciter and Accessories

1. Rating: The generator's KW ratings shall be as indicated on the Drawings, 0.8 p.f., 1800 RPM, 3 phase, 4-wire, 60 Hertz, 480 volts, 12 leads, with a maximum temperature rise of 130 degrees C (both armature and field) by resistance at full rated load in ambient air of 40 degrees C. The generator shall conform to NEMA Standard MG-1.
2. Performance: The instantaneous voltage dip shall not exceed 15 percent of rated voltage when any load is applied. Recovery of stable operation shall occur within 5 seconds. Steady state modulation shall not exceed + ½ percent.
3. Construction:
 - A. The generator and exciter shall be dripproof, with split sleeve, or ball race bearings. A shaft-mounted brushless exciter shall be a part of the assembly. The stator cores shall be built up of high grade silicon steel laminations precision punched, and individually insulated. Armature lamination followers and frame ribs shall be welded integral with the frames for support of the stator core. A directional blower shall be mounted on the unit to draw cooling air from the exciter and over the rotor poles and through louvered openings on the opposite end.
 - B. The exciter shall be a shaft driven PMG pilot exciter feeding the main's exciter, fast response type, with a rotating 3-phase full-wave bridge. The exciters shall have a low time constant and large capacity to minimize voltage transients under severe load changes.
 - C. The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-33.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotors and stators shall be limited to 130° C. The excitation systems shall be

of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within +/- 0.25% at any constant load from 0% to 100% of rating. The regulators must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability and volts-per-hertz operations; and be protected from the environment by conformal coating.

- D. Generator rotor poles shall be built up of individually insulated silicon steel punchings. Poles shall be wound and bonded with high strength epoxy resin. Cage connections to the amortisseur rings shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be securely bolted to the rotor shaft with bolts sized for the centrifugal forces on the rotor. Generator windings shall be braced for full line to ground fault currents, with solidly grounded neutral system.

4. Accessories and Attachments

- A. Low Voltage Terminal Boxes: The generators shall have separate AC and DC low voltage terminal boxes with suitably numbered terminal strip for required connections.
- B. Engine Water Heater: Thermostatically controlled and sized to maintain the manufacturer's recommended engine coolant temperature to meet start-up requirements of NFPA-99 and NFPA-110, Level 1. Power supply shall be 120 volts single phase.
- C. Alternator Heater: Sized to prevent the accumulation of moisture or dampness in the alternator windings. Power supply shall be 120 volts single phase.

5. Generator Associated Controls:

- A. Voltage Regulator:
 - i) The generator MANUFACTURER shall furnish a hermetically sealed, silicon controlled rectifier type voltage regulator employing a zener reference with a +1 percent regulation for the generator. The regulators shall include 3-phase voltage sensing, automatic short circuit protection and shall include automatic underfrequency protection to allow the generator to operate at no load at less than synchronous speed for engine start-up and shutdown procedures. Switches and/or fuses shall not be used to provide this protection. An over-voltage sensing module with manual reset shall be furnished with the regulator. A volts per Hz., sensing module shall be provided as part of the regulation system.
 - ii) A voltage adjustment rheostat for 5 percent voltage adjustment on the unit shall be provided.

- iii) High voltage step-down potential transformers shall be provided for the voltage regulator power input and sensing circuits if required.
- B. Sustained Short Circuit: A permanent magnetic exciter shall be provided on the unit for sustaining a current of 300 percent during a short circuit, permitting the generator breaker to trip on overload.

W-16216.02 Sound Attenuated, Weather-Protective Enclosures

1. Enclosure shall be manufactured by Phoenix Products of Jacksonville, Florida.
2. The intent of this Specification is to provide the generator system with sound attenuated, weatherproof type generator set enclosures complete in every detail and requiring no additional in-field modifications or assembly, except where specifically allows by these Specifications. The enclosure is to be accurately dimensioned so as to be in compliance with the National Electrical Code (NEC), and the National Fire Protection Association (NFPA) for clearance of all specified items included therein, and all applicable fire codes for a structure and application of this type.
3. The enclosure shall conform to the following construction and design criteria shown on the Structural Drawings. The enclosure shall be designed for the wind loads listed below. Enclosure manufacturer to submit to the Engineer structural drawings and a certification signed and sealed by a Professional Engineer registered in the State of Florida stating that the enclosure is rated to withstand these wind loads.

Wind Loads:

Ultimate Wind Velocity, V_{ULT}	151 MPH
Nominal Wind Velocity, V_{ASD}	117 MPH
Exposure Category	C
Risk Category	III

4. Enclosure shall also include Florida Department of Community Affairs Modular Building Insignia
5. Enclosure shall consist of a roof, two (2) sidewalls, two (2) end walls, and be manufactured of formed aluminum components. The enclosure is to be provided with a means for securely attaching the entire structure to the base/fuel tank as specified within.
6. Roof, sidewalls and end walls shall be of formed 0.125 marine grade aluminum. The roof is to be bolted to both side and end walls to form a complete weather and wind resistance assembly.
7. Wall framing shall be incorporated in the panels by forming an open back box

structure. Skin material shall be minimum thickness .080" 3003 grade aluminum. Enclosure shall have a baked on powder-coat finish for maximum corrosion resistance. Exterior skin panels shall be integral to the wall structure and not separate pieces riveted onto framing members. Wall panels shall be no wider than 36" each and shall be removable without the use of special tools. Wall and roof panels shall be designed so that field replacement can be accomplished without disassembly of the entire structure if damage should occur.

8. Standard enclosure exterior color is white.
9. Roof assembly shall be cambered to aid in rainwater runoff. Roofs with thicknesses of less than 0.125" nominally shall not be considered. Roof applications assemblies are to be mechanically fastened to the vertical wall sections. Glued or crimped roofs shall not be allowed nor considered as an acceptable alternative.
10. Air handling shall be as follows: Air will enter the enclosure through a Hood, Plenum or Sound Attenuated Louvers/Baffles, as determined by the specific application and shall allow for the airflow demand for proper cooling to generator set package. The cooling air Inlet system shall prevent water intrusion into the enclosure with the generator set operating at full rated load while allowing for a maximum air restriction of less than 0.30" H₂O. Radiator Discharge shall be through a gravity operated extruded aluminum backdraft type damper and into a vertical discharge plenum or hood. Discharge plenum/hood shall discharge air upward and be provided with a means to positively drain any and all water entering the discharge device. Air discharge devices shall in no event restrict airflow by more than 0.25" H₂O. To ensure adequate airflow for cooling and combustion the static restriction over the entire system shall not exceed 0.50" H₂O. Both Intake and Discharge hoods and plenums shall be provided with removable bird/rodent screening to prevent the entrance of debris, birds, rodents and other vermin.
11. All interior sidewalls shall contain non-asbestos thermal acoustic insulation with fire retardant properties. The insulation shall be completely covered by mill finish 0.050" perforated aluminum lining secured to the enclosure interior.
12. Four-point lifting provisions shall be provided and have sufficient capacity suitable for rigging the entire Enclosure assembly.
13. A minimum of two (2) single access doors shall be provided. Doors shall be manufactured of the same material as enclosure. Doors shall be fully gasketed to form a weather tight perimeter seal. Door hinges shall be full-length stainless-steel piano type and shall be attached with stainless steel hardware. Door handles shall be of a corrosion resistant material and shall provide for a lockable, secure entry point into the enclosure. Doors shall be insulated with no less insulation than is provided in the enclosure walls for sound attenuation.
14. Enclosure manufacturer shall provide all necessary hardware to internally mount the exhaust silencer(s) specified herein. Silencer mounting hardware shall maintain the weatherproof integrity of the enclosure system. If the silencer is mounted internally it should discharge upward into the radiator discharge plenum or hood where possible, otherwise the enclosure manufacturer shall provide an aluminum

rain collar and rain dress shield. Rain Collar and Dress Shield shall be manufactured of aluminum or stainless steel and designed as a circular fabricated part that does not require hole indexing by the installing contractor during site installation

15. As a minimum the enclosure shall provide an average 42db(A) sound reduction as measured at one meter, five feet above grade level under free field conditions to allow for a maximum of 75db(A) at 5 meters from the enclosure.
16. Electrical Package:
 - A. (4) LED Lights in Vapor Proof Fixtures. Lights shall be controlled by Switches Located at each of the doors.
 - B. Engine Jacket Water Heater
 - C. Alternator Space Heater
 - D. Engine Starting Battery Charger
 - E. Emergency Stop Pushbutton: Provide a NEMA 4X SS, Red, Mushroom-head emergency pushbutton that will immediately stop the generator upon activation. Provide a placard above the pushbutton to read "Generator Emergency Shut Down". Refer to drawings for pushbutton and placard location and details.
 - F. Prewired mini power zone for all electrical components. Provide panel schedule and electrical load calculations for sizing of mini power zone.
17. Provide an aluminum platform and stair assembly to access all doors on the generator enclosure as shown in the drawings. Platform and stairs shall comply to the latest edition of the Florida Building Code. Refer to structural drawings for loading requirements.

W-16216.02 Exhaust Systems

1. Exhaust Silencers - A critical type, side inlet, end outlet, Miratech or equivalent silencer and a flexible stainless steel exhaust fitting properly sized shall be furnished and installed at the time of manufacture of the Generator system. The silencers 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. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine MANUFACTURER. So called "spiral" or truck mufflers are disallowed and will not be considered as equal to the industrial quality silencers specified above.
2. The silencers shall be fitted with a tail pipe extension and rain cap to prevent the entrance of rainwater.
3. Rain Skirt - At the point where the exhaust pipe flexible tubing penetrates the roof of the enclosure, a suitable "rain skirt" and collar shall be provided by the

MANUFACTURER.

It shall be designed to prevent the entrance of rain and allow for expansion and vibration of the exhaust piping without chafing or stress to the exhaust system. This detail must appear on the drawings submitted for approval.

W-16216.02 Automatic Starting System

1. Starting Motor - A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be 12 volts.
2. Automatic Control - Fully automatic engine start-stop controls in the generator control panels shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and loss of engine coolant. Alarms for approaching high water temperature and impending low oil pressure shall also be included. Controls shall include a 30-second single cranking cycle limit with lockout or a cyclic crank system with lockout and overcrank protection.
3. Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be 12 volts, and the battery set shall be rated no less than 90 ampere hours. Necessary cables and clamps shall be provided.
4. Battery Trays - battery trays shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be constructed of fiberglass and so treated as to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over of battery electrolyte shall be contained within the tray to prevent a direct path to ground.
5. Battery Chargers - A current-limiting, automatic 12-volt DC charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Amperage output shall be no less than ten (10) amperes. Chargers shall be wall mounting type in NEMA 1 enclosure, and U.L. listed as an industrial control panel. The chargers shall be as manufactured by SENS per NFPA 110 and U.L. 508. The chargers shall be mounted and wired within the enclosure for the generator set by enclosure manufacturer.

W-16216.02 Main Line Circuit Breakers

1. Type - Main line, 600 volts, 100% rated, molded case circuit breaker mounted upon and sized to the output of the generator shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions.
2. Main Line Circuit Breaker shall have an adjustable trip rating as shown on the Drawings.
3. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit

protection. The circuit breaker shall meet standards established by Underwriters Laboratories, National Electric Manufacturers Association, and National Electrical Code.

4. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.
5. Circuit breaker shall have battery voltage operated shunt trip wired to safety shutdowns to open the breaker in the event of engine failure. Provide circuit breaker status (Open/Closed) for remote monitoring by SCADA.
6. The rating of the circuit breakers shall allow the starting of full generator SKVA.
7. The circuit breaker enclosure, together with all specified circuit breakers, shall be designed for the specific generator set specified and be equipped with rear copper stabs, or load cable lugs and be finish painted to match the generator set.

W-16216.02 Generator Control Panels

1. Type - A generator-mounted, NEMA 1 type, vibration isolated, 14-gauge steel control panel shall be provided for the generator set. Control panel shall be Caterpillar model EMCP4.4.
2. Regulation of NFPA 110 Level 2 shall apply for instrumentation, alarm and shutdown. The instrumentation panel shall include, but not necessarily be limited to:
 - A. Gages for engine: digital or analog gages with $\pm 2\%$ full scale accuracy :
 - a. Oil Pressure
 - b. Engine Coolant Temperature
 - c. Voltmeter for DC Battery
 - B. Gages for generator: digital or analog gages with $\pm 2\%$ full scale accuracy:
 - a. AC Ammeter: Dual range
 - b. AC Voltmeter: Dual range
 - c. Frequency Meter: Range of 45-65 Hz.
 - C. 0-3000 RPM Tachometer - digital or analog gage with $\pm 2\%$ full scale accuracy.
 - D. A seven-position phase selector switch with – OFF position to show meter display of current and voltage of each generator phase. This selector switch may be manual or push-button.
 - E. A power source with circuit protection – 12 or 24 VDC.
 - F. An AC interlock to prevent starter re-engagement with engine running.
 - G. DC circuit protection.
 - H. Eight (8) individual fault indicator lights for :

- a. Overcrank Shutdown – Red
 - b. Overspeed shutdown – Red
 - c. High Coolant Temperature – Red
 - d. Low Engine Oil Pressure – Red
 - e. High Engine Coolant Temperature Prealarm – Yellow
 - f. Low Engine Oil Pressure Prealarm – Yellow
 - g. Low Fuel – Yellow
 - h. Run – Green
3. Switches and Controls
- A. Rheostat for adjusting output voltage of the generator to $\pm 5\%$ of nominal voltage.
 - B. Over voltage protection shutdown switch.
 - C. Emergency stop switch mounted on control panel.
 - D. Engine start switch – with Run, Off, Reset, Automatic positions.
 - E. Five minute engine cool down timer.
 - F. Cyclic cranking switch.
4. Dry contacts for remote generator running indication, remote generator fail indication and cranking battery low voltage wired to terminal strips. At a minimum provide dry contacts for generator running, generator fault, cranking battery low voltage, and main circuit breaker status. Refer to drawings for required conduit/conductors.
5. All electrical penetrations in any enclosure shall be properly sealed from the weather.
6. Digital or solid state meters or metering devices shall be acceptable as a substitute for the electromechanical devices specified.
7. Engraved, screw-on type nameplates will identify each function indicated without abbreviation of function description. So-called international symbols will not be acceptable substitutes for this mandatory requirement.
8. Timing Functions - All control panel timing functions shall be accomplished by metal encased, solid-state, plug-in timing relays with 2PDT output contacts rated for ten (10) amperes. All solid-state time delay relays shall be reverse polarity protected and shall not function or be damaged by the application of improper polarity. Open printed circuit board type time delay circuits will not be accepted.
9. Control Relays - All control relays shall be the 3PDT plug-in type with .187QC blade terminals rated for (10) amperes. Each relay shall be equipped with a manual push to operate check button, L.E.D. or neon visual indicator, and see-thru dust

cover for contact inspection and protection. Exposed contact and octal base plug-in relays are not acceptable.

10. Relay Sockets - All relay sockets shall be of the molded thermoplastic type, suitable for snap mounting on standard D.I.N. rail. Relay sockets will have wire clamp type terminals for secure wire connections, and one (1) piece bus bar connectors between the actual relay blade and wire clamp terminal. Relay sockets shall be rated for fifteen (15) amperes at 300V. Printed circuit board type relay sockets and relay sockets with push- on quick connect terminals are not acceptable.

W-16216.02 Generator Fuel System

1. Due to limited physical dimensions available at the site the units must have the exact physical dimensions as shown on the Drawings.
2. Fuel tank shall be UL 142 rated and maximum 54” in height.
3. The generator tank shall be sized to provide 72-hours of continuous operation at 100% load and assuming a 90% tank capacity.
 - A. Interstitial space with FDEP Approved Leak Detection Switch (FPI LS1001 EQ#817).
 - B. Mechanical Fuel Level Gauge (Visible at Fill Point).
 - C. Supply and Return Connections.
 - D. 2” Fill with Lockable Cap with FDEP spill containment.
 - E. Vent Fittings Installed Per UL 142.
 - F. Low Level Fuel Alarm Switch (FPI LS1001 EQ#817). Set at 40% remaining capacity wired to Control Panel Terminal Strip.
 - G. High Level Fuel Alarm Switch (FPI LS1001 EQ#817). Set at 90% tank capacity wired to Control Panel Terminal Strip. Provide local red alarm light and local audible alarm to indicate high level during fueling
 - H. Cable Stub Up Opening Under Circuit Breaker.
 - I. Tank coated with Two Part Epoxy Primer and painted Gloss Black.
 - J. Tank sealed and shipped under vacuum per Florida Administrative Code Chapter 62-762 and NFPA30.
 - K. Tank shall carry a two (2) hour fire rating.
 - L. Tank shall be manufactured by Phoenix Products of Jacksonville, Florida.

W-16216.03 Automatic Transfer Switch

1. The Automatic Transfer Switch shall be UL 1008 Listed. Automatic Transfer Switch shall be Eaton, Service Entrance Rated, Molded Case Circuit Breaker Type, 400 amp, 480 volt, 3 pole, ATC-900 controller, with stainless steel enclosure. Catalog No ATV9LDB30400XDU.

2. Standard Features: 1b, 1c, 1d, 2a, 3b, 3c, 3d, 4b, 5h, 5j, 5k, 5l, 5m, 6b, 7a, 8e, 10b, 10d, 12c, 12d, 12g, 12h, 14c, 14d, 15e, 15f, 23m, 26h, 26j, 26k, 26l, 26m, 32a, 42, 48f, 48u, 49c.

3. Optional Features: 12l, 12m, 16b, 37a, 38b, 51f1, 54b, 61f, 80d.

4. Features Description:
 - A. 1b. Time Delay Normal to Emergency Adj. 0-9999 sec
 - B. 1c. Time Delay Normal Disconnect Adjustable 0-10 Sec
 - C. 1d. Time Delay Normal Reconnect Adjustable 0-60 Sec
 - D. 2a. Time Delay Engine Start Adj. 0-120 sec
 - E. 3b. Time Delay Emergency to Normal Adj. 0-9999 sec
 - F. 3c. Time Delay Emergency Disconnect Adjustable 0-10 Sec
 - G. 3d. Time Delay Emergency Reconnect Adjustable 0-10 Sec
 - H. 4b. Time Delay Engine Cool-off Adj. 0-9999 sec
 - I. 5h. Emergency (S2) Sensing Phase Reversal
 - J. 5j. Emergency (S2) Sensing Under Voltage/Under Freq
 - K. 5k. Emergency (S2) Sensing Over Voltage/Over Freq
 - L. 5l. Emergency (S2) Sensing Voltage Unbalance
 - M. 5m. Emergency (S2) Sensing Phase Loss
 - N. 6b. Test Pushbutton
 - O. 7a. Time Delay Engine Fail Adj. 0-6 sec
 - P. 8e. Bypass All Timers
 - Q. 10b. Source Selector - Utility to Utility or Utility to Gen
 - R. 10d. Source Selector - Generator to Generator
 - S. 12c. LED Indicator Normal Position
 - T. 12d. LED Indicator Emergency Position
 - U. 12g. LED Indicator Normal Source Available
 - V. 12h. LED Indicator Emergency Source Available
 - W. 12l. Normal Trip 400 Amps
 - X. 12m. Emergency Trip 400 Amps
 - Y. 14c. Normal (S1) Source Available (4 Form C)
 - Z. 14d. Emergency (S2) Source Available (4 Form C)
 - AA. 15e. Normal (S1) Position Indication (1 Form C Micro Switch Outputs)
 - BB. 15f. Emergency (S2) Position Indication (1 Form C Micro Switch Outputs)
 - CC. 16b. Power Switch Overcurrent Protection Both Normal & Emergency
 - DD. 22. Ground Bar
 - EE. 23m. Auto Plant Exerciser Selectable-Disabled/Daily/Calendar Dates, 0-600
 - FF. min. Load/No Load w/Fail Safe
 - GG. 26h. Normal (S1) Sensing Phase Reversal
 - HH. 26j. Normal (S1) Sensing Under-voltage/Under-frequency
 - II. 26k. Normal (S1) Sensing Over-voltage/Over-frequency

- JJ. 26l. Normal (S1) Sensing Voltage Unbalance
- KK. 26m. Normal (S1) Sensing Phase Loss
- LL. 32a. Time Delay Neutral Adjustable 0 - 120 seconds
- MM. 37a. Rated as Suitable for Service Entrance w/o Ground Fault
- NN. 38b. Steel Cover for Controller
- OO. 42. IBC/CBC Seismic Qualified
- PP. 48f. MODBUS Communication
- QQ. 48u. USB Port for Memory Stick
- RR. 49c. Multi-Tap Transformer
- SS. 51f1. 100KA CVX Surge Device on S1
- TT. 54b. Upgrade 316 Stainless 4X
- UU. 61f. Power Loss Buffer ATC Comm (includes DCT module)
- VV. 80d. Fireman's Kill Switch Terminal Blocks

W-16216.03 Generator Set Field Quality Control

1. A factory authorized service representative of the product supplied, shall inspect all field assembled and installed components and make any necessary corrections to insure proper equipment operation. Any cost associated with this procedure shall be born by the generator supplier.

W-16216.03 Generator Set Training and Demonstration

1. A factory representative of the product shall provide the City's maintenance personnel with a thorough period of instruction and hands-on session regarding the operation, trouble shooting and maintenance of all components of the product. Typical training period: one hour.
2. Training shall be video taped and given to the City for future training.

W-16216.03 Generator Testing

1. The engine-generator sets shall be given the MANUFACTURER'S standard factory load test prior to shipment.
2. Prior to final acceptance of the generator set, all equipment furnished under this Section shall be field tested per NFPA 110 to show it is free of any defects and the generator set can operate satisfactorily under full load test using resistance type load banks (brine tanks not acceptable). Test shall be for four (4) continuous hours. Any defects which become evident at this time shall be corrected before acceptance.
3. An all-in-place static alignment check of all rotating components shall be made prior to first start-up, after unit is secured in place and all final connections are made.
4. Site Tests: An installation check, start-up and load test shall be performed by the manufacturer's local representative. The Engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

- A. Fuel, lubricating oil, an antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
- B. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, generator strip heaters, annunciator, etc.
- C. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
- D. 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.
- E. External load bank tests shall be performed with the following criteria:
 - i) One (1) hour at 25% load
 - ii) One (1) hour at 50% load
 - iii) One (1) hour at 75% load
 - iv) One (1) hour at 100% load

Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the load bank tests and a written report shall be provided to the Engineer for record purposes. If, for any reason, any of the one hour load bank tests are interrupted, the associated test shall be repeated.

- 5. A final alignment check and/or adjustment shall be made successful completion of the load bank tests.

W-16216.03 Generator Set Spare Parts

- 1. The spare parts shall include, but not necessarily be limited to the following:
 - A. Six (6) Fuses of each type and size used.
 - B. One (1) Oil, air and fuel filter.
 - C. One (1) set of belts.
 - D. One (1) of each special tool or device, if any, required to maintain the generator set and included equipment.

W-16216.03 Warranty

- 1. Equipment furnished under this Section shall be guaranteed against defective parts and workmanship under terms of the MANUFACTURER'S and dealer's warranty.

But, in no event, shall it be for a period of less than five (5) years and 2,500 operating hours from date of acceptance of the system by the city of Tampa and shall include labor, parts and travel time for necessary repairs at the job site. Submittal data received without written warranties as specified will be rejected in their entirety.
