PART 1 - GENERAL

1.1 Description of Systems

.1 Provide an automatic, unattended, emergency power supply system consisting of:
- .1 Air cooled low voltage diesel electric generating unit with control panel.
- .2 Accessories and equipment specified in this specification.

.2 Provide design, fabrication, testing, transportation, demonstration and guarantee of the equipment.

1.2 Design Criteria

.1 Design equipment suitable to meet the following criteria:
- .1 Total load: 14.4 kW.
- .2 Motor load: 8.0 KW.
- .3 Largest motor: 2.24 kW.
- .4 Voltage: 208 V.
- .5 Frequency: 60 Hz.
- .6 Phase/Wire: 3 phase, 4 wire.
- .7 Power factor: 0.8 lag.
- .8 Load harmonic content: 20% THD (current).
- .9 Maximum rotational speed: 3600 rpm.
- .10 Interrupting capacity: 15 MVA.
- .11 Duty Rating: standby.
- .12 Performance: automatic;
- .13 Elevation above sea level: 100m
- .14 Ambient temperature: 40 degree C.
- .15 Relative humidity: 60%.

.2 Unit must be capable of starting, attaining settled voltage and frequency limits and accepting 80% rated load with voltage and frequency settling to the specified steady state bands, all with 15 seconds for any temperature between 0 deg. C to 40 deg. C.

.3 Use engine manufacturer's standard, published continuous (prime) horsepower rating in assessing engine capacity and derate this rating for the specified conditions and engine driven accessories in accordance with latest revisions of ISO 3046/1.

.4 Description of generating set operation:
- .1 Automatic starting on abnormal or loss of normal voltage: voltage sensing relays shall sense all three phases of the hydro supply. If the voltage on any one phase should drop below preset limits (adjustable) for an adjustable period of time, the engine start contact shall close and cause the engine to start.
- .2 When the emergency supply has reached settled voltage and frequency preset limits (adjustable) the transfer switch will transfer the load to the emergency supply.
- .3 The set will continue to supply the load until hydro supply returns or the set is shut down manually or under failure conditions.
- .4 On hydro restoration, confirmed by three phase sensing of voltage above an adjustable preset, for a time period in excess of three minutes (adjustable), the transfer switch

will transfer the load to the hydro supply. Provide a dead bus timer to allow motor starters to drop out and motors to stop prior to connecting to hydro.

.5 An adjustable time delay relay shall allow the engine to run unloaded to cool down and subsequently to shut down, ready for the next cycle.

.6 The engine shall be equipped with a key switch with the following positions: Auto-off-crank-start, key removable in auto position only.

.7 Automatic shut down on

- .1 Overcranking
- .2 Overspeed
- .3 High Engine Temperature
- .4 Low lubricating oil pressure
- .5 Over and under frequency
- .6 Emergency breaker failure
- .7 Electrical fault lock-out on short circuit and generator over and under voltage.

1.3 Quality Assurance

.1 All work shall meet requirements of Quality Standard CSA Z299.3.

1.4 Shop Drawings

.1 To section 01340

.2 Shop drawings and specifications shall include, but not be limited to, the following:

- .1 Engine: make, model, rating and performance curves.
- .2 Starter motor, make, model.
- .3 Generator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.
- .4 Voltage Regulator: make, model, type.
- .5 Governor: type, model.
- .6 Battery: make, type, voltage, capacity.
- .7 Charger: make, model, input and output rating.
- .8 Submit a general outline drawing of the complete assembly showing engine and generator mounting, exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings horizontal and vertical dimensions, minimum door opening required for moving the unit, head room required for removal of piston and connecting rod, and weight of engine, generator, baseplate and exhaust silencer.
- .9 Identify exact locations and details where necessary of interconnecting services to permit final engineering.
- .10 Baseplate construction details and materials.
- .11 Transfer and bypass system: make, model, type.
- .12 Type and layout of all panels.
- .13 Schematic and wiring diagrams of engine, generator, control panel, automatic transfer and bypass panels complete with interconnecting wiring diagrams.
- .14 Single line diagram showing all breakers, switches, metering and protective relays.

.15 Field wiring diagrams.
.16 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

.3 Express all dimensions and data in metric units and symbols followed by in bracket imperial units and symbols wherever applicable, CSA Z234.1-1973, Metric Practice Guide.

.4 Device Numbering System shall be in accordance with IEEE 200-1975 Reference Designations for Electrical and Electronics Parts and Equipment.

1.5 Maintenance Data and Instruction Manuals

.1 Provide, but not be limited to, the following in English for incorporation into instruction manuals:
- .1 Complete set of reviewed shop drawings.
- .2 Factory test data of engine, generator, exciter, control logic, metering and all other pertinent test data.
- .3 Maintenance and operation bulletins for:
  - .1 Engine and Accessories
  - .2 Generator
  - .3 Voltage Regulator and Accessories
  - .4 Exciter
  - .5 Permanent magnet generator if installed
  - .6 Battery charger
  - .7 Speed Governor
  - .8 Starting Motor
  - .9 Batteries
  - .10 Ventilating Equipment
  - .11 Timers, Relays, Meters
  - .12 Power Circuit Breakers
  - .13 Controller, Contactors
  - .14 Other Accessories

.4 If brochures are submitted, these shall be originals; photocopies are not acceptable. Brochures shall contain all technically relevant data.

.5 Complete sequence of system operation.

.6 Complete bill of materials including nameplate data of equipment and accessories.

1.6 Delivery and Storage

.1 Prepare and crate all equipment to be supplied for protection against shipping and storage damage.

.2 Provide a minimum 12.5 mm plywood outer covering single vapour barrier inside.

.3 Each package to have shipping weight, address, dimensions and Department D number and brief description of contents clearly stencilled on at least two sides. Staple on the outside a packing list contained in a waterproof envelope. Place a copy of packing list inside.

1.7 Guarantee

.1 Provide a written guarantee signed and issued in the name of the Owner stating that the complete assembly consisting of the diesel generator unit and all equipment and accessories is guaranteed against defects and malfunction for a period of one year from the date of installation or two years from the date of factory delivery whichever is the lesser.

1.8 Spares

.1 For panels provide the following:
- .1 One spare control circuit breaker per rating.
- .2 Twenty four spare indicating light bulbs per rating.
- .3 One spare control relay and socket per rating and contact arrangement.
- .4 One spare contactor operating coil.
- .5 One set of contacts (3) for the transfer contactor.

.2 Provide for the generator unit, a standard set of engine manufacturer's spare parts for one year normal operation 1,000 operating hours. Spares to include as a minimum.
- .1 Six fuel filter elements for each type of fuel filter/water separator.
- .2 Six lubricating oil filter elements.
- .3 Three air cleaner elements.
- .4 Two V-belts for each type

.3 Where metric size nuts and bolts are used; provide one set of sockets complete with ratchet handle and set of combination wrenches, to fit all sizes used.

.4 Provide conclusive evidence that a Canadian distributor has been established and will stock in Canada spare parts likely to be required during the normal life of the engine.

1.9 Acceptance Tests

.1 General: before acceptance, assemble and setup the unit, complete with specified equipment, for tests at the supplier's plant. Tests shall be witnessed by a representative of the Owner on a date mutually agreed on. Provide suitable test area with adjustable loading facilities. Supplier shall ensure that the engine has run in sufficiently prior to load test, all test forms filled in, system debugged and recorders connected.

.2 Examination of product: A complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.

.3 Non-operational tests and checks: perform following test and checks before starting the unit:
- .1 Shaft alignment, end float, angular and parallel.
- .2 Cold resistance of generator windings.
- .3 Belt tensioning.
- .4 Equipment grounds.
- .5 Electrical wiring.

.6 All grease lubricating points.
.7 Personnel safety guards.
.8 Air cleaner.
.9 Lubricating oil type and level.
.10 Type of fuel.
.11 Vibration isolator adjustment.
.12 Temperature and pressure sensors.
.13 Engine exhaust system.
.14 Tools.
.15 Spares.

.4 Operation test and check: on completion of non-operational tests and checks, start the unit cold. Provide multi-channel recorder and record the following:
.1 Time for unit to start and reach settled voltage and frequency.
.2 Time from initiation of start to full load application, with voltage and frequency settled.
.3 Voltage and frequency transient and steady state limits for full load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions.
.4 Record battery voltage drop during cranking.

.5 Protection and control demonstration: on completion of operation test and check, demonstrate the following:
.1 Overheat protection.
.2 Low oil pressure protection.
.3 Cranking cut out.
.4 Overcrank protection (3 tries).
.5 Overspeed protection.
.6 Under and over frequency.
.7 Under and over voltage.
.8 Electrical fault protection:
.1 Failure to close breaker.
.2 Failure to build up voltage.
.3 Generator short circuit and overcurrent.
.9 All control functions.

.6 Load tests: load test the unit minimum one hour each on 25%, 50%, 75% and for 24 h at full rated 100% rated load in ambient room temperature of 40 degree C. Take following data at the start of load test and every one hour interval thereafter:
.1 Frequency.
.2 Voltage.
.3 Current.
.4 Kilowatts.
.5 Generator winding temperature.
.6 Generator frame temperature.
.7 Engine temperature.
.8 Oil temperature and pressure.
.9 Manifold pressure.
.10 Ambient room temperature.
.11 Generator cooling air outlet temperature.
.12 Exciter field current and voltage.

.13 Vibration displacement.
.14 Ambient air temperature inside panel with all doors closed.

.7 Miscellaneous: provide an accurate means for determining fuel and lubricating oil consumption. Provide strip chart recorders for monitoring frequency, voltage and load. Recorder shall have a selection of speeds to allow accurate measurement of voltage, frequency and time during the tests. The recorder shall have been calibrated by the recorder manufacturer (or designated representative) within three months of the factory testing. The Owner retains the option of using its own instruments to verify the accuracy of the recorder.

.8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is the lowest temperature registered out of a group of three thermometers when placed in engine room as follows:

.1 One thermometer located on each side of the engine block, approximately two-thirds of the length of the block back from front end of block, 900 mm out from block and at a height equal to height of block. A third thermometer located over end of exciter on the unit centreline, approximately 150 mm above top of exciter.

.2 Take the thermometer showing the lowest temperature to give true ambient air temperature. Adjust temperature to maintain this thermometer at 40 degree C during heat test.

.9 Voltage and frequency regulation tests: on completion of load tests take the hot resistance reading of generator windings. Subject the unit to hot voltage and frequency regulation tests for full load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa.

.10 Panel performance and functions: check sequence of operation under service conditions. Make provision for supplying and connecting required levels of voltage for primary circuits. Test overcurrent relays by impressing current in secondary circuits.

.11 Hi-pot tests: perform over potential tests on primary and secondary wiring in accordance with appropriate EEMAC Standard.

.12 Additional tests: perform any tests, consistent with the contract, that Owner may require to satisfy himself of the adequacy and satisfactory operation of the unit.

.13 Supplier shall complete the forms with the requisite information pertaining to make, model and serial numbers prior to the test.

.14 Supplier shall record all test data on the forms, recording charts and manufacturers' test forms and be complete with diagrams and description of test results, deficiencies and corrective action. Test data sheets shall be signed by the supplier.

1.10 References

.1 Canadian Standards Association (CSA).

.2 Electrical and Electronic Association Manufacturers of Canada (EEMAC).

.3 National Electrical Manufacturers Association (NEMA).

.4 American National Standards Institute (ANSI).

.5 Institute of Electrical and Electronic Engineers (IEEE).

.6 American Society of Mechanical Engineers (ASME).

.7 American Society for Testing and Materials (ASTM).

.8 Society of Automotive Engineers (SAE).

.9 Canadian Government Specifications Board (CGSB).

.10 International Standards Organization (ISO).

PART 2 - PRODUCTS

2.1 Assembly

.1 Provide the following items plus such other items as necessary to make the unit complete as implied or intended:
- .1 Diesel Engine.
- .2 Diesel Engine Accessories.
- .3 Baseplate and Drip Pan.
- .4 Vibration isolators.
- .5 Governor.
- .6 Engine Exhaust System.
- .7 Engine Cooling System.
- .8 Engine Ventilating System.
- .9 Starting Motor(s).
- .10 Batteries and Rack.
- .11 Battery Charger.
- .12 Generator and Exciter.
- .13 Voltage Regulator and Accessories.
- .14 Spares and Accessories.
- .15 Fuel Tank.

2.2 Mounting

.1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter. Mount unit on a common, heavy duty, fabricated steel baseplate. Design and materials of baseplate must be approved by engine manufacturer and Owner.

.2 Baseplate of sufficient rigidity to maintain alignment of engine-generator shafts and frames under all conditions incident to shipping, installation and service.

.3 Machine engine-generator feet and baseplate sole plates parallel and true. Shimming to be steel type and only permitted underneath the generator feet.

.4 Support baseplate on spring type isolating fixtures from welded side brackets located in such a manner that bottom of baseplate will be approximately 25 mm above supporting floor. Isolators shall have cast iron housings and be complete with levelling bolts, adjustable oil proof snubbers and minimum 6 mm sound pads. Isolation efficiency to be not less than 95%.

.5 Determine quantity and location of isolators in such a manner that each isolator will carry equal proportion of weight and that the pressure exerted on the floor by each isolator does not exceed 345 kPa.

.6 Isolators shall be shipped loose for installation at project site.

2.3 Diesel Engine

.1 Full diesel, heavy duty, cold start, liquid cooled, vertical in-line or vee, and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years. Turbo supercharged engine acceptable providing brake mean effective pressure (BMEP) at rated output does not exceed 1800 kPa. Mechanically driven superchargers not acceptable.

.2 Engine shall have a minimum of four (4) cylinders.

.3 Engine with auxiliary starting aids (e.g., glow plug assist start) not acceptable.

.4 Equip engine air intakes with dry type heavy duty air cleaners located close to the inlet manifold. Cleaner element to be directly replaceable with elements of Canadian manufacture.

.5 Provide engine wiring of auto-marine type with plastic shield in liquid-tight conduit and fittings with insulated bushings. Use stranded, minimum No. 14 AWG, TEW 105 degree C and coloured coded wires. Terminate wiring with coded, insulated terminals flanged fork type. Terminal blocks heavy duty, screw type. Wire markers of slip on oil proof type. Junction boxes on unit of liquid-tight type. Maximum of two wires per terminal block.

.6 Provide high quality lubricating oil pressure gauge, lubricating oil temperature gauge, tachometer, cooling air temperature gauge (exit air) thermocouple, exhaust pyrometer and other standard gauges and instruments. Calibrate and scale gauges and instrument in both metric and imperial units and symbols. Oil temperature sensors to be mounted on engine full flow pressure line. Hoses or tubing for gauges shall be high pressure reinforced type.

.7 Mount unit accessories, including gauges, instruments, and protective sensors, in such a manner that machine vibrations are isolated or dampened.

.8 Dynamically balance complete engine-flywheel generator arrangement after assembly. Guarantee no torsional or other harmful vibrations within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating. Cyclic irregularity to be no greater than 1/250.

.9 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.

.10 Provide removable wet type cylinder liners. Furnish cylinder head with removable valve seat insert and guides.

.11 Provide personnel safety guards for exposed moving parts and exhaust manifolds. Provide platform for servicing upper part of engine where applicable.

.12 Engine control panel shall be complete with:
.1 Lubricating oil pressure gauge.
.2 Lubricating oil temperature gauge.
.3 Cooling air temperature gauge.
.4 Low coolant level gauge.
.5 Engine switch auto-off-crank-start selector switch and crank pushbutton.
.6 D.C. main power supply circuit breaker.
.7 Terminal blocks for connection to D.C. power supply, engine monitoring and shutdown device.
.8 Provide low pressure, high coolant temperature, and overspeed protection to shut down engine on manual operation.

2.4 Cooling and Ventilating System

.1 Coordinate with mechanical trade for a complete cooling and ventilating system for the unit in the accordance with Manufacturer's recommendations.

.2 Cooling medium to be air and to be affected by radial fans fitted to flywheel or axial flow fans driven by minimum two belts from engine crank shaft. Cooling system to have sufficient cooling effect to keep exhaust air temperature within manufacturer's tolerances with unit operating at rated load under specified conditions. Ventilating system to be in accordance with Mechanical Drawings. Exhaust air duct and louvres to be provided by mechanical trade.

.3 Ventilation system shall be complete with canvas connections, mounting hardware, modulating damper motors, dampers, inlet and outlet hoods, bird/insect/screen, air filters, manual potentiometer, damper linkages, low voltage transformer, thermostat, fan motor. Provide positive seal, zero heat loss louvers Air filter shall be 25 mm deep

disposable type with fiberglass filter media and an initial static pressure drop not to exceed 25 Pa based on face velocity of 2.54 m/s. American Air Filter # M57 Heavy Duty Industrial.

.4 Ventilating system shall operate as follows:
.1 Air inlet and outlet damper closed when engine not running.
.2 On engine start, air inlet damper to open. Inlet damper minimum opening to be set by manual potentiometer. Thermostat shall modulate inlet and outlet dampers to maintain set room temperature. Fan to start when inlet louvres 90% open (adjustable).

2.5 Lubrication System

.1 Provide a full pressure lubricating system complete with duplex filters and oil cooler.

.2 Oil pump shall be engine driven gear type complete with strainer.

.3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable with elements of Canadian manufacture. Cooler to have sufficient capacity to maintain oil temperature within engine manufacturer's tolerances with unit operating at rated load under conditions specified.

.4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap. Permit complete drainage in a convenient manner.

.5 Operational requirements are such that unit may lay idle for periods up to one month and then be required to start and assume full rated load within the specified (15 seconds) time period. To protect service life of engine components, provide an electrical motor driven, integrally mounted, gear type oil priming pump with interval timer and breaker type combination starter. Starter mounted in control panel. Lubrication oil pressure switch to stop priming pump when engine is running. Where pump is not being provided, submit a letter with Tender certifying that oil pump is not required for these conditions and will not direct from the service life of engine components.

.6 All metallic oil hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

2.6 Fuel System

.1 A fuel system including a day tank is provided by mechanical trade.

.2 Bring fuel supply and return lines to extreme forward part of baseplate with drop ear elbows to be affixed thereto. Connect the other end of each elbow with 1 m of flexible neoprene hose.

.3 Provide, loose, approximately 9 m of copper tubing and necessary fittings including two SAE flare union nuts (long) with half unions for connecting 12 mm gate valves to be supplied by others.

.4 All non-metallic fuel hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

2.7 Exhaust System

.1 Provide a complete exhaust system including heavy duty industrial grade silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, of suitable length, to absorb both vertical and horizontal expansion; all flanges, bolts, gaskets, adjustable hangers and pipe and pipe-thimble to permit projection of pipe 1.0 m beyond wall. Exhaust tail pipe end to be cut at 45 degree angle and terminate in bird screen. All interior exhaust piping and silencer shall be insulated.

.2 Arrange exhaust system to suit openings as shown on drawings. Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to the engine.

.3 Provide exhaust pyrometers located on common exhaust manifold or two pyrometers on separate manifolds. Pyrometer range to include temperature at 110% load.

2.8 Speed Governor

.1 Provide full electronic governor with speed changer and dry type actuator. Governing system shall be in accordance with ISO 3046/4-1978(E).

.2 Governor shall provide the following features:

.1 Ten turn locking type manual speed adjustment.
.2 Speed regulation, steady state, no-load to full load and vice versa: +/-0.25%.
.3 Transient peak, no-load to full-load and vice versa: +/-10%.
.4 Recovery time to steady state condition on application of 80% full load from no load not to exceed 3 seconds.
.5 Frequency shall be externally adjustable from zero to 5% while engine is running.
.6 Class A accuracy.

2.9 Starting System

.1 Provide a complete starting system including cranking starting motor(s), batteries, battery stand, heavy-duty battery cables and battery charger.

.2 Provide positive engaging type cranking motor(s). Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment not acceptable.

.3 Provide lead acid battery with sufficient capacity in an ambient room temperature of 0 degree C to crank the unit at engine manufacturer's recommended cranking starting speed for a period of 3 minutes. Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, to be not less than 1.75 V per cell. Size battery on the basis of engine and battery manufacturer's published data. Batteries to be dry charged, specific gravity of electrolyte 1.220 when fully charged at 27 degree C. Battery termination shall be bolt-on or study type. Terminals and all exposed electrical connections shall be protected from accidental short circuit by falling conductive objects on the battery. Such protection shall be transparent.

.4 Provide battery stand coated with acid resistant paint and fabricated from angle irons with 20 mm plywood bottom and heavy duty casters for ease of movement.

.5 Provide battery charger with 120 volt AC input and output equal to 1.20 of the ampere-hour capacity of the battery based on a 8 h rate. Output voltage ripple shall be 3% or less. Provide an AC input circuit breaker and a 24 h terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals. Provide 5 spare fuses inside charger panel. Charger to be CSA approved.

.6 Provide necessary heavy duty, maintenance-free battery cables and connectors. Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load. Cable length to be sufficient to allow battery to be located on either side of the engine.

2.10 Generator

.1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing. Generator to have a full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection, and meet or exceed EEMAC MG1-22 and current IEEE Standards.

.2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.

.3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 2.4 times rated current.

.4 Generator winding insulation shall be Class F; winding temperature rise not to exceed 80 degree C as measured by resistance in an ambient temperature of 40 degree C.

.5 Identify generator windings with metal tags. Bring widnings to insulated terminals in a metal junction box mounted on the side or top of generator. Size junction box to permit

mounting of engine and generator low voltage controls and wiring terminals blocks. Provide barrier in junction box to separate low and high voltage wiring.

.6 Provide a voltage regulation system complete with auto/manual control module. Voltage regulator shall be capable of withstanding continuous vibration, 15G shock and temperature up to 50 degrees C while maintaining accuracy to plus/minus 1%.

.7 Steady-state voltage regulation not to exceed 1%. Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.

.8 Design equipment to minimize radio frequency interference (RFI) under all operating conditions. Balanced telephone influence factor (TIF) to meet or better requirements of EEMAC Standard MG1-22.43.

2.11 Panel-General

.1 Panel shall be of indoor, free-standing, dead front, metal-enclosed steel construction complete with lifting eye bolts. Doors shall have formed edges, be reinforced by stiffeners and complete with lockable handles.

.2 Design and construct panel to withstand strains, jars, fibrations and other conditions incident to shipping, storage, installation and service.

.3 Panel to be CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.

.4 Identify all instruments and controls with lamicoid or metal engraved nameplates fastened by rivets or screws for permanent identification. All items mounted on door shall also be identified with nameplates. Nameplates shall not be attached to removable items such as relays and wireway covers.

.5 Provide panel with bolted rear covers.

.6 Factory wire panel completely. Use stranded, minimum No. 14 AWG, TEW 105 degree C and coloured for control wiring. Use No. 10 AWG for CT secondary connections:

.1 Blue - DC control
.2 Red - AC control
.3 Black - PT secondary connections
.4 Orange - CT secondary connections
.5 Green - non-current carrying ground
.6 White - current carrying ground
.7 Yellow - interlocks
.8 Brown - generator excitation system.

.7 Code wiring at each wire end with permanent, non-aging slip on markers. Support and run wiring neatly. Protect wiring from mechanical damage by grommets and shields.

.8 Terminal blocks to be coded, clamp type, serrated for positive and of tough, non-brittle, unbreakable nylon, MTE size 3,453/0 or equivalent. For current transformer secondary circuits, provide terminals blocks of dual connector type, Electrovert 9060 or equal. Provide test block for current transformer secondary connections.

.9 Provide door detect mechanism to maintain hinged door at the open position.

.10 Supply loose 2 sets of wiring markers for each external wiring connection. Markers shall be contained in a plastic bag and secured inside the panel.

.11 Use wiring duct for interconnection within panel.

.12 Direct inter-panel connection not permitted, use terminal blocks.

2.12 Control Panel

.1 Provide a solid state control panel complete with all control and power modules for sensing, timing, logic and instrumentation to control the diesel generator set.

.2 The control panel shall include, but not be limited to, the following features:

- .1 Three position function selection switch - Off, Auto, Run.
- .2 Emergency stop control switch.
- .3 Self test switch to perform a self-test of the system and display all fault messages.
- .4 Automatic programmable (365 days) and exerciser.
- .5 Inverse time-voltage sensors for monitoring normal and emergency voltage and frequency.
- .6 All controls necessary to provide system operation as described in 1.2.
- .7 Annunciator lights for the following as a minimum:
  - .1 Overcrank
  - .2 Low Oil Pressure
  - .3 High Coolant Temperature
  - .4 Low Coolant Level
  - .5 Overspeed
  - .6 Frequency Limit
  - .7 Voltage Limit
  - .8 Contactor Failure.
- .8 Analog AC metering panel that displays 3-phase output power conditions:
  - .1 Amps per phase.

.2 Voltage per phase and line to line.
.3 Frequency.
.4 Kilowatt.
.5 Power factor.

.3 The function selection shall operate as follows:
.1 Reset: to reset the engine-generator set after it has been shut down on a protective device.
.2 Off: the engine-generator set is shut off.
.3 Auto: provides automatic operation of the engine generator set and transfer system.
.4 Run: exercises the engine generator set without load. In the event normal power fails during this mode, the transfer system will operate to connect load to the set.

.4 The control panel shall include the following time delays and adjustments.
.1 Crank delay: Preset at 3-20 sec.
.2 Restart: Preset at 15 sec.
.3 Anticipated fail: Preset at minimum time setting.
.4 Engine start: Preset at 5 sec.
.5 Normal: Preset at 15 min.
.6 Dead Bus: Preset at 5 sec.
.7 Cool Down: Preset at 15 min.

.5 The control panel shall be equipped with a cycle crank provision which shall crank the engine three times with an adjustable rest delay of 3-20 seconds preset at 5 seconds.

.6 The control panel shall provide the following features:
.1 Front panel programming and display using keypad and to allow changing of parameters, operating configuration, status, values, etc.
.2 Security access code to prevent unauthorized changes.
.3 Self diagnostics, continually operating in the background, to ensure proper operation of the microprocessor.
.4 Non-volatile memory to store all operating logic, configuration and set points upon total loss of power.
.5 Sufficient internal power to maintain control outputs and operating sequence upon loss of DC supply from working battery.
.6 Isolation of inputs and outputs to ensure correct operation and no damage in the event of transient voltages.
.7 Operation counter for number of diesel starts (non-resetable).
.8 Operating temperature 0-50 deg. C.
.9 The control panel shall be equipped with output relays with Form C dry contacts for remote monitoring at PLC:
.1 Three auxiliary "Run" relays.
.2 Generator "Auto" status.

.3 Generator common shutdown "Fault" alarm.
.4 Low fuel level alarm.
.5 NFPA 110 alarm relays.

.7 Main Breaker

.1 A three pole, solid state, CSA and ULC listed molded case type with adjustable long time, short time and instantaneous trips shall be supplied and fixed mounted on the generator, the breaker shall be supplied shall be rated 208 V, frame size of 208 A and trip sensor of 500 A.

2.13 Finishing and Painting

.1 Properly clean, finish and paint equipment with a smooth and durable finish. Colour to be orange - submit colour chart for approval.

.2 The exterior of the acoustic enclosure to be painted green in colour. Submit colour chart for approval.

.3 Provide one half pint can of each paint used for touch up.

2.14 Standard of Acceptance

.1 Diesel Generator: Onan Model EHC CIC, Cummins Ontario Inc. Contact: Mr. Rick McWatt Phone (519) 473-6668, Fax (519) 473-6696.

.2 Should the Contractor wish to substitute the specified unit with another, the Contractor shall be responsible for undertaking all sound studies, ventilation studies, emission studies, and submissions to the Engineer. The Contractor shall also prove to the Owner that the substitution will be an economic benefit to the Owner. Refer to General Conditions for details on substitutions.

PART 3 - EXECUTION

Not used

END OF SECTION

PART 1 - GENERAL

1.1 Description

.1 CSA Approved automatic transfer switch.

.2 Transfer load from normal supply to standby generator unit when generator unit reaches rated frequency and voltage.

.3 Transfer load back to normal power on restoration of utility power.

.4 Load break design.

1.2 Description of System Operation

.1 Normal sequence of operation:

- .1 Automatic starting on abnormal or loss of normal voltage: voltage sensor shall sense all three phases of the hydro supply. If the voltage on any one phase should drop below preset limits for an adjustable period of time, (adjustable set at 3 seconds) the generator start contact shall close and cause the generator to start. Also, a hydro power failure signal will be sent to the PLC.
- .2 When the emergency supply has reached settled voltage and frequency preset limits (adjustable) the automatic transfer switch will transfer the load to the emergency supply.
- .3 The generator will continue to supply the building load until hydro supply returns or the set is shut down manually or under failure conditions.
- .4 On hydro restoration, confirmed by three phase sensing of voltage above an adjustable preset, for a time period in excess of three minutes (adjustable), the transfer switch will transfer the load to the hydro supply. Provide a dead bus timer to allow motor starters to drop out and motors to stop prior to connecting to hydro.
- .5 An adjustable time delay relay shall allow the engine to run unloaded to cool down and subsequently to shut down, ready for the next cycle.

1.3 Quality Assurance

.1 All work shall meet requirements of Quality Standard CSA Z299.3.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01340.

.2 Shop drawings shall include, but not be limited to, the following:

- .1 General outline drawings of the complete assembly
- .2 Schematic and wiring diagrams of automatic transfer switch complete with interconnecting wiring diagrams.

.3 Field wiring diagrams and interconnecting wiring diagram with the generator control panel, and PLC's RPU.

1.5 Maintenance Data and Instruction Manuals

.1 Submit all O & M Manual material in accordance with section 01740

.2 PRovide, but not be limited to, the following in English for incorporation into instruction manuals:

- .1 Complete set of reviewed shop drawings.
- .2 Factory test data.
- .3 Maintenance and operation bulletins for:
  - .1 ATS
  - .2 Other Accessories
- .4 Complete sequence of system operation.

1.6 Acceptance Tests

.1 General:

- .1 Submit test procedures for Engineer for review. Notify Engineer at least 14 days in advance of tests.

.2 ATS operation tests:

- .1 Demonstrate manual transfer of the ATS
- .2 Demonstrate automatic transfer simulating hydro power failure and retransfer upon Hydro power is restored.

1.7 References

.1 Canadian Standards Association (CSA).

.2 Electrical and Electronic Association Manufacturers of Canada (EEMAC).

.3 National Electrical Manufacturers Association (NEMA).

.4 American National Standards Institute (ANSI).

.5 Institute of Electrical and Electronic Engineers (IEEE).

.6 American Society for Testing and Materials (ASTM).

.7 Canadian Government Specifications Board (CGSB).

.8 International Standards Organization (ISO).

PART 2 - PRODUCTS

2.1 Automatic Transfer Switch

.1 Automatic Transfer Switches:
- .1 Open transition transfer switch, solenoid operated electro-mechanical transfer switch (ATS).
- .2 100 A, 208 V.
- .3 EEMAC 1 enclosure.
- .4 Transfer switch shall be complete with utility side, manually operated, lockable feature.
- .5 Fault withstanding rating: 22 kA min. symmetrical for three cycles.
- .6 Standard of Acceptance: ASCO Electric 7000 series.

.2 Provide termination points for bus connection on side and bottom of external power cables.

.3 Provide two ground lugs; one at each end. The lug shall be capable of accepting ground conductor of range from No. 8 to No. 2/0 AWG.

.4 Provide instrumentation, switching and control as indicated.

.5 Provide volt free form C dry contacts to indicate:

- .1 Normal power "On".
- .2 ATS at normal position.
- .3 ATS at Emergency position.

.6 Provide a calendar-based exerciser for programming generator tests.

.7 Provide the following time delays and adjustments:
- .1 Engine start: Preset at 5 sec.
- .2 Normal: Preset at 15 min.
- .3 Deadbus: Preset at 5 sec.
- .4 Cooldown: Preset at 15 min.

2.2 Finishing and Painting

.1 Properly clean, finish and paint equipment with a smooth and durable finish. Use grey gloss 501.108 except inside of panel to be painted with white gloss 513-101 in accordance with CGSB 1GP-12c schedule of paint colours.

.2 Provide one half pint can of grey gloss paint for touch up, colour as per 2.19.1.

PART 3 - EXECUTION

3.1 Installation

.1 Locate, install and connect auto-transfer equipment.

.2 Make power and control connection as indicated.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 16010.

.2 Energize transfer equipment from normal power supply and simulate transfer and retransfer.

END OF SECTION