METROLINX

Backup Power Supply Generator Specification

Specification 26 32 00

Revision 01
Date: March 2023

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an Agency of the Government of Ontario

Amendment Record Sheet

Amendment in Clause No.	Date of Amendment	Description of Changes
Cover page	March 2023	Removed 'Capital Projects Group' to update organizational changes
1.2.3, 1.2.7,1.3.4, 2.1.3	March 2023	Updated design requirements and numbering on Electrical Identification and Nomenclature specification
1.8.2, 2.10.7, 2.12.2	March 2023	Updated delivery, storage, and handling requirements, control requirements and indoor installation requirements.
3.2	March 2023	Updated Installation and Commissioning requirements

LIST OF CONTENT

1. GENERAL

1.1. SCOPE OF WORK

1.1.1. Labour, products, equipment, and services necessary for backup power supply generator work in accordance with the Contract Documents.

1.1.2. The term "genset" is used throughout this specification in reference to "backup power supply generator", "standby generator", or "standby electric power generation system"

1.1.3. The responsibility for performance to this specification shall not be divided among individual component manufacturers but must be assumed solely by the primary manufacturer. This includes generating system design, manufacture, testing, and having a local supplier responsible for service, parts, and warranty for the total system.

1.1.4. The intent of this Section is to provide Metrolinx with a genset complete in every detail and requiring no additional in-field modifications or construction, except where specifically allowed by this Section.

1.2. DESIGN REQUIREMENTS

1.2.1. The equipment furnished and the equipment installation, wiring methods and materials used shall conform to the latest edition of the Ontario Electrical Safety Code, Electrical Safety Authority (ESA) Bulletins and Supplements issued by the Electrical Safety Authority, and the applicable Metrolinx Standards. In case of any conflicts, the more stringent requirement shall apply.

1.2.2. Design equipment and systems to all applicable standards of CSA, ULC, IEEE, ESA.

1.2.3. Design equipment and systems to the latest version of GO DRM.

1.2.4. Design equipment and systems to standards and codes to the latest editions adopted by and enforced by local authorities having jurisdiction (AHJ).

1.2.5. The genset shall consist of a reliable power source that will supply Metrolinx's requirements for keeping Metrolinx operational during an electrical utility interruption. This requirement can be achieved by diesel-electric genset and controls, gasoline electric genset and controls, natural-gas electric genset and controls, or an electrical storage system that can provide the minimum backup support for full load operations.

1.2.6. Gensets shall be designed to run life safety and operational systems for the site.

1.2.7. Gensets shall be designed to provide backup power for full load operations for 48 hours, 24 hours, or 8 hours based on facility priority as indicated on the Contract Drawings

1.2.8. Gensets shall be designed to provide the standby power rating as indicated on the Contract Drawings. In addition to the rating, the genset shall be capable of supplying all losses associated with accessories such as air cleaners, radiator fan, lubricating oil pump, fuel transfer pumps, jacket coolant pump, turbocharger, governor, alternator and exciter.

1.2.9. Gensets shall be designed to start, be at synchronous speed and full voltage and connected to the emergency load(s), inclusive of the automatic transfer system time delays, all within 15 seconds start up during the loss of normal utility power supply.

1.2.10. Gensets shall be designed to shutdown automatically upon return of normal utility power supply.

1.2.11. Genset design shall conform to CSA Standard CAN/CSA-C282 - Emergency Electrical Power Supply for Buildings.

1.2.12. Genset design shall allow complete assembly and testing at the factory.

1.2.13. Gensets shall be designed to be “in-building” design or the "packaged skid-mounted" design depending on the Contract Document requirements.

1.2.14. Genset design shall allow for mounting on a house-keeping concrete pad(s).

1.2.15. Natural-Gas generators are to be considered only if the fuel is guaranteed available for the minimum 48-hour, 24-hour or 8-hour operation based on facility priority and the size required is 150 KVA or smaller.

1.2.16. A permanent, outdoor load bank with multiple steps of resistance loads will be used to test the genset. The genset shall be designed to be compatible with the load bank, the load bank requirements are provided in Section 26 37 00.

1.2.17. Under short circuit conditions, the generator shall be capable of delivering sufficient current to enable protective breakers to trip.

1.3. RELATED WORKS

1.3.1. Section 26 05 00 - Electrical General Requirements.

1.3.2. Section 26 05 13 – Medium Voltage Cables.

1.3.3. Section 26 05 21 - Electrical Conductors and Cables.

1.3.4. Section 26 05 23 – Electrical Identification and Nomenclature

1.3.5. Section 26 05 31 - Splitter Boxes, Junction Boxes and Pullboxes.

1.3.6. Section 26 05 34 - Raceway for Electrical Systems.

1.3.7. Section 26 12 13 - Liquid Filled Transformer.

1.3.8. Section 26 12 16 - Dry Type Transformer.

1.3.9. Section 26 13 26 - Metal-Clad Switchgears.

1.3.10. Section 26 23 00 - Low Voltage Switchgears.

1.3.11. Section 26 24 13 - Switchboards and Panelboards.

1.3.12. Section 26 24 19 - Motor Control Centres.

1.3.13. Section 26 27 26 - Receptacles and Plugs.

1.3.14. Section 26 28 00 - Circuit Breakers and Fuses.

1.3.15. Section 26 28 23 - Disconnect Switches.

1.3.16. Section 26 29 10 - Motor Starters and Contactors.

1.3.17. Section 26 36 23 - Transfer Switch.

1.3.18. Section 26 37 00 - Outdoor Load Bank.

1.4. REFERENCE STANDARDS

1.4.1. Ontario Electrical Safety Code (OESC).

1.4.2. Ontario Building Code (OBC).

1.4.3. Metrolinx Standards, Drawings and Specifications.

1.4.4. GO Design Requirement Manual (DRM).

1.4.5. Metrolinx Electrical Safety Document.

1.4.6. CSA Z462, Workplace Electrical Safety.

1.4.7. CAN3 C235, Preferred Voltage Levels for AC Systems, 0 to 50,000V.

1.4.8. CAN3-Z299.4, Quality Assurance Program - Category 4.

1.4.9. CAN/CGSB-3.6-M90, Diesel Fuel.

1.4.10. CAN3-C13-M83, Instrument Transformers.

1.4.11. CAN3-C17-M84, Alternating-Current Electricity Metering.

1.4.12. CAN4-S601-M84, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.

1.4.13. CSA B139, Ontario Installation Code for Oil-Burning Equipment.

1.4.14. CSA C22.2 No. 100, Motors and Generators.

1.4.15. CSA C22.2 No. 0.22, Evaluation Methods for Arc Resistance Ratings of Enclosed Electrical Equipment.

1.4.16. CSA C22.2 No. 29, Panelboards and Enclosed Panelboards, latest edition.

1.4.17. CSA C22.2 No. 5, Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures.

1.4.18. CSA-B139 - Installation Code for Oil-Burning Equipment

1.4.19. CSA-C282, Emergency Electrical Power Supply for Buildings.

1.4.20. CSA Z460, Canadian Standard on Lockout/Tagout.

1.4.21. CSA Z463, Standard - Electrical Systems Maintenance.

1.4.22. EEMAC MG1-22.

1.4.23. EEMAC, Electrical Equipment Manufacturer's Association of Canada.

1.4.24. IEC 8528 Part 4, Control Systems for Generator Sets.

1.4.25. IEEE 446, Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

1.4.26. IEEE C37.13, Low Voltage AC Power Circuit Breakers Used in Enclosures.

1.4.27. IEEE C37.16, Preferred Ratings, Related Requirements and Application for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors.

1.4.28. IEEE C37.17, Trip Devices for AC and General-Purpose DC Low Voltage Power Circuit Breaker.

1.4.29. IEEE C37.20.1, Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.

1.4.30. IEEE C37.20.7, Guide for Testing Metal-Enclosed Switchgear Rated up to 38kV for Internal Arcing Faults.

1.4.31. IEEE C37.50, Test Procedure for Low Voltage AC Power Circuit Breakers Used in Enclosures.

1.4.32. IEEE C37.51, Conformance Testing of Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies.

1.4.33. NEMA 250, Enclosures for Electrical Equipment (1,000V Maximum).

1.4.34. NEMA ISC10, AC Generator Sets.

1.4.35. NEMA MG1, Motors and Generators.

1.4.36. NEMA PB 1, Panelboards.

1.4.37. NEMA SG3, Low Voltage Power Circuit Breakers.

1.4.38. NEMA SG5, Power Switchgear Assemblies.

1.4.39. NETA, Acceptance Test Standards.

1.4.40. NFPA 110, Standard for Emergency and Standby Power Systems.

1.4.41. NFPA 31, Standard for Installation of Oil Burning Equipment.

1.4.42. UL 1066, Low Voltage AC and DC Power Circuit Breakers Used in Enclosure / rooms.

1.4.43. UL 1558, Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.

1.4.44. UL 2200, Stationary Engine Generator Assemblies.

1.4.45. UL 489, Molded Case Circuit Breakers and Circuit Breaker Enclosures.

1.4.46. UL 50, Enclosures for Electrical Equipment.

1.5. SPARE PARTS

1.5.1. Provide a set of parts and any specialized tools necessary for the commissioning of the genset(s) including:

a) Air filter elements;

b) Lubricating oil filter elements;

c) Fuel oil filter elements; and

d) Fuses.

1.5.2. Provide a spare set of specialized tools necessary for the maintenance of the genset(s). These shall be left on site permanently.

1.6. TRAINING

1.6.1. Train Metrolinx personnel on basic operational and maintenance procedures. Allow for minimum of 8 hours of on-site time to train in all aspects of equipment and system(s) operation(s), per group to be trained. Allow for two (2) groups.

1.6.2. Training shall be specific to equipment, model number, and version installed. Provide material for each participant and include record drawings and comprehensive operating and maintenance manual for equipment installed.

1.7. WARRANTY

1.7.1. The contractor shall provide a manufacturer warranty for the work of this section with a minimum warranty period of five years after acceptance by Metrolinx. Warranty shall include the following:

a) Twenty-four hours per day, seven days per week emergency service coverage, all parts and labor included. Service response time of within four hours onto site shall be required; and

b) Extended maintenance package with a minimum of four site inspection and maintenance visits per year for the full warranty period from date of acceptance free from defects in workmanship and material. Maintenance includes but is not limited to lube oil changes, filter changes and load bank testing. Load bank test duration shall be four hours.

1.7.2. All repairs made under this warranty shall be done at no expense to the Metrolinx, including travel time and expenses.

1.7.3. Maintainer shall provide a maintenance and repair log on site to record system faults, a description of each fault and work performed and parts replaced.

1.8. DELIVERY, STORAGE AND HANDLING

1.8.1. Shipping and handling in accordance with Manufacturer's instructions.

1.8.2. Preparation for shipment to include protection of equipment and accessories against corrosion, dampness, breakage, or vibration injury in transportation and handling. Package to prevent tampering or pilfering. Notify Metrolinx immediately if any equipment is found to be damaged or tampered with.

1.8.3. Furnish necessary bus connections, wire jumpers, bolts, nuts, washers, etc., suitably packaged and marked to facilitate field assembly. Identify each shipping container with name of contents, Contract number and equipment number permanently marked and readily visible

1.9. SUBMITTALS

1.9.1. Product Data Package

a) Provide the following drawings for all components of the assembly:

1) Outline dimension drawings (including weights);

2) Single line diagrams;

3) Schematic diagrams; and

4) Wiring/interconnection diagrams.

b) General:

1) Sound pressure data;

2) Emissions data; and

3) Noise data.

c) Engine:

1) Make, model and ratings;

2) Horsepower versus engine speed;

3) Fuel consumption verses load (0% to 110%); and

4) Oil consumption verses load (0% to 110%).

d) Alternator:

1) Make, model and ratings;

2) Time versus current damage curve; and

3) Decrement curve.

e) Main breaker:

1) Make, model and ratings; and

2) Time versus current curve showing proper co-ordination with alternator damage curve for full range of output.

f) Battery: make, model, type, and capacity.

g) Battery charger: make, model and type.

h) Fuel system components make, model and capacity for:

1) Fuel tank: make, model and capacity;

2) Governor: make, model and type with performance values;

3) Exhaust silencer: make, model, type, and ratings;

4) Control panel: functional description, and component descriptions;

5) Voltage regulator: make, model and type; and

6) Fuel oil distributor inspection certificate.

i) Instrumentation: make, model, and type.

j) Bill of material.

k) Recommended spare parts list.

l) Structural specifications for genset foundations (dimensions, load levels, vibration levels).

m) Operations manual, indicating:

1) Manual starting;

2) Automatic starting;

3) Load transfer;

4) Time from start signal to unit ready to accept full load;

5) Shutdown;

6) Pre-shutdown alarm functions;

7) Shutdown functions; and

8) Emergency stop procedure.

n) Maintenance manual.

o) Installation Manual.

p) Factory Test Procedure.

q) Reference list of customers to gensets of similar specification and size have been supplied in the past and details of equipment supplied.

r) Details of maintenance departments including location of maintenance departments, response time and parts availability.

1.9.2. Shop Drawings Package:

a) Provide the following drawings for all components of the assembly:

1) Outline dimension drawings (including weights);

2) Single line diagrams;

3) Schematic diagrams; and

4) Wiring/interconnection diagrams.

b) Factory Test Procedure.

1.9.3. Commissioning Package

a) Submit the following:

1) As-built shop drawings;

2) Certified test reports;

3) Commissioning procedures, including step by step instructions for all commissioning tests;

4) Commissioning checklists;

5) Commissioning reports; and

6) Commissioning test sheets.

1.9.4. Closeout Data Package

a) Submit the following:

1) As-installed drawings;

2) Certified test reports;

3) Completed Commissioning reports;

4) Completed Bill of material;

5) Recommended spare parts list;

6) Operations manual;

7) Maintenance manual;

8) Installation Manual; and

9) Complete set of information indication component makes, types, ratings, part numbers, performance data and settings.

1.10. QUALITY ASSURANCE

1.10.1. Refer to Section 26 05 00.

1.10.2. All electrical items shall be approved by CSA and/or ULC.

1.10.3. Provide factory quality assurance in accordance with CAN3-Z299.1.

1.10.4. Ensure that components of the system are compatible with each other and are properly coordinated and aligned.

1.10.5. Equipment supplied must be by a Vendor who has been engaged in the manufacture of this type of equipment specified herein on a continuous basis for a minimum period of 5 years. There shall be one source of responsibility for warranty, parts, and service through a local representative with factory trained personnel.

1.10.6. The genset Manufacturer and major component manufacturers shall have established workshops, extensive inventory of parts, and service personnel based in the region of the installation site.

2. PRODUCTS

2.1. GENERAL

2.1.1. The genset shall be able to withstand the environmental conditions stated in Section 26 05 00 without damage or degradation of operating characteristics:

2.1.2. The genset shall consist of the following items, plus such other items as may be necessary to make the unit a self-contained and complete power unit capable of operating independently:

a) Engine;

b) Alternator;

c) Cooling system;

d) Fuel system;

e) Exhaust system;

f) Instrumentation;

g) Controls; and

h) Genset breaker.

2.1.3. All materials and parts comprising the units herein specified shall be new and unused, a standard product of current manufacture and of the highest grade, free from all defects or imperfections affecting performance. Workmanship shall be of the highest grade, in accordance with modern practice.

2.1.4. Sound attenuation to be reduced sound levels at 7 m when generator is running at full load inside a building or a stand-alone package unit.

Table 2-1 Generators Noise Levels

Generators Noise Levels (kW)	dB(A)	Metres
≤150	65	7.0
>150 to ≤500	75	7.0
> 500	80	7.0

2.1.5. The complete genset shall be free of critical speeds of either a major or minor order that will endanger the satisfactory operation or cause undue vibration in the plant, equipment, or structure.

2.2. ENGINE

2.2.1. General

a) The engine shall be of the high speed (1800 rpm) design, capable of operating its alternator at full load, continuously for a 48-hour period.

b) The engine shall conform to the following performance criteria:

1) Rating - Engine brake horsepower shall be sufficient to deliver full rated genset kW and kVA at the installation site when operated at rated rpm and equipped with all engine-mounted parasitic and external loads such as radiator fans and power generators;

2) Start time and load acceptance – genset shall start, achieve rated voltage and frequency, and be capable of accepting load within 15 seconds when properly equipped and maintained; and

3) Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.

c) The engine speed shall be controlled by an electronic governor integrated into an electronic engine control system.

d) An automatic mechanical or electrical overspeed protection device shall be provided, independent of the governor. The setting of this device is to be 10% above normal operating speed of the engine to prevent tripping except under complete failure of the governing system.

e) Engine-driven cooling water pump(s), centrifugal type, shall provide adequate cooling to the engine.

f) An engine accessory rack shall be provided, which shall be a compact assembly designed to embody all the basic engine auxiliaries in an easily maintained unit. All engine fuel, lubricating oil and cooling water piping shall be completed at the factory with provisions made for simple site connection.

g) Engine oil changes shall not be required under continuous running before 350 hours. The diesel engine shall require only standard grades of generally available heavy-duty lubricating oils. The sump of the engine shall have adequate capacity to permit operation of the engine for 48 hours without adding oil.

h) Engine shall be completely tight without any leaking of fluids

i) Suitable oil drip pans shall be provided.

j) The lubricating oil system shall be of the pressure type with a helical gear type lubricating oil pump located on the outside of the engine and driven from the crankshaft. The oil inlet is to be protected by a suction strainer. A pressure relief valve is to be provided at the oil outlet.

k) An oil cooler shall be provided, consisting of a steel housing with a removable brass tube and thin oil cooler core. The oil temperature shall be controlled automatically by the engine coolant.

l) A duplex lubricating oil filter shall be provided as a multiple element full flow type. An automatic 100% bypass system shall be provided.

m) The lubrication oil pump shall be a positive displacement type that is integral with the engine and gear driven from the engine gear train. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.

n) The bypass valve must be integral with the engine filter base of receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.

o) System shall utilize synthetic lubricants with compatible filtration, and compatible engine seals, approved by the engine manufacturer.

2.2.2. Diesel Engine

a) The engine shall comply with E.P.A. Tier 4 final standards for emissions.

2.2.3. Gasoline Engine

a) Gasoline engines shall be minimum lean burn gas combustion type utilizing full authority electronic engine management and four-cycle design.

2.3. FUEL SYSTEM

2.3.1. Diesel Engine

a) The engine shall be designed to utilize No. 2 diesel fuel oil.

b) An engine-driven positive displacement fuel pump shall circulate the fuel through the fuel filters and to the injectors. The pressure shall be regulated by relief valves of a bypass system. A duplex type fuel filter mounted on the engine shall be provided on the discharge side of the engine-driven fuel pump.

c) Provide an engine mounted air-cooled fuel oil cooler. Cooler is to be designed to limit the return fuel oil temperature to less than 35 °C. Fuel cooler is to be complete with all hardware, fans, starters and accessories required.

2.3.2. Gasoline Engine

a) The engine shall be designed to utilize regular unleaded gasoline with an octane rating of 87

b) An engine-driven positive displacement fuel pump shall circulate the fuel through the fuel filters and to the injectors. The pressure shall be regulated by relief valves of a bypass system. A duplex type fuel filter mounted on the engine shall be provided on the discharge side of the engine-driven fuel pump.

c) Provide an engine mounted air-cooled fuel oil cooler. Cooler is to be designed to limit the return fuel oil temperature to less than 35 °C. Fuel cooler is to be complete with all hardware, fans, starters and accessories required.

2.3.3. Natural-Gas Engine

a) The natural-gas fuel system shall consist of gas pressure regulators and controlled fuel supply.

b) The natural-gas engine shall be able to deliver rated power when operating on dry natural gas having a low heating value (LHV) of 905 Btu/cu ft. (33.74 kJ/L).

c) Lean burn technology shall provide exhaust emissions levels as low as 3.87 g/(kw/hr) NOx.

d) For natural-gas gensets a low-pressure fuel alarm must be provide with alarms that the pressure is getting low. The alarms should occur prior to the pressure of the fuel not being great enough to keep the generator operational.

2.3.4. Fuel tank(s)

a) Underground storage tank(s) are not permitted above ground tank(s) shall be used

b) Genset shall be provided with either a day tank working together with a separate storage tank or a single tank sized to suit a minimum 48-hour, 24-hour, or 8-hour runtime at full load based on facility priority.

c) The fuel tank(s) shall be ULC listed and include all necessary accessories to meet the applicable codes and requirements of the Authority Having Jurisdiction (AHJ).

d) Tank(s) shall be in accordance with CAN/CSA-B139 and all AHJ approvals shall be obtained.

e) The design shall ensure tank design adheres to the requirement of being 3 m from the property line in accordance with CAN/CSA-B139.

f) Fuel fill station shall be located for easy access by tank truck.

g) Genset sub-base fuel tanks shall be UL-142 labeled and shall be supplied with a lockable fill cap. All necessary vent and fuel lines for proper engine performance shall be provided as well as a means to readily detect the fuel level in the tank without the use of a measuring stick.

h) The system shall be equipped with a fuel containment basin with a normal capacity of 110% of the fuel tank and shall be supplied with a leakage detector switch in the basin and wired to an indicating light on the genset control panel.

i) The fuel tank shall be fitted with a low fuel level alarm. This switch shall activate whenever the fuel level in the tank is 20% or less remaining.

j) Tank(s) shall include fuel leak alarms.

k) Provide pressure relief vales valves for installations with overhead day tanks.

l) Tank(s) shall be double wall secondary containment that is UL 142 Listed.

m) Tank(s) shall be heavy gauge steel construction with electrical stub-up openings to provide genset wiring provisions through the base tank.

n) Tank(s) shall be complete with fittings: fuel supply with check valve (sized per unit), fuel return (sized per unit), 2" NPT for venting, NPT for emergency vent (sized per unit), NPT for fill, 1.5" NPT for fuel level gauge, and 3/8" NPT basin drain.

o) Tank(s) Interior tank baffle shall separate cold engine supply from hot return fuel.

p) The manufacturer shall guarantee the structural and mechanical integrity of the tank for setting the genset directly on top of the tank.

q) Provide a separate dedicated critical high-level float switch installed in the fuel tank to act as a redundant shut-down to prevent over-filling of the fuel tank.

2.4. STARTING SYSTEM

2.4.1. The engine shall be supplied with a 24 V lead acid battery of sufficient ampere hour capacity for 5 cranking cycles of 10 seconds ON - 10 seconds OFF, at 10°C., with a battery end voltage not less than 80 % of rated voltage, in addition to control power requirements of the engine-mounted control panel, plus 25% excess capacity.

2.4.2. The start battery shall be automatically maintained in a charged condition with a battery charger sized to recharge a completely discharged battery to 80% of capacity in 4 hours and to full capacity in not more than 12 hours. Provide an industrial quality heavy duty fully automatic charger with voltmeter, ammeter, and output circuit breaker. Charger output voltage regulation shall be within +/- 1% for line voltage variation +/- 10%.

2.4.3. The signal to start the engine shall be provided from the genset control panel sensing under voltage and/or under frequency of the normal utility source. This signal so enables the engine genset to start and arrive at full speed and be ready to accept load within 15 seconds.

2.4.4. A battery tray shall be provided for the batteries. It shall be constructed and so treated as to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over of battery electrolyte shall be contained within the tray to prevent a direct path to ground. A separate tray shall be provided for each battery bank and placed on each side of the engine on all dual starter motor equipped units.

2.5. COOLING SYSTEM

2.5.1. A direct connected radiator shall be provided and located on the common sub-base.

2.5.2. Radiator shall be of the vertical core design for horizontal air discharge.

2.5.3. Fan blades shall be of the air foil design to minimize power requirements and noise.

2.5.4. Cooling liquid shall be 50/50 solution of ethylene glycol and inhibited water.

2.5.5. The radiator shall include a welded and bolted steel frame, a plenum chamber, a rolled venturi fan ring, lifting holes, core guard and fan guard supported by the frame. Continuous copper plate fins, solder bonded to flat brass tubes shall be provided.

2.5.6. Manifold tanks shall be removable to allow access to tube ends for cleaning. Provision shall be made to compensate for a thermal expansion or contraction between the steel frame supports and the non-ferrous core.

2.5.7. The cooling water temperature during engine operation shall be controlled by an automatic, modulated valve, pre-piped in the engine cooling loop, which shall control the flow of coolant through the radiator. This valve shall also provide for fast engine warm-up and a constant flow of engine coolant.

2.5.8. An engine coolant expansion and storage tank of adequate capacity for this system shall be provided with the radiator. The tank shall be equipped with a low-level alarm sensor and it shall be connected to the "suction side" of the coolant pump.

2.5.9. Thermostatically controlled electrical immersion heaters shall be supplied for 208 V, 3 phase, 60 Hz operation. This device shall furnish heat to the engine cooling water when the engine is shut down. Thermal siphon flow shall maintain the engine coolant at a temperature of 40°C, as per CSA C282 (but no higher than 45°C).

2.5.10. Coolant required for cooling engine jacket and lubricating oil shall be provided from a radiator that can be remote mount or direct connected mounted on the common base. Engine after-coolers are to be jacket coolant connected for cooling combustion air. If Vendor requires a separate source of cooling water for engine jacket, the Vendor shall include the cost of providing such separate source as part of their supply.

2.5.11. Under no circumstances shall the floor area or any of its parts be considered for cooling air intake or discharge requirements of the genset or its associated equipment

2.6. COMBUSTION AIR INTAKE SYSTEM

2.6.1. The air intake system shall include a disposable type filter, which shall be mounted on the genset directly connected to the inlet.

2.7. COMBUSTION AIR EXHAUST SYSTEM

2.7.1. Supply a hospital plus grade silencer complete with stainless steel flexible section of exhaust pipe and any necessary adapters to accommodate standard flanges. Muffler shall be supplied with inlet and outlet adapters to suit site conditions. All exhaust piping and lagging of exhaust pipe within the building shall be the responsibility of the Contractor. Silencer and piping shall be adequately braced and supported.

2.7.2. Provide all gaskets, hardware, nuts and bolts for engine and silencer flanges.

2.7.3. The silencer shall be mounted such that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe sizes shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations of the engine.

2.7.4. Each silencer shall be fitted with a 90° tail pipe extension (elbow) terminating in a vertical position.

2.7.5. At the point where the exhaust pipe penetrates the roof of the space/room, a suitable "rain skirt" and collar shall be provided. It shall be designed to prevent the entrance of rain yet allow for expansion and vibration of the exhaust piping without chafing or stress to the exhaust system.

2.8. ALTERNATOR

2.8.1. Provide a single bearing type alternator designed to be bolted directly to the engine flywheel. The alternator shall be self-ventilated and of drip-proof construction.

2.8.2. The alternator shall be 3-phase, revolving fields, synchronous machine of salient pole construction with amortisseur windings.

2.8.3. The alternator shall have wound Class H insulation.

2.8.4. Connect neutral point of alternator winding to a fully insulated terminal in the terminal box. Ground the alternator neutral to the electrical room ground bus using minimum #3/0 AWG copper insulated green grounding conductor in conduit for protection against damage. Connect grounding conductor and bonding conductor so as to preserve integrity of generator winding ground fault sensor. The alternator terminal box shall be extra-large, suitable for feeder termination.

2.8.5. Alternator Ratings

a) Output: As required by the application.

b) Speed: 1800 rpm (same as engine, with 50% overspeed capability).

c) Voltage: As required for the application.

d) Phase: As required for the application.

e) Frequency: 60 Hz.

2.8.6. The alternator shall be magnetically and mechanically balanced. The rotor shall be liberally proportioned to withstand all strains to which it may be subjected. The poles shall be securely fastened to the rotor so that they cannot be displaced by vibration or centrifugal force. The alternator shall be designed to co-ordinate with the engine to minimize torsional vibration effects.

2.8.7. The alternator shall be supplied with a brushless exciter and high performance static regulator rated to give excitation of the alternator under all load conditions, including overload specified for the alternator.

2.8.8. The alternator and exciter shall be CSA approved. If there are any deviations, these should be indicated on the shop drawings.

2.8.9. The alternator, exciter and voltage regulator must be supplied by the same manufacturer as a complete, co-ordinated package.

2.8.10. A current forcing circuit shall be provided with the voltage regulator to supply a minimum of 300% of nominal alternator output for at least 10 seconds to allow proper co-ordination of system protective devices.

2.8.11. The automatic static voltage regulator shall operate automatically in conjunction with the exciter to maintain the generator output voltage within +/- 2% of rated voltage from no load to full load at 0.8 to 1.0 power factor and visa-versa. The regulator adjustment shall be based on the average of the three phase voltages. The voltage stability shall be within +/- 0.5% of its average RMS value at any steady state load condition from no load to full load and for all ambient temperatures.

2.8.12. When the continuous rated load of the alternator of any power factor from 0.8 to 1.0 is suddenly applied, the momentary voltage drop shall not exceed 25% and shall return to normal voltage within 5 seconds. The output voltage shall not be affected by frequency changes within 10% of rated frequency.

2.8.13. The voltage regulator shall be designed for independent or parallel running of the alternators, complete with an external loading control and a parallel running switch. The correct sharing of reactive load between alternators running in parallel shall be achieved by means of quadrature current compensation (droop circuit), which allows the voltage to drop slightly with reactive load.

2.9. MOUNTING BASE

2.9.1. A complete mounting assembly shall be provided. The engine, generator, radiator, pumps, control cabinets, etc. shall be mounted on a common fabricated steel sub-base. This frame shall be mounted on adjustable spring isolators. The baseplate shall be mounted on isolation pads.

2.9.2. The mounting of the engine on the base shall be such that piping is extended beyond the sub-base for convenience of draining the oil sump.

2.9.3. The sub-base shall be provided with hooks, hubs, etc. for the attachment of slings. These shall be suitable for moving the unit with the engine wet or dry.

2.9.4. Sub-base shall be securely bolted to foundation/structure under genset. Vendor shall supply all foundation bolts suitable for securing the vibration mounts to the structure/foundation.

2.9.5. The basic structure shall meet all seismic requirements of Zone 4 or equivalent.

2.10. CONTROLS

2.10.1. Each genset is to be provided with a control panel.

2.10.2. Control panel shall be a NEMA 1, sprinkler proof enclosure.

2.10.3. Control panel shall be suitable for top and bottom cable and conduit entry.

2.10.4. Control panel shall include a microprocessor based main control model (MCM).

2.10.5. MCM shall include a digital communication protocol as shown on the Contract drawings. This communications method is for remote monitoring of the genset by a supervisory system by Others.

2.10.6. Control panel shall include all controls as are required for a complete and functional genset. Control functions include but are not limited to:

a) Power metering;

b) Genset operation (speed control, voltage control);

c) Transfer switch coordination;

d) Genset switchgear operation;

e) Load shedding;

f) Load sharing;

g) Utility synchronization;

h) Alarming; and

i) Interfacing with remote supervisory systems.

2.10.7. Control panel shall include a 14" LCD/TFT touch screen. The following maintenance functionality shall be included at a minimum in the genset control via the touch screen:

a) Engine running hours display;

b) Recent alarms with corresponding codes or description;

c) Service maintenance interval (running hours or calendar days);

d) Main and day tank fuel levels;

e) Engine crank attempt counter;

f) Engine successful starts counter;

g) Twenty events are stored in control panel memory; and

h) Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:

1) Day of week;

2) Time of day to start; and

3) Duration of cycle.

2.10.8. Separate hardwired controls shall be provided as follows in addition to the touch screen:

1) A manual emergency stop button connected to stop the engine after a configurable time delay regardless of the mode of operation;

2) Alarm silence switch;

3) Alarm reset switch;

4) Alarm test switch;

5) Lube oil pressure gauge;

6) Fuel oil pressure gauge;

7) Tachometer;

8) Running hour meter; and

9) Run mode switch - three positions:

i) Off - stop and lock out the engine, or reset safeties, or both. With the switch in this position, a signal shall be initiated in the control panel indicating "Generator Not on Automatic", “Not in Auto”, or similar language;

ii) Auto (Automatic) - with the switch in this position, the system will accept either an automatic emergency start/stop signal or a remote manual start/stop signal should the system be manually initiated for maintenance exercise; and

iii) Man. (Manual) - manually start and run the engine.

2.10.9. Visual indication and audible alarms shall be provided for the functioning of any of the alarms listed below. Each alarm signal shall be wired to an auxiliary relay with 1 N.O. and 1 N.C. contact for connection to a remote supervisory system provided by Others. These alarms shall also be available on the digital communications protocol. All alarms shall be stored in the MCM memory accompanied by a time, date, and engine hour stamp. All alarm shall be manually reset, unless otherwise indicated. Control panel shall include annunciators for all genset alarms. Annunciator shall include a lamp test push-button, alarm horn and alarm acknowledge pushbutton.

a) Overcrank;

b) Low oil pressure;

c) Low oil temperature;

d) High engine coolant temperature;

e) Overspeed;

f) Emergency stop;

g) Engine temperature too low for reliable start;

h) High engine temperature pre-alarm;

i) Low fuel pressure;

j) Control switch not in automatic position;

k) Low voltage in battery;

l) Low coolant level;

m) Generator breaker open;

n) Battery charger AC failure;

o) Generator trouble (Key alarm, monitored by Building Automation System);

p) Low Fuel (50%) (Key alarm, monitored by Building Automation System); and

q) Critical Low Fuel (25%) (Key alarm, monitored by Building Automation System).

2.10.10. Visual indication shall be provided for the functioning of any of the conditions listed below; Each signal shall be wired to an auxiliary relay with 2 N.O. and 2 N.C. contact for connection to a remote supervisory system provided by Others. These signals shall also be available on the digital communications protocol.

a) Generator running (Key signal, monitored by Building Automation System)

2.10.11. Control panel auxiliary relays, where required, shall be totally enclosed plug-in type. Relays shall be suitable for 120 V AC operation.

2.10.12. Each control panel shall have the following analog meters:

a) Voltage for each phase;

b) Current for each phase;

c) kVA;

d) kW;

e) Power factor;

f) Frequency (Hz);

g) Accumulated MWh;

h) kW demand, kW peak; and

i) Elapsed time meter.

2.10.13. Genset starting and stopping

a) Genset shall receive start and stop commands from the Automatic Transfer Switch (ATS) associated with the genset. Refer to Section 26 36 23. Genset shall be fully compatible with the ATS.

2.10.14. Load shed control

a) Load shedding/adding shall be accomplished by use of the MCM.

b) MCM shall shed loads on a timed basis in priority sequence by sensing the genset's demand load. The genset shall not be subjected to sustained overloads at any time.

c) MCM shall be capable of sequential load-shed and load-addition. MCM shall control up to six (6) branch devices

2.10.15. Bus synchronizing

a) Genset to bus synchronization shall be accomplished by use of the MCM.

b) The genset MCM shall force the genset to match the frequency, phase and voltage of the bus it's synchronizing to. The synchronizer shall be capable of proper operation even with high bus voltage distortion.

2.10.16. MCM shall provide storage, in non-volatile memory, of the following parameters:

a) Maximum and minimum values of voltage (per phase);

b) Maximum and minimum values of power factor;

c) Maximum value of current (per phase);

d) Maximum value of kVA;

e) Maximum value of kVAR;

f) Maximum value of kW; and

g) Maximum value of kW demand;

2.10.17. Programmable Inputs and Outputs

a) The MCM shall include the ability to accept a minimum of 8) total with 6 programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

b) The control shall include the ability to accept a minimum of 8 total with 6 programmable relay output signals. The output relays shall be rated for 2A @ 30VDC and consist of 6 Form A (Normally Open) contacts and 2 Form C (Normally Open & Normally Closed) contacts.

c) The control shall include the ability to operate 1 discrete output, integral to the controller, which is capable of sinking up to 300 mA.

2.11. GENSET BREAKER

a) The genset breaker shall meet the requirements of Section 26 23 00 - Low Voltage Switchgear and Section 26 13 26 - Metal Clad Switchgear.

b) The genset breaker is to be mounted on the genset unless indicated otherwise on Contract Drawings.

c) In addition to the genset breaker other breakers shall be provided on the genset as shown on the Contract Documents.

2.12. ENCLOSURE/ROOM

2.12.1. In accordance with the Contract Documents the genset shall either be an "indoor installation" type of a "package installation type" as detailed below.

2.12.2. Indoor Installation

a) An indoor installation requires all genset components to be installed indoors in a purpose built genset room. In this configuration the genset shall be open to the room for ease of maintenance.

b) At least 1.5 m clearance shall be provided on all sides of the genset. Space occupied by the any overhanging components shall not interfere with the clearance requirements.

c) All louvers shall be designed to help prevent the entrance of driving rainwater or snow, but shall have sufficient free area to allow for engine-generator cooling air requirements. The louvers shall open automatically upon generator start and close upon generator shutdown. Heavy-duty bird screens over the intake louvers shall be provided.

2.12.3. Package Installation

a) This configuration is an alternative option for Generator Enclosures based on site conditions. Please refer to the latest GO Design Requirements Manual for further information.

b) This configuration shall include a sound attenuated enclosure mounted on the genset sub-base for outdoor installation.

c) The enclosure shall be NEMA 3R for outdoor use, fabricated from heavy gauge steel sheet, finished in accordance with this Section to minimise corrosion. Enclosure partitions and baffles of same material as enclosure.

d) Vibration pads shall be provided at mounting locations.

e) Include enclosure drip shields

f) Include provisions for lifting of the complete enclosure.

g) Enclosure shall be self-contained outdoor sound attenuated enclosure / room c/w structural steel mounting base.

h) Provide heaters within enclosure to maintain ambient operational temperature of generator for proper start-up and minimum 10°C in conformance with CAN/CSA-C282.

i) All doors on the enclosure shall be strategically located in areas as to allow ease of maintenance on the genset and allow good access to and visibility of instruments, controls, engine gauges, etc. The doors shall be fitted with stainless steel bolt-on, lift off hinges. Each door shall be fitted with flush-mounted, key lockable latches or pad lockable latches. The latch hardware shall allow escape from within when locked externally. Door holdback hardware shall be provided to secure the door during installation and maintenance. All doors shall be gasketed to prevent leaks.

j) All louvers shall be designed to help prevent the entrance of driving rainwater, but shall have sufficient free area to allow for engine-generator cooling air requirements. The louvers shall open automatically upon generator start and close upon generator shutdown. Heavy-duty bird screens over the intake louvers shall be provided.

k) The roof must also be sealed using a thermoplastic polyolefin membrane to prevent leaks. Roof shall be slanted to allow water runoff.

l) All exterior components of the enclosure shall be assembled utilizing stainless steel bolts, nuts, and lock washers. All seams shall be sealed to prevent leaks.

m) The enclosure is to be thermally insulated. Insulation material is to be fiberglass held in place with a galvanized perforated metal liner.

n) The enclosure shall be equipped with a load center for all generator-related equipment such as but not limited to battery charger, jacket water heater(s), lighting, receptacles. The load center shall be mounted within the enclosure and allow for a single-entry point for external power supply.

o) Vapor proof lights shall be installed within the enclosure and strategically located on either side of the genset. They shall be ceiling mounted and parallel to the length of the unit. Their AC power source shall be taken from the genset load center. The light switch box, located by one of the entrance way doors, shall have its own grounded duplex receptacle mounted therein for use by maintenance personnel.

p) The floor of the enclosure shall be designed and constructed in such a manner as to prevent the entrance of rodents. This shall be accomplished with solid metal or "diamond plate" but, in any event, must be capable of fully supporting any ancillary equipment specified which may be secured to it plus the anticipated weight of maintenance personnel and their tools.

q) The enclosure shall allow suitable space and clearances within the enclosure to mount and maintain the specified battery charger, engine starting batteries, racks and cables, main line circuit breaker, engine-generator control panel, and other items as specified or as shown on the drawings.

r) Adequate guards shall be provided to protect operating personnel from exposed moving parts. Guards shall be provided around all exposed parts whose surface temperature exceeds 82.22°C. These guards shall be suitably insulated or ventilated to keep their temperature below the 82.22°C limit.

s) Heavy gauge steel grate platforms with stairs and railings shall be provided around the packaged unit as to allow ease of maintenance on the genset.

2.13. IDENTIFICATION

2.13.1. Furnish colour coding in accordance with specification 26 05 23 – Electrical Identification and Nomenclature.

2.13.2. Provide identification for equipment and the sub-components in accordance with specification 26 05 23 – Electrical Identification and Nomenclature.

2.13.3. Provide nameplates, warning signs and labels as required by the AHJ.

2.14. WIRING

2.14.1. All genset conduit and wiring to the various ancillary equipment supplied with the package and shall be pre-wired in accordance with all governing codes pursuant to this application.

2.14.2. All genset wiring shall be in conduits made from rigid metal, or liquid-tight material specifically manufactured for electrical use. All connections at the genset shall be flexible.

2.14.3. Provide knockouts for field installation. No knockouts shall be left open; all open knockouts shall be sealed with knockout plugs only.

2.14.4. Provide a grounding terminal for safety grounding in each cable termination compartment installed within 100 mm of compartment door in an easily accessible location.

2.15. FINISH

2.15.1. Finish shall provide maximum corrosion protection for the provided material.

2.15.2. The package unit exterior colour in accordance with ANSI 61 gray, or manufacturer's standard colour.

2.15.3. Interior surfaces of enclosure and compartments requiring paint finish:

a) Apply two coats of finish, CAN/CGSB-1.88 alkyd base enamel over primer, colour per manufacturer's standard, gloss finish; and

b) Factory standard finish providing equivalent level of quality and features, subject to approval, may be proposed under alternatives.

2.15.4. Vendor to provide touch-up paint.

3. EXECUTION

3.1. FACTORY QUALITY CONTROL

3.1.1. Arrange for Metrolinx to witness above at Manufacturers facility as part of factory acceptance testing. Notify Metrolinx 21 calendar days prior to set up the factory acceptance testing schedule.

3.2. INSTALLATION AND COMMISSIONING

3.2.1. Do not use genset to provide power for construction or other purposes, except for site testing unless specifically approved in writing by Metrolinx.

3.2.2. The Contractor shall install the genset at the job site. The installation shall include the provision of all material and labour to provide a complete, functioning system meeting all Contract requirements. It is the responsibility of the Contractor to check and test all equipment supplied by the systems manufacturer to assure that it is suitable for the installation and meets all Contract requirements.

3.2.3. Provide the services of the manufacturer's staff to support in the start-up and installation, testing and commissioning and calibration of the generators. Provide these services for such period and for as many visits as necessary to get the emergency generators in working order and to ensure that Metrolinx is conversant with all aspects of emergency generator care and operation.

3.2.4. Testing shall be conducted in accordance with the latest edition of ANSI/NETA ATS – Standard for Acceptance Testing for Electrical Power Equipment and Systems. Provide fuel, load bank and other equipment as required for testing.

3.2.5. Provide initial filling of day tank and main storage fuel tank once generator is commissioned and ready for operation.

END OF SECTION