

SECTION 262000 - EMERGENCY POWER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General provisions and other electrical systems are specified in other Sections of Division 26.
- B. This Section covers the emergency power supply system, including engine-generator sets, each with controls and control panel, remote alarm annunciator, generator docking stations, paralleling and control equipment, automatic transfer systems, and accessories to automatically parallel and supply power during a utility power failure.
- C. Emergency power supply system installation and performance shall meet NFPA 110-2019, Level 1, Type 10 applications.
- D. Vibration isolation is specified in Section 260010, Electrical General.
- E. This Section includes responsibilities and obligations in support of the performance verification specified in Section 260090, Electrical Performance Verification.

1.2 QUALITY ASSURANCE

- A. Conform to the following:
 - 1. 40 CFR 63 Subpart ZZZZ-2018.
 - 2. NECA/EGSA 404-2014.
 - 3. UL 2200-2012.
 - 4. North Carolina State Electrical Code-2018.

1.3 RECORD DRAWINGS

- A. In addition to the requirements specified in Section 260010, Electrical General, include:
 - 1. Equipment outlines, showing front and side plan views, electrical power one-line diagram, and equipment ratings.
 - 2. Schematic drawings.
 - 3. Wiring diagrams.
 - 4. Interconnection wiring diagram, showing field interconnections between engine-generator sets, switchboards, automatic transfer switch systems, annunciators, and day tanks.
 - 5. Material lists, cross referenced to schematics for component identification.
 - 6. Narrative sequence of operation description, detailing operating modes.
 - 7. Ladder diagram and program listing for programmable controller with each logic rung's purpose clearly defined, including identification of inputs and outputs.
 - 8. Generator decrement curve, damage curve, and available fault current at the generator terminals.
- B. Equipment drawings shall specifically show the interface between the paralleling controls and remote devices.

1.4 SERVICE

- A. Manufacturer shall maintain a local parts and service facility, within 50 miles of this Project, which shall have inventory to cover not less than 80% parts service within 24 hours and 95% within 48 hours. Further, the facility shall have a factory-trained service representative to furnish installation, test, and start-up

supervision necessary for final approval and acceptance, as well as to perform maintenance, oil sample analysis, and repairs on components.

1.5 SERVICE CONTRACT

- A. Make available to the Owner a service contract which, as an option, may be accepted. The contract shall be for the complete services rendered over a period of 1 year beginning at completion of the Contractor's 1 year warranty, and shall include, but not be limited to, the following:
1. Manufacturer's recommended procedures for weekly inspection and maintenance.
 2. Quarterly inspection to review the weekly maintenance records being kept by the Owner and train any new operating personnel. Inspection shall include scheduled oil sampling. A system load test shall be included.
 3. Annual inspection shall include the above items except that the engine-generator sets shall be run under 100% load. Provide load banks, electrical connections, and fuel for these tests. Test shall be for minimum of 4 hours.
 4. Work shall be done during normal business hours. Should any work, by its nature, be required to be performed after business hours, the Owner shall be responsible for any overtime charges. Provide a written estimate of any potential overtime charges and obtain written prior approval before proceeding.
- B. WARRANTY: In addition to other warranties specified herein, equipment shall be guaranteed against defective parts and workmanship under terms of the manufacturer's standard warranty for a period of not less than 5 years from date of initial start-up of the system and shall include parts, labor, and travel time.

PART 2 - PRODUCTS

2.1 SEQUENCE OF OPERATION

- A. Loss of normal power: upon receipt of a signal to start from automatic transfer switches, manual control, or other remote device, engine-generator sets shall automatically and independently start, accelerate to rated frequency and build up to rated voltage. The first start system shall monitor this process, and on finding an engine-generator set at 90% of rated voltage and frequency, shall automatically disable other units from closing to the bus, and shall close the ready unit to the bus. At this time first priority transfer switches shall begin the time delay transfer sequence, and on completion transfer their loads to the system bus.
1. The priority controls shall prevent overloading of the system bus by providing inhibit signals to prevent transfer of selected loads to the emergency system until sufficient generating capacity is available on the bus, or until the priority override switch is actuated.
 2. After the first unit is closed to the bus, the control of the remaining units shall be switched to the synchronizer in each paralleling control, which shall cause the engine-generator set to synchronize with the system bus, and then close to it at the proper time.
 3. As each unit closes to the bus, the unit shall assume its proportional share of the total load on the bus.
- B. Failure of a unit to start or synchronize: if a unit fails to start, after the overcrank time delay in the engine-generator set control has expired, the unit shall be shut down, and an alarm shall sound. The priority control shall prevent the lowest priority loads from being added to the system without manual intervention. The priority override key switches shall allow low priority loads to be manually added to the bus. Bus overload monitoring shall protect the first priority loads in the event that the bus is inadvertently overloaded.
1. If a unit fails to synchronize, after a preset time delay, an alarm shall sound, but the unit shall continue to attempt to synchronize until signaled to stop, by manual operation of system control switches.

- C. Bus overload: if a bus overload occurs for any reason, a load shed signal shall be generated to initiate load shedding in the system.
 - 1. If the bus does not return to proper frequency within a predetermined period of time, additional load shed signals shall be generated.
- D. Load demand mode: when the system is running in the emergency mode with the load demand switch in the on position, controls shall continuously monitor the total load on the bus. If the total load on the bus falls below preset limits for a period of 15 minutes, the controller shall automatically shut down engine-generator sets in an operator predetermined order, until the minimum number of engine-generator sets required to safely handle the load remain on the bus.
 - 1. On sensing that the available bus capacity is being approached, the standby units shall automatically be restarted, in the reverse order of which they were shut down, and paralleled with the bus to assume their proportional share of system load.

2.2 ENGINE-GENERATOR SETS

A. General:

- 1. Engine-generator sets shall be factory assembled and tested, and shall be mounted on a structural steel frame with vibration isolators.
- 2. Power rating: engine-generator sets shall have standby rating. Rating shall be based on operation at rated rpm when equipped with operating accessories, including air cleaners, lubricating oil pump, fuel transfer pump, fuel injection pumps, jacket water pump, governor, alternating current generator, radiator fan, and exciter regulator.

B. Exterior Enclosures:

- 1. Metal non walk-in weatherproof type. Enclosures shall be factory assembled and wired, and shall have the following features:
 - a. AC load center, 100 A minimum, with an individual circuit for each AC load inside the enclosure.
 - b. A minimum of 2 each interior luminaires and convenience receptacles. Luminaires shall be vaportight LED.
 - c. Personnel doors, minimum 2. Doors shall be fully gasketed with forged aluminum hinges with stainless steel pins and nylon bushings. Doors shall have stainless steel handles, padlock provisions, plated 3-point locking mechanisms, and panic bar interior openers.
 - d. Exterior steps shall be provided to personnel doors where bottom of door is 18" or higher above finished grade.
 - e. Interior walls and ceiling covered with acoustical material, finished with mill finished perforated aluminum panels.
 - f. Stainless steel bird screens on exterior openings.
 - g. Lifting eyes, maximum 6.
 - h. Minimum of 1 dry-type fire extinguisher.
 - i. Enclosures shall consist of a roof, 2 sidewalls, and 2 end walls of prepainted aluminum stressed-skin monocoque construction and shall include provisions for an internally mounted exhaust silencer. Exterior finish shall be prepainted aluminum with color selected by the Architect.
 - j. Intake and discharge louvers shall be constructed of aluminum and shall be sized to allow full load operation of the engine-generator set at specified site conditions without deration.
 - k. Manufacturer: same as engine-generator set manufacturer, or Altorfer Power Systems, Chillicothe Metal Company, or Pritchard-Brown.

C. Diesel Engines:

- 1. Water-cooled, inline or vee compression diesel type designed to operate on No. 2 fuel oil.

2. Engines shall be equipped with flexible fuel connections, fuel, lube oil, and intake air filters, crankcase emission filtration system, lube oil cooler, fuel transfer pump, hand fuel priming pump, service meter, gear-driven water pump, and instruments, including a fuel pressure gauge, water temperature gauge, and lubricating oil pressure gauge. Engines shall be designed and equipped to return unburned fuel to the day tank. Engine cooling system shall be pretreated to prevent internal corrosion.
3. Governors: shall maintain isochronous frequency regulation from no load to full rated load. Steady state operating band shall be $\pm 0.25\%$. Governors shall include provisions for remote speed adjustment, and shall include load share provisions for paralleling with present and future units.
4. Protective devices:
 - a. Safety shutoffs shall include high water temperature, low oil pressure, electrical overspeed, low fuel, and engine overcrank.
5. Radiators:
 - a. Engine-mounted, with fan, designed for operation at ambient temperature of 110°F.
6. Silencers: cylindrical style selected with companion flanges equal or greater in size to the connecting pipe, and flexible stainless steel bellows-type exhaust wye connector and fittings as required. Silencers shall be sized such that the maximum allowable backpressure for the engine-generator set is not exceeded as installed, including exhaust piping upstream of silencer, wye fitting, silencer, and exhaust piping downstream of silencer. Silencers shall be _____ grade and have a minimum noise reduction of 33 dBA.
7. Automatic Starting System:
 - a. Starting motors: 24 V electric starting system with positive engagement drive and capacity to crank the engine at a speed which shall start the engine under operating conditions. Starting pinion shall disengage automatically when the engine starts. Starting system shall incorporate an automatically reset circuit breaker for antibutt engagement.
 - b. Automatic controls: fully automatic start-stop controls shall be provided in the control panel. Controls shall include one 45 s continuous cranking cycle with lockout and manual reset feature. Provide for automatic paralleling controls and annunciation.
 - c. Jacket water heaters: 2 engine-mounted thermal circulation tank-type immersion water heaters incorporating an adjustable thermostatic switch shall be furnished to maintain engine jacket water at 90°F in a still air ambient temperature of 10 F. Heaters shall be 208 V, 1-phase, 60 Hz each.
 - d. Batteries and Battery Chargers:
 - 1) Batteries shall be lead-acid storage type. Battery set shall be rated by the battery manufacturer in accordance with requirements of engine manufacturer. Battery rack, cables, and clamps shall be provided. Batteries shall be capable of cranking the engine for 45 seconds at 32°F.
 - 2) Chargers shall use transistor-controlled magnetic amplifier circuits to provide continuous taper charging and shall maintain rated output voltage within $\pm 1\%$ from no load to full rated load. Chargers shall be the dual rate type (float and equalize) with a minimum rating of 10 A. Chargers shall be furnished in a NEMA 1 enclosure with a DC ammeter and DC voltmeter, and shall include malfunction alarm contacts for use in conjunction with remote annunciator.
8. Oil sample analysis kit: shall include 1 sample extraction gun, 10 bottles, 10 postage paid mailers, and instructions.

D. Controls:

1. Control Panel:
 - a. A control panel shall be provided and shall contain the following devices and provide the following functions:
 - 1) A control switch labeled Automatic-Off-Run to perform the following functions:

- a) Automatic: start and stop the engine-generator set automatically by the closing and opening of a remote contact.
 - b) Off: stop the engine-generator set.
 - c) Run: manually start and run the engine-generator set.
- b. Separate visual indication and common audible alarm shall be provided for:
- 1) Overcrank.
 - 2) Low coolant level.
 - 3) Low coolant temperature.
 - 4) Anticipatory high coolant temperature.
 - 5) High coolant temperature.
 - 6) Anticipatory low oil pressure.
 - 7) Low oil pressure.
 - 8) Overspeed.
 - 9) Low fuel.
 - 10) Control switch not in automatic position.
 - 11) Contacts for local and remote common alarm.
 - 12) Air shutdown damper (when used).
- c. Separate visual indication shall be provided for:
- 1) Generator supplying load.
 - 2) Utility supplying load.
 - 3) Low battery voltage.
 - 4) High battery voltage.
 - 5) Battery charger AC failure.
- d. Switches shall be provided for:
- 1) Alarm silence.
 - 2) Lamp test.
 - 3) Emergency stop.
 - 4) Start engine.
 - 5) Transfer load.
- e. Controls shall shut down and lock out the engine-generator set under the following conditions:
- 1) Overcrank.
 - 2) Overspeed.
 - 3) Low oil pressure.
 - 4) High coolant temperature.
 - 5) Air shutdown damper (when used).
 - 6) Remote emergency stop.
 - 7) Low coolant level.
- f. A clock exerciser shall be provided in the control panel.
- g. The control panel shall continuously monitor control conductors installed between the fire pump controller and the engine-generator set. Loss of integrity of the remote start circuit shall initiate visual and audible annunciation and start the generator as required per NFPA 70.
2. Remote Alarm Annunciator:
- a. A battery-powered remote annunciator shall be provided to operate outside of the generator room at the location indicated on the Drawings. The annunciator shall indicate the alarm condition of the engine-generator set as follows:
 - 1) Individual visual signals shall indicate:
 - a) Generator supplying load.

- b) Utility supplying load.
 - c) Battery charger malfunctioning.
 - 2) Individual visual signals plus a common audible signal shall warn:
 - a) Low oil pressure.
 - b) Low water temperature.
 - c) High water temperature.
 - d) Low fuel main tank.
 - e) Overcrank.
 - f) Overspeed.
 - g) Ground fault indication.
 - h) Remote emergency shutdown.
 - i) Generator switch in non-automatic position.
 - 3) Generator controller shall be monitored by the fire alarm system for the following conditions:
 - a) Generator running
 - b) Generator Fault
 - c) Generator switch in non-automatic position
 - 4) Switches shall be provided for:
 - a) Lamp test.
 - b) Alarm silence.
3. Remote Emergency Manual Stop Station:
- a. Provide a remote manual stop pushbutton station in weatherproof enclosure with lift cover and audible and silent remote alarm signal to the remote alarm annunciator panel when the lift cover is raised for engine-generator set shutdown.
 - b. Manufacturer: Eaton, Pilla, or Square D.
4. Provide a set of contacts in annunciator panel for BAS tie in for generator status and general alarm monitoring.

E. Generators:

- 1. Type: 3-phase, single-bearing, synchronous type, wet wound, tropicalized, and shall comply with NEMA MG 1-2016, Part 22. Class H insulation shall be used on the stator and rotor, and both shall be further protected with an asphalt modified epoxy on end coils. Generators shall incorporate reactive droop compensation for parallel operation with future unit, and shall also include a resettable thermal protector and fuse for exciter/regulator protection against extended low power factor loads and faults. Provide paralleling suppressors for protection of generator excitation system. Generator rotors shall be dynamically balanced within 0.0005" peak-to-peak amplitude displacement at both ends of shafts and shall sustain 25% overspeed.
- 2. Regulators: 3-phase sensing RMS voltage regulators, automatic volts-per-hertz type, solid state exciter/regulator, shock-mounted inside generator. Voltage regulation shall be $\pm 1\%$ from no load to full rated load. Accessible voltage drop, voltage level, and voltage gain controls shall be included in the module. Voltage level adjustment shall be a minimum of $\pm 10\%$. Provide cross-current compensation circuit with on/off switch. Modules shall include the following protective features:
 - a. Current limit circuits shall restrain the exciter field current while allowing full forcing voltage to be applied to obtain rapid response during transient conditions or service overloading on the generator.
 - b. A time delay circuit shall sense the current limit operation and interrupt field current to the generator after 10 s.
 - c. Loss of field monitoring.

3. Devices:
 - a. 3.5", 90° scale, 2% accuracy instruments:
 - 1) Ammeter.
 - 2) Voltmeter.
 - 3) Frequency meter.
 - 4) Wattmeter.
 - b. Running time meter.
 - c. Heavy duty meter control switches for:
 - 1) Voltmeter, 7-position.
 - 2) Ammeter.
4. Permanent magnet pilot excitor: generators shall incorporate a permanent magnet pilot excitor feature to provide isolation of the excitor from the generator stator windings to prevent irregularities of voltage wave form caused by load conditions. Permanent magnet pilot excitor shall also provide for a minimum of 300% rated current for 10 seconds during short circuit conditions for selective tripping of downline protection devices on a load short circuit.
5. Provide a unit-mounted circuit breaker.
 - a. Breaker shall be equipped with an electronic trip unit with the following front panel adjustments:
 - 1) Long time pick-up.
 - 2) Long time delay.
 - 3) Short time pick-up.
 - 4) Short time delay.
 - 5) Instantaneous pick-up.
 - 6) Energy reducing maintenance switch if 1,200 A or larger.
 - 7) Ground fault alarm.

F. Factory Tests:

1. Engine-generator sets shall be factory tested before shipment. Tests shall be as follows:
 - a. Warm-up and Adjustments:
 - 1) Warm-up at synchronous speed with 1.0 power factor electrical load.
 - 2) Final high idle speed adjustment, voltage level adjustment, and voltage gain adjustments.
 - 3) After adjustments, the following shall be recorded:
 - a) Generator speed.
 - b) Frequency.
 - c) Power.
 - d) Line-to-line voltages.
 - e) Average voltage.
 - f) Frequency stability.
 - g) Voltage stability.
 - h) Overshoot.
 - i) Fan power.
 - j) Engine-generator set efficiency at test speed and 1.0 power factor, fuel density, inlet air temperature, inlet air pressure, inlet air restriction, fuel temperature in injection pump housing, and total running time.
 - b. Subject unit to a sequence of load changes up to and including full load to determine transient response characteristics as follows:
 - 1) Voltage dip - percent of instantaneous voltage drop on addition of load.
 - 2) Voltage overshoot - percent of instantaneous voltage rise on subtraction of load.

- 3) Frequency dip - percent of instantaneous frequency drop on addition of load.
 - 4) Frequency overshoot - percent of instantaneous frequency rise on subtraction of load.
 - 5) Recovery time - time necessary to achieve steady state voltage and frequency after sudden additions or subtractions of load.
2. Upon completion of the tests, the manufacturer shall submit 6 sets of the certified test reports demonstrating test procedure compliance and data recorded. In addition, an oil sample shall be taken during the test at full and partial load, then laboratory analyzed for signs of unusual wear. Testing shall be performed on the actual serial number units assigned for delivery to this Project.

G. Manufacturer: Caterpillar, MTU, Cummins-Onan, or Kohler.

2.3 PARALLELING AND CONTROL EQUIPMENT

A. Paralleling and control equipment shall automatically start, synchronize, and place in operation the 2 engine-generator sets, and control the loading of those sets as specified herein.

B. Paralleling Control Panels:

1. A paralleling control panel shall be provided for each engine-generator set. Panels shall contain the following components and devices:
 - a. Front Panel Devices:
 - 1) 3.5", 90° scale, 2% accuracy instruments:
 - a) Ammeter.
 - b) Voltmeter.
 - c) Frequency meter.
 - d) Wattmeter.
 - b. Running time meter.
 - c. Heavy duty meter control switches for:
 - 1) Voltmeter, 7-position.
 - 2) Ammeter.
 - d. Automatic-off-run selector switch. Functions of this switch shall be coordinated with the engine-generator set control switches mounted on the set to provide the following functions:
 - 1) Emergency stop.
 - 2) Automatic starting, controlled by paralleling system.
 - 3) Manual starting/paralleling.
 - 4) Inhibit starting of the engine-generator set.
 - 5) Manual starting of the engine-generator set.
 - e. Breaker trip/close push button switches. Manual breaker closing shall not be possible unless the synchronizing lamps are on and manual mode permissive relay is utilized.
 - f. Lighted control reset push button switch.
 - g. Lamp test push button switch.
 - h. Synchronizing lamps with on/off switch. Synchronizing lamps shall be minimum 1.5" diameter with clear bulbs and visible filaments.
 - i. Locking, 10 turn, voltage and frequency adjust pots.
 - j. Oiltight individual alarm lamps, minimum 1" diameter, and a common audible alarm shall be provided for:

<u>Function</u>	<u>Alarm Lamps</u>	<u>Audible Alarm</u>	<u>Shutdown Unit</u>
Failure to synchronize	amber	*	
Low oil pressure	amber	*	

<u>Function</u>	<u>Alarm Lamps</u>	<u>Audible Alarm</u>	<u>Shutdown Unit</u>
Low fuel-daytank	amber	*	
Low engine temperature	amber	*	
High engine temperature	amber	*	
Not in automatic	red	*	
High engine temperature	red	*	*
Low oil pressure	red	*	*
Overcurrent	red	*	*
Loss of field	red	*	*
Reverse power	red	*	*
Overcrank	red	*	*
Overspeed	red	*	*
Breaker closed	red		
Control lockout	red	*	
Low coolant level	red	*	*
Overvoltage	red	*	*
Automatic mode	green		
Breaker open	green		
Engine-generator set running	green		
Demand mode standby	green		
Cool down mode	green		

2. Control devices shall be industrial type oiltight with contact ratings a minimum of twice the maximum circuit ampacity they are controlling. Indicator lamps shall be changed from the front of the panel, without requiring the removal of the lamp holder or any wiring. Indicator lamp condition (on or off) shall be visible in bright room lighting conditions.
3. Control panels shall contain the following internal controls:
 - a. Electrically operated power circuit breaker with electronic trip unit (long, short, and instantaneous trips) and under voltage release. Size shall be as indicated on the Drawings.
 - 1) The electronic trip unit shall provide the following front panel adjustments:
 - a) Long time pick-up.
 - b) Long time delay.
 - c) Short time pick-up.
 - d) Short time delay.
 - e) Instantaneous pick-up.
 - f) Ground fault pick-up.
 - g) Ground fault delay.
 - h) Ground fault alarm.
 - 2) Manufacturer: GE, or Westinghouse.
 - b. Electronic isochronous load sharing module for controlling the engine governors during synchronizing and to provide isochronous load sharing. The isochronous load sharing module and engine governor shall be a coordinated system of a single manufacturer.
 - c. First start sensor with automatic mode permissive relay to connect first engine-generator set to reach approximately 90% of rated frequency and voltage to the emergency bus. The first start sensor for each engine-generator set shall be solid state and be sequentially enabled. The first start sensor shall positively prevent out-of-phase paralleling if 2 or more engine-generator sets reach operating conditions simultaneously and shall include redundant circuitry to ensure operation, even if the primary system is disabled. System shall include controls to recognize the failure of the first breaker signaled to close, and allow system operation to proceed despite this failure.
 - d. Synchronizer to electronically adjust the engine governor to match the frequency and phase angle of the bus. Synchronizer shall maintain the engine-generator set frequency within 20

electrical degrees of the bus for 0.5 s before circuit breaker closing. Each unit shall have its own synchronizer.

- e. Automatic mode permissive relay, used in conjunction with the synchronizer to assure that the breaker for the generator does not attempt to close out of phase with the bus, due to errant operation of the synchronizer.
- f. Separate mode permissive relay, to be used with synchronizing lamps during manual paralleling, to prevent accidental closure of the breaker with the generator out of phase with the bus.
- g. Control modules shall contain a system of diagnostic LEDs to assist in analyzing proper system function, consisting of: first on line; in phase; emergency bus on; engine-generator set on; synchronizer on; and dead bus mode.
- h. Electronic reverse power relay to sense reverse power flow through the generator paralleling circuit breaker. When the reverse power condition exceeds a preset level, adjustable from 2% to 20% of the generator's full power rating, for a given time period, adjustable from 0.4 s to 20 s, the circuit breaker shall be tripped open and the engine-generator set shut down.
- i. Pulse alarm system to sound alarm at first fault and at each subsequent fault.
- j. Engine-generator set start contacts.
- k. Cooldown time delay, adjustable: 1 min to 15 min.

C. Master Controls:

- 1. Master, totalizing controls shall monitor and control the operation of the paralleling system. The master panel shall include:
 - a. A front panel, including:
 - 1) Heavy duty key switches for the following functions:
 - a) Load restore.
 - b) Load pick-up, priority override, 1 per level.
 - c) Load demand mode on/off.
 - 2) Underfrequency reset push button switch.
 - 3) Alarm silence push button switch.
 - 4) 3.5", 90° scale, 2% accuracy instruments:
 - a) Ammeter.
 - b) Voltmeter.
 - c) Wattmeter.
 - 5) Heavy duty metal control switches for:
 - a) Voltmeter, 7-position.
 - b) Ammeter.
 - c) Manufacturer: Electroswitch 24 series.
 - 6) Demand mode sequence selector switch.
 - a) Manufacturer: Electroswitch 24 series.
 - 7) Alarm horn.
 - 8) System test system.
 - a) Manufacturer: Electroswitch 24 series.
 - 9) Oiltight individual alarm lamps, minimum 1" diameter, and a common audible alarm shall be provided for:

<u>Function</u>	<u>Alarm Lamps</u>	<u>Audible Alarm</u>
System test	green	
Load demand mode	green	

<u>Function</u>	<u>Alarm Lamps</u>	<u>Audible Alarm</u>
Priority load pick-up	green	
Load shed	red	*
Utility power failure	red	
Bus underfrequency	red	*

2. Control devices shall be industrial type, oiltight with contact ratings a minimum of twice the maximum circuit ampacity they are controlling. Indicator lamps shall be changed from the front of the panel, without requiring the removal of the lamp holder or any wiring. Indicator lamp condition (on or off) shall be visible in bright room lighting conditions.
3. Internal Controls:
 - a. Programmable controller for load demand, load pick-up, and load shed functions.
 - b. 2 level load pick-up output contacts, rated 10 A, 600 V (3 contacts per level).
 - c. 2 level load shed output contacts, rated 10 A, 600 V (3 contacts per level).
 - d. Electronic underfrequency relay with time delay.
 - e. Time delay start, adjustable: 0 s to 15 s.

D. Manufacturer: same as the manufacturer of the engine-generator sets. Automatic transfer switch or switchgear supplier shall work under contract to the engine-generator set manufacturer who shall have sole source responsibility for their work.

2.4 AUTOMATIC TRANSFER SWITCH SYSTEMS

A. General:

1. Each system shall be the product of one manufacturer. Automatic transfer switches shall include a 2-way bypass isolation switch where indicated on the Drawings. Automatic transfer switches shall be closed-transition type where indicated on the Drawings. Each system shall comply with NEMA ICS 10-2005 Part 4 and UL 1008-2014, and shall be rated for total system load.
2. Construction: each system shall be supplied completely assembled in a NEMA 1 enclosure. Systems shall be completely factory assembled and tested prior to shipment. Power interconnections shall be silver-plated copper bus bar. Control interwiring shall be provided with disconnect plugs. A visual position indicator shall be provided to indicate bypass-isolation switch position. Pilot lights shall indicate availability of power sources and automatic transfer switch position. Switches shall include a detailed instruction plate.
3. Performance: switch performance shall meet or exceed the following requirements and, if so requested by the Architect, be verified by certified laboratory test data.
 - a. Temperature rise: measurements shall be made after the overload and endurance tests.
 - b. Withstand and closing ratings: rated to withstand the available RMS symmetrical short circuit current at the switch terminals with the upstream over-current protection. When protected by molded case circuit breakers, switches shall have the following minimum withstand and closing ratings:

<u>Ampere Size</u>	<u>Symmetrical Amperes RMS at 480 V AC</u>
30	10000
70-150	22000
260-400	42000
600-800	65000
1000-1200	85000
1600-4000	100000

- c. Dielectric: measurements shall be made at 1960 V RMS minimum following the withstand current rating test.

- d. Transient withstand: control panel shall pass the voltage surge withstand test per IEEE C37.90.1-2012 and the voltage impulse withstand test per NEMA ICS 1-2000 (R2005, R2008, R2015).
 4. Manufacturer, automatic transfer switches: ASCO 7000 series, Russelectric RMT, or Zenith ZTS.
 5. Manufacturer, automatic transfer and bypass switches: same as the manufacturer of the engine-generator set or ASCO 7000 series, Russelectric RTB, or Zenith ZBTS.
- B. Automatic Transfer Switches:
1. Electrical operation shall be accomplished by a momentarily energized solenoid operating mechanism which receives power from the source to which the load is being transferred. Operating transfer time shall be a maximum 0.17 s. Each position shall be mechanically locked.
 2. Operation shall be inherently double-throw whereby contacts move simultaneously and with no programmed delay in a neutral position. An overload or short circuit shall not cause the switch to go to a neutral position.
 3. Inspection of contacts, movable and stationary, shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The maintenance handle shall permit the operator to stop the contacts at any point throughout the entire travel to inspect and service the contacts.
 4. Switches shall have switched neutrals and shall have fully rated neutral transfer contacts which shall momentarily interconnect the neutrals of the sources and load during the transfer/retransfer operation.
 5. Automatic transfer switches shall include separately mounted control panels with adjustable solid state sensing and timing functions, and the following operational characteristics:
 - a. Time delay on momentary dips in normal source (0.5 s to 6 s) factory set at 1 s delay in transfer switch and engine starting signals.
 - b. Time delay on transfer to emergency for controlled loading for generator (0 min to 1 min), factory set at 0 min.
 - c. Time delay on retransfer to normal (0 min to 30 min), factory set at 15 min. Automatic bypass if emergency source fails and normal source is available.
 - d. Toggle switch to manually bypass time delay on retransfer.
 - e. Close differential voltage sensing of normal source phases (pick-up adjustable from 85% to 100% of nominal and dropout adjustable from 75% to 98% of pick-up), factory set to pick-up at 95% and drop out at 85% of nominal.
 - f. Independent single phase voltage (85% to 100%) and frequency (90% to 100% pick-up) sensing of the emergency source to prevent premature transfer, factory set to pick-up at 90% of nominal voltage and 95% of nominal frequency.
 - g. Test switch, momentary type, to simulate failure to normal source.
 - h. Pilot lights to indicate switch position.
 - i. Auxiliary contacts, 1 closed on normal and 1 closed on emergency, rated 10 A, 480 V.
 - j. Time delay and sensing functions shall be adjustable over the ranges specified herein and shall operate with minimum drift, not to exceed $\pm 1\%$ of set frequency, $\pm 2\%$ of set voltage, and $\pm 10\%$ of set time delay, over the temperature range of -5°F to 160°F . The control panel shall be provided with a protective cover and an isolation plug in the wiring harness to disconnect the control wiring between the control panel and the main transfer panel. The control panel shall not draw more than 15 VA continuously under normal operating conditions.
 - k. Contacts that close when normal source fails for initiating engine starting, rated 10 A, 32 V DC.
 - l. In phase monitor control for motor load transfer, with capability of switching between synchronized utility sources.

- m. Load shed control circuit shall operate from a normally closed set of remote contacts so that upon opening the remote contacts, the automatic transfer switch load shall remain connected to the normal source or shall be transferred to the normal source regardless of the normal power source condition.

C. Bypass-Isolation Switches:

1. A 2-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from source and load power conductors. Main contacts shall be manually driven.
2. Bypass to the load-carrying source shall be effected without any interruption of power to the load.
3. The bypass handle shall provide 3 operating modes: bypass-to-normal; automatic; and bypass-to-emergency. The operating speed of the bypass contacts shall be the same as that of the associated automatic transfer switch and shall be independent of the speed at which the manual bypass handle is operated. In the automatic mode, the bypass contacts shall be out of the power circuit.
4. The isolation handle shall provide 3 operating modes: closed, test, and open. The test mode shall permit testing of the entire emergency power system, including the automatic transfer switches. The open mode shall completely isolate the automatic transfer switch from source and load power conductors. When in the open mode, it shall be possible to withdraw the automatic transfer switch for inspection or maintenance without removal of power conductors.
5. When in the test or open modes, the bypass switch shall function as a manual transfer switch allowing transfer and retransfer of the load between the 2 available sources without the feedback of load regenerated voltage to the transfer switch.

D. Closed-Transition Transfer Switches:

1. Closed-transition transfer switches shall transfer without load interruption by momentarily connecting both sources of power when both sources are available and within acceptable parameters. The maximum interconnection time shall be no greater than 100 ms. The closed-transition transfer switch shall operate as a make-before-break switch.
2. Closed-transition transfer switch controllers shall include the following features in addition to those listed for automatic transfer switches:
 - a. Source differential sensing for closed-transition operating mode. The sensor shall enable transfer/retransfer between energized sources in the closed-transition mode only when the two sources have a maximum voltage differential of 5%, frequency differential of 0.2 Hz, and are within 5 electrical degrees of each other.
 - b. Time delay on failure to synchronize normal and emergency sources prior to closed-transition transfer (1 min to 5 min), factory set at 5 min.
 - c. Voltage, frequency, and phase rotation sensing on both the normal and emergency sources.

E. Remote Annunciator:

1. Industrial grade interface providing transfer switch status indication and transfer/retransfer control for up to 8 transfer switches. LED/LCD indication of switch status and positions, push buttons to initiate transfer switch operation and testing.
 - a. Manufacturer: ASCO 5350 Remote Annunciator or equal by Russelectric, or Zenith.

2.5 GENERATOR DOCKING STATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. TRYSTAR; ESL Power Systems

B. General Requirements

- C. Docking station shall include 16 Series Camlok Panel Mounts for use as connection to Portable Generator.
- D. Entire package must be listed to ETL or UL 1008 Standards. UL listing of individual components is not acceptable.
- E. Enclosures:
 - 1. NEMA 3R rain-tight, 304 GA aluminum enclosure
 - 2. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
 - 3. Front and side through a front access panel shall be accessible for maintenance.
 - 4. Top, side, and bottom through a front access panel shall be accessible for permanent cabling.
- F. Finishes:
 - 1. Paint after fabrication. Finish by Architect.
- G. Phase, Neutral, and Ground Buses:
 - 1. Material: Silver-plated Copper
 - 2. Equipment Ground Bus: bonded to box.
 - 3. Isolated Ground Bus: insulated from box.
 - 4. Ground Bus: 50% of phase size.
 - 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
 - 6. Round edges on bus.
 - 7. Temporary generator connectors shall be Camlok style mounted on gland plate.
 - 8. Camlok shall be color coded according to system voltage
 - 9. A phase – Black or Brown
 - 10. B phase – Red or Orange
 - 11. C phase – Blue or Yellow
 - 12. N Neutral – White
 - 13. G Ground – Green
 - 14. Temporary connectors shall include protective flip lids to prevent accidental contact.
 - 15. Permanent connectors shall be broad range set-screw type, located behind an aluminum barrier.
 - 16. Short Circuit & Withstand Rating
 - 17. Shall be minimum 65KAIC unless otherwise indicated on drawings.
- H. Voltage & Amperage:
 - 1. 480V, 3 phase. Ampacity as indicated on drawings.
- I. Phase Rotation Monitor Device:
 - 1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal.
 - 2. Integral circuit breaker.
 - 3. Must be UL 489 Listed Breaker
 - 4. Breakers shall be removable for service and maintenance.
 - 5. Circuit breaker manufacturer shall be same as the switchboard manufacturer.
 - 6. Breaker shall be equipped with an electronic trip unit with the following front panel adjustments:
 - 7. Long time pick-up.
 - 8. Long time delay.
 - 9. Short time pick-up.
 - 10. Short time delay.
 - 11. Instantaneous pick-up.
 - 12. Energy reducing maintenance switch if 1,200 A or larger
 - 13. Ground fault alarm.

- J. Additional accessories shall be included in submittal drawings as follows:
1. A: Two Wire Auto Start
 2. C: Battery Charger Receptacle 20A GFCI 125V
 3. D: Block Heater Receptacle 30A L5-30 125V
 4. M: Listed Monitoring Device

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install 2 remote annunciator and control panels where indicated on the Drawings, including interconnecting wiring and conduit.
- C. Install remote emergency manual stop pushbutton external to the engine-generator set enclosure. Provide a label as specified in Section 260010, 2.10, E on the pushbutton station enclosure, stating "EMERGENCY GENERATOR STOP PUSHBUTTON".
- D. Provide control wiring from transfer switches to engine-generator set controls for automatic start-stop control.
- E. Provide control wiring from transfer switches to each group of the elevator controllers for transfer switch position and load disconnect control. Refer to Division 14, Conveying Equipment for specific elevator requirements.
- F. Provide control wiring from each closed-transition transfer switch to the associated upstream normal and emergency source shunt trip circuit breakers for remote operation by protective relaying.
- G. Fill cooling systems with 50% ethylene glycol solution.

3.2 OIL SAMPLE ANALYSIS

- A. Service facility oil sample analysis laboratory shall be open to inspection during normal working hours. Laboratory shall perform oil sample analysis at no additional cost to the Owner for the kit specified hereinbefore.
- B. Scheduled oil sampling shall be of the atomic absorption spectrophotometry method and shall be accurate to within a fraction of 1 ppm by weight for the following elements: iron, chromium, copper, aluminum, silicon, and lead.
- C. In addition, samples shall be tested for the presence of water, fuel dilution, and antifreeze.
- D. Immediate notification shall be provided to the Owner when analysis shows any critical reading. If readings are normal, a report showing that the equipment is operating within established parameters shall be provided.

END OF SECTION 262000