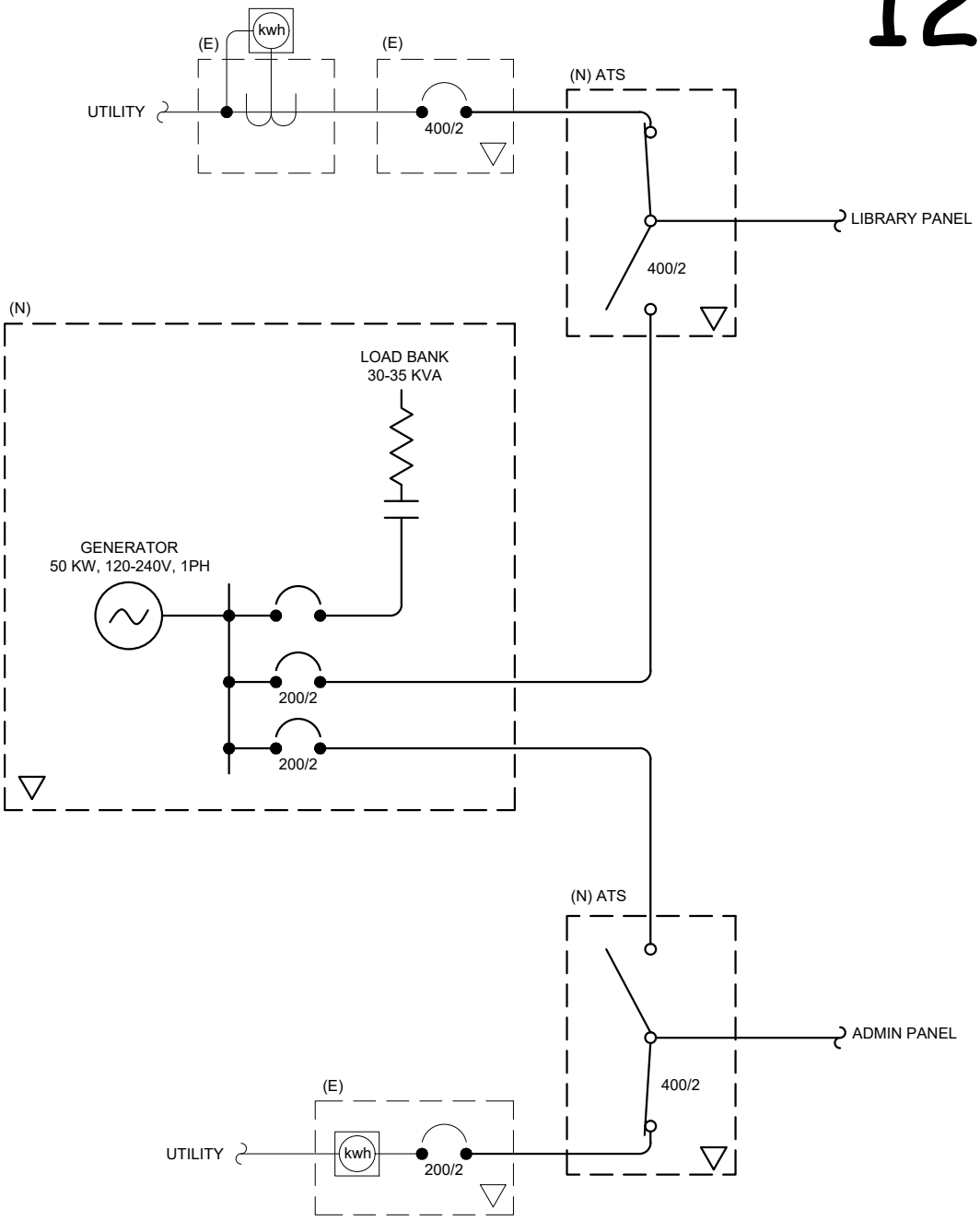
12C



RESPEC
Juneau, AK
9109 Mendenhall Mall Rd, Ste. 4
Juneau, AK 99801
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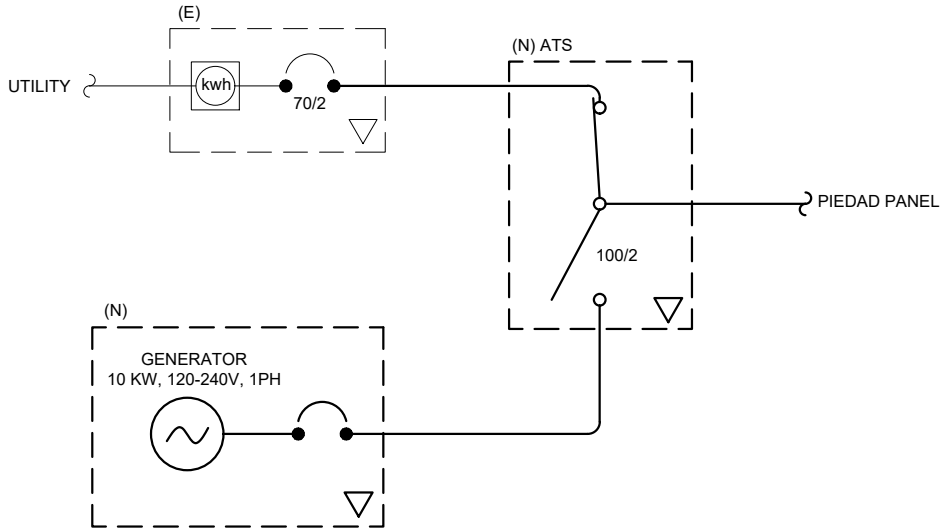
Fax: 907.586.3771
AECC163270

HAINES BOROUGH
HAINES LIBRARY & ADMINISTRATIVE OFFICES GENERATOR
SINGLE LINE DIAGRAM - POWER DISTRIBUTION

DESIGN:	BCH
DRAWN:	PEL
CHECKED:	BCH
12/12/2023	

PROJ No. I0632.23004

FIGURE E1



Juneau, AK
9109 Mendenhall Mall Rd, Ste. 4
Juneau, AK 99801
Phone: 907.780.6060
Fax: 907.586.3771
AECC163270

HAINES BOROUGH
HAINES PIEDAD WATER TREATMENT PLANT GENERATOR
SINGLE LINE DIAGRAM - POWER DISTRIBUTION

DESIGN:	BCH
DRAWN:	PEL
CHECKED:	BCH

PROJ No. I0632.23004

FIGURE
E2

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contactor-type automatic transfer switches.
2. Transfer switch accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Contactor-type automatic transfer switches.
2. Transfer switch accessories.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for three cycles.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

1. Surge Protective Device: Service rated.

J. Neutral Terminal: Solid and fully rated unless otherwise indicated.

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed tape markers at terminations.

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

M. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 2 equipment according to NFPA 110.

B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
3. Conductor Connectors: Suitable for use with conductor material and sizes.
4. Material: Tin-plated aluminum.
5. Main and Neutral Lugs: Mechanical type.
6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
7. Ground bar.
8. Connectors shall be marked for conductor size and type according to UL 1008.

C. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.

1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
3. Fully automatic break-before-make operation with center off position.

D. Manual Switch Operation, Non-Load-Breaking: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for standby-emergency systems. Include results of test for the following conditions:

    a. Overvoltage.
    b. Undervoltage.
    c. Loss of supply voltage.
    d. Reduction of supply voltage.
    e. Alternative supply voltage or frequency is at minimum acceptable values.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with Drawings and Specifications.
    b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.
e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.
b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Verify time-delay settings.
c. Verify pickup and dropout voltages by data readout or inspection of control settings.
d. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Transfer switches will be considered defective if they do not pass tests and inspections.

F. Remove and replace malfunctioning units and retest as specified above.

G. Prepare test and inspection reports.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 263213.13 - DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diesel-engine-driven generator sets.
2. Diesel engine.
3. Diesel fuel-oil system.
4. Control and monitoring.
5. Generator overcurrent and fault protection.
6. Generator, exciter, and voltage regulator.
7. Load bank.
8. Outdoor engine generator enclosure.
9. Vibration isolation devices.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.2 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour (liters per hour) at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight**,** including full fuel tank, supplied enclosure, subbase-mounted fuel tank, **load bank,** and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIESEL-ENGINE-DRIVEN GENERATOR SETS

A. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine generator housing, subbase fuel tank, engine generator, batteries, battery racks, silencers, load banks, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst-case normal levels.
3. Component Importance Factor: 1.0.

B. B11 Compliance: Comply with B11.19.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 110 requirements for Level 2 EPSS.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).
2. Altitude: Sea level to 1000 feet (300 m).

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Power Rating: Standby.

D. EPSS Class: Engine generator shall be classified as a Class 48 according to NFPA 110.

E. Service Load: 50 kW.

F. Frequency: 60 Hz.

G. Voltage: 240-V ac.

H. Phase: Single-phase, three wire.

I. Induction Method: Naturally aspirated.

J. Governor: Adjustable isochronous, with speed sensing.

K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

L. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

M. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a single-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time:

    a. Comply with NFPA 110, Type 10 system requirements.

2.4 DIESEL ENGINE

A. Fuel: ASTM D975, diesel fuel oil, Grade 1-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.

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

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer:

1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

    a. Minimum sound attenuation of 25 dB at 500 Hz.
    b. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 78 dBA or less.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F (10 deg C) regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F (minus 40 to plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 37.

B. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

C. Fuel Filtering: Remove water and contaminants larger than 1 micron.

D. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

E. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Tank level indicator.
2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills.
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration:

1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

a. Engine lubricating-oil pressure gage.
b. Engine-coolant temperature gage.
c. DC voltmeter (alternator battery charging).
d. Running-time meter.
e. AC voltmeter.
f. AC ammeter.
g. AC frequency meter.
h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:

    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low-water temperature alarm.
    g. High engine temperature prealarm.
    h. High engine temperature.
    i. High engine temperature shutdown device.
    j. Overspeed alarm.
    k. Overspeed shutdown device.
    l. Low fuel main tank.

        1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for six hours at full load.

    m. Coolant low-level alarm.
    n. Coolant low-level shutdown device.
    o. Coolant high-temperature prealarm.
    p. Coolant high-temperature alarm.
    q. Coolant low-temperature alarm.
    r. Coolant high-temperature shutdown device.
    s. EPS load indicator.
    t. Battery high-voltage alarm.
    u. Low cranking voltage alarm.
    v. Battery-charger malfunction alarm.
    w. Battery low-voltage alarm.
    x. Lamp test.
    y. Contacts for local and remote common alarm.
    z. Generator overcurrent-protective-device not-closed alarm.
    aa. Hours of operation.
    bb. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Overcurrent Protective Device:

1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:

a. Tripping Characteristic: Designed specifically for generator protection.
b. Trip Rating: Matched to generator output rating.
c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
d. Mounting: Adjacent to, or integrated with, control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Range: Provide limited range of output voltage by adjusting the excitation level.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.

2.9 LOAD BANK

A. Description:

1. Permanent, radiator-mounted**,** resistive unit capable of providing a balanced single-phase, load to engine generator at 50 percent rated-system capacity. Unit shall be capable of selective control of load in 25 percent steps of load-bank rating and with minimum step changes of approximately 5 and 10 percent available.

B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and stainless-steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases. Galvanized steel is prohibited. Element's maximum resistance shall be between 100 and 105 percent of rated resistance.

C. Load-Bank Heat Dissipation: Provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.

D. Load-Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, enclosure within generator enclosure, accessible from exterior through hinged doors.

E. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.

F. Control Sequence: Automatically control the elements to maintain 50 percent generator load during operation. Include manual control for maintenance operation.

2.10 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description:

1. Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph (160 km/h).

C. Hinged Doors: With padlocking provisions.

D. Lighting: Provide weather-resistant LED lighting with 30 fc (330 lx) average maintained.

E. Thermal Insulation: Manufacturer's standard materials and thickness.

F. Muffler Location: Within enclosure.

G. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

H. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.

I. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

2.11 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.12 FINISHES

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

2.13 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with IEEE 115 and with NFPA 110, Level 2 Energy Converters.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.

5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Testing Agency:

1. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

   a. Visual and Mechanical Inspection:

      1) Compare equipment nameplate data with Drawings and the Specifications.
      2) Inspect physical and mechanical condition.
      3) Inspect anchorage, alignment, and grounding.
      4) Verify that the unit is clean.

   b. Electrical and Mechanical Tests:

      1) Perform insulation-resistance tests according to IEEE 43.

         a) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.

      2) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      3) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet (8 m) from edge of the generator enclosure, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Remove and replace malfunctioning units and retest as specified above.

H. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.2 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **12** months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contactor-type automatic transfer switches.
2. Transfer switch accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Contactor-type automatic transfer switches.
2. Transfer switch accessories.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: 60 amperes. Apply as defined in UL 1008 for continuous loading and total system transfer.

F. Tested Fault-Current Closing and Short-Circuit Ratings: 10 KAIC. Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for three cycles.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

J. Neutral Terminal: Solid and fully rated unless otherwise indicated.

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed tape markers at terminations.

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

M. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 2 equipment according to NFPA 110.

B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
3. Conductor Connectors: Suitable for use with conductor material and sizes.
4. Material: Tin-plated aluminum.
5. Main and Neutral Lugs: Mechanical type.
6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
7. Ground bar.
8. Connectors shall be marked for conductor size and type according to UL 1008.

C. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.

1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.

2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
3. Fully automatic break-before-make operation with center off position.

D. Manual Switch Operation, Non-Load-Breaking: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing of Normal and Alternate Source: Sense low phase-to-ground voltage. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:

a. Overvoltage.
b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.
e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.
b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Verify time-delay settings.

c. Verify pickup and dropout voltages by data readout or inspection of control settings.
d. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Transfer switches will be considered defective if they do not pass tests and inspections.

F. Remove and replace malfunctioning units and retest as specified above.

G. Prepare test and inspection reports.

3.2 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 263213.13 - DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diesel-engine-driven generator sets.
2. Diesel engine.
3. Diesel fuel-oil system.
4. Control and monitoring.
5. Generator overcurrent and fault protection.
6. Generator, exciter, and voltage regulator.
7. Load bank.
8. Outdoor engine generator enclosure.
9. Vibration isolation devices.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.2 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour (liters per hour) at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, including full fuel tank, supplied enclosure, external silencer, subbase-mounted fuel tank, and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIESEL-ENGINE-DRIVEN GENERATOR SETS

A. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine generator housing, subbase fuel tank, engine generator, batteries, battery racks, silencers, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst-case normal levels.
3. Component Importance Factor: 1.5.

B. B11 Compliance: Comply with B11.19.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 110 requirements for Level 2 EPSS.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).
2. Altitude: Sea level to 1000 feet (300 m).

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Power Rating: Standby.

D. EPSS Class: Engine generator shall be classified as a Class 48 according to NFPA 110.

E. Service Load: 10 kW.

F. Frequency: 60 Hz.

G. Voltage: 240-V ac.

H. Phase: Single-phase, three wire.

I. Induction Method: Naturally aspirated.

J. Governor: Adjustable isochronous, with speed sensing.

K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

L. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

M. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a single-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time:

    a. Comply with NFPA 110, Type 10 system requirements.

2.4 DIESEL ENGINE

A. Fuel: ASTM D975, diesel fuel oil, Grade 1-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.

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

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer:

1. Semicritical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

    a. Minimum sound attenuation of 18 dB at 500 Hz.
    b. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F (minus 40 to plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 37.

B. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

C. Fuel Filtering: Remove water and contaminants larger than 1 micron.

D. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

E. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Tank level indicator.
2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills.
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration:

1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Analog control panel with dedicated gages and indicator lights for the instruments and alarms indicated below.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

    a. Engine lubricating-oil pressure gage.
    b. Engine-coolant temperature gage.
    c. DC voltmeter (alternator battery charging).
    d. Running-time meter.
    e. AC voltmeter.
    f. AC ammeter.
    g. AC frequency meter.
    h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:

    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low-water temperature alarm.
    g. High engine temperature prealarm.
    h. High engine temperature.
    i. High engine temperature shutdown device.
    j. Overspeed alarm.
    k. Overspeed shutdown device.

l. Low fuel main tank.

1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for six hours at full load.

m. Coolant low-level alarm.
n. Coolant low-level shutdown device.
o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant low-temperature alarm.
r. Coolant high-temperature shutdown device.
s. EPS load indicator.
t. Battery high-voltage alarm.
u. Low cranking voltage alarm.
v. Battery-charger malfunction alarm.
w. Battery low-voltage alarm.
x. Lamp test.
y. Contacts for local and remote common alarm.
z. Generator overcurrent-protective-device not-closed alarm.
aa. Hours of operation.
bb. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Overcurrent Protective Device:

1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:

a. Tripping Characteristic: Designed specifically for generator protection.
b. Trip Rating: Matched to generator output rating.
c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
d. Mounting: Adjacent to, or integrated with, control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Range: Provide limited range of output voltage by adjusting the excitation level.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description:

1. Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

a. Sound Attenuation Level: 85 dB

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph (160 km/h).

C. Hinged Doors: With padlocking provisions.

D. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

E. Muffler Location: External to enclosure.

F. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Testing Agency:

1. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Perform insulation-resistance tests according to IEEE 43.

            a) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        3) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Remove and replace malfunctioning units and retest as specified above.

H. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.2 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **12** months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13