SBC LOCAL EXCHANGE CARRIER

STANDARD SPECIFICATION

FOR

ENGINE ALTERNATOR SETS

SUMMARY OF KEY INFORMATION

SITE: _____

SITE INSPECTION DATE: _____

PROPOSAL DUE DATE: _____

INSTALLATION COMPLETE DATE: _____

ENGINEER'S NAME: _____

ENGINEER'S ADDRESS: _____

TELEPHONE NUMBER: _____

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1. INTRODUCTION

1.1 INTENT

The intent of this specification is to cover requirements for the provision of a completely assembled, reliable automatic start engine alternator set, and the delivery and installation of the described unit at the _____ Central Office, located at _____

1.1.1 TEST DATA

Factory certified test data will be submitted with the bid package on horsepower curves, alternator ratings, voltage dip and recovery, motor starting curves and engine injector pump manufacture. The engine alternator set shall be rated at _____kW, 0.8 lagging to unity power factor, _____ volt, ___ phase, ____ wire, 60 Hz.

1.2 INCLUDED EQUIPMENT AND SERVICES

- Engine alternator set per the main body of this specification.
- Installation and grounding details per appendix: ____
- Power sensing and transfer scheme per appendix: ____
- Time delay relay scheme per appendix: ____
- Parallel operation per appendix ____
- Day tank and catch basin per appendix: ____
- Base tank per appendix:
- Acoustically attenuated enclosure for outdoor installations per appendix: ____
- On set transfer switch per appendix: ____
- Remote radiator per appendix: ____
- Remote control panel per appendix: ____
- Auxiliary load bank per appendix: ____
- Battery heater per appendix: ____
- Special acoustical limits per appendix: ____
- Trailer for portable application per appendix: ____
- Power factor meter per appendix: ____
- Intelligent Power system (IPS) interface per ATTACHMENT 1: ____
- Handling of Asbestos Gaskets per appendix: ____

1.3 INTRODUCTORY NOTES

1.3.1 QUALITY STANDARDS

All materials and parts comprising the units herein specified shall be new and unused, of current manufacture, and of the highest grade, free from defects and imperfections. The prime mover shall be of substantially domestic manufacture and shall comply with all applicable SAE standards. The finished unit shall comply in all respects with all applicable trade standards and all federal, state, county and municipal ordinances, rules and regulations. This may require UL Listing or other approved third party certification at some sites.

The engine alternator set shall not require any additional alignment or adjustment between the crankshaft and the alternator shaft at the job site. The sub-base shall be equipped with lift lugs for lifting and leveling devises for field leveling the floor. Alternator shaft shall be designed for site disassembly at the engine crankshaft joint by flanged connection.

1.3.2 EXHAUST EMISSION REQUIREMENTS

The completed and installed engine generator set shall be in compliance with all applicable Air Pollution Control Laws (including, for California locations, Chapter 3, Article 1 of the California State Health and Safety Code). Where subject to more than one emission law or standard, the more stringent law or standard shall apply. The contractor is responsible for obtaining and paying for all permits and licenses for construction, installation and operation including those required by any local Air Quality Management District or commission. The permits and licenses shall cover at least the entire period of construction until issuance of completion notice by the Power Equipment Engineer and shall include the first year of operation (after acceptance).

The contractor is responsible for all costs associated with bringing the completed and installed engine alternator set into compliance with all state and local air pollution or air quality laws, regulations, standards or ordinances.

1.3.3 EARTHQUAKE STANDARDS

The engine alternator set shall be completely mounted on a sub-base for installation on a concrete pad or floor by means of appropriately sized _anchors. __ The securing system shall be designed for seismic loads describe in Bellcore Technical Reference TR-EOP-000063 (latest issue). This specification is for a alternator set that shall be placed in seismic Zone ____ as outlined in the above mentioned TR.

1.3.4 VIBRATION

Engine alternator set vibration transmitted to the floor shall be limited to 3 mils at 10 feet from the set, running at 100% load. Vibration isolators(spring type e.g. Caldyne or =) shall not permit any additional lateral motion, lifting, sliding or tipping, during a seismic event. The vendor shall supply any hardware required for compliance, i.e., angle brackets every 3 feet. Natural rubber or other materials susceptible to diesel fuel or oil deterioration shall not be used as isolation material.

It is mandatory that all parts for the completed unit be available within 48 hours and that service be available 24 hours a day, 7 days a week.

NO DEVIATIONS WILL BE MADE FROM THESE SPECIFICATIONS WITHOUT THE WRITTEN APPROVAL OF THE TELCO POWER EQUIPMENT ENGINEER,

2. GENERAL REQUIREMENTS

2.1 ENGINEERING AND INSTALLATION REQUIREMENTS

The design, construction and installation of this engine alternator system shall conform to the requirements of all applicable safety codes - national, state and local codes and ordinances; including but not limited to, the National Electric Code (NEC), Underwriters Laboratory (UL) or equivalent third party certification agency, Occupational Safety and Health Act (OSHA). The engine alternator set, as installed, shall conform to the requirements of NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines. Provisions of Technical Publication TP76300

Installation Guide shall be strictly followed. (NOTE: Installations in California will strictly follow The Pacific Bell Central Office Equipment Installation and Job Acceptance Handbook (IJAH) until notified it has been cancelled and replaced).

2.1.1 KILOWATT OUTPUT

The engine alternator set shall be designed and configured for reliable starting and operation at:_____ kilowatts at 0.8 power factor over the entire range of operating conditions for the site.
Site altitude: _____ feet above mean sea level.
Site engine room maximum ambient temperature:_____.
Site engine room minimum ambient temperature:_____.

2.1.2 OUTPUT VOLTAGE

The engine alternator system shall provide outputs within the range A limits specified by ANSI C84. 1-1982, "Voltage Ratings (60 HZ) for Electrical Power Systems and Equipment" and provide one of the preferred systems voltages per Table 1 of this ANSI document.
Output voltage: _____VOLTS AC, _____PHASE, _____ WIRE, 60 HZ.

2.1.3 FIRE RESISTANCE OF WIRING

Wiring used in the engine alternator system shall be certified by its manufacturer to meet either of the following standards:

- IEEE Standard 383
- Underwriters Laboratories Standard 1581, or
- *UL 94V0*

Note 1: *Cables meeting the flammability requirements of UL Standard 910 and UL Standard 1666 also meet the flammability requirements of IEEE 383 standard test.*

Note 2: *Wiring shall not be painted.*

2.1.4 BUILDING INTERFACES

This engine alternator set installation shall comply with all relevant spatial and environmental requirements of the Uniform Building Code (*UBC*) including but not limited to those for critical facilities located in seismic zone 4. Provisions of the Bell Communications Research (*Bellcore*) Technical Reference TR-EOP-000063, (latest issue), Network Equipment Building System (*NEBS*), shall be adhered to. The NEBS document is available directly from Bellcore at the following address:

Bellcore Documentation Coordinator
8 Corporate Place Room 3A184
Piscataway, New Jersey 08854 - 4196
800-521-2673

The determination of relevance of any area subject to dispute in the above requirements shall be made by the SBC Local Exchange Carrier (LEC) Power Engineer.

2.1.5 TORSIONAL VIBRATION ANALYSIS

The complete engine alternator shaft system shall be designed for torsional loads the unit may experience during normal continuous operation, as well as transient load conditions and short circuit conditions. The torsional vibration analysis shall include reactions from 1st to 4th order. The engine alternator shaft system shall not normally operate at speeds near any critical resonance of any order. Written results of the Torsional Vibration Analysis shall be made available to the SBC LEC Power Engineer, upon demand.

2.1.6 ENGINE VIBRATION

All engine alternator set mounted accessories shall be supported as to prevent degradation or failure due to the effects of engine vibration. Components such as electrical devices shall be isolated from these vibrations. Mechanical components shall be supported with brackets designed to withstand any residual vibration of the engine alternator set.

2.1.7 WIRE AND CABLE CONNECTIONS

All wire and cable connections #10 AWG and larger shall be made using UL listed, or other approved third party certified agency, "circumferential" crimp (compression) type copper connectors manufactured by T&B or Burndy. Tooling and dies used shall be UL or approved third party certified. The crimping tool or dies shall emboss the crimped connection in such a way that it may be easily identified that the correct tool or die for the connector was used**. The exception to this requirement would be if the modification of any UL or approved third party certified device would violate the certification or void the warranty.**

2.1.8 ACOUSTIC LIMITS

The complete engine alternator set installation shall meet all applicable local, county, and state) sound level requirements, or those of the special acoustical appendix (if provided), whichever is lower.

2.1.9 CONFORMANCE VERIFICATION

In addition to the performance testing covered in section 4, the TELCO power engineer may require physical tests, manufacturers' documentation or documentation of engineering analysis in substantiation of any or all of the technical requirements contained in this specification.

3. SPECIFIC REQUIREMENTS

3.1 ALTERNATORS

3.1.1 ALTERNATOR DESIGN

The alternator shall be of a brushless design utilizing silicon rectifiers. These rectifiers shall be located for easy access and replacement, and shall not be obstructed. The Alternator shall be a Permanent Magnet Generator (PMG) unit. The Alternator shall be sized using a minimum Class F standard.

3.1.2 OUTPUT REQUIREMENTS

The load power factor shall be within the range of 0.65 leading to 0.8 lagging for the ac output voltage conditions of the engine-alternator. The Crest factor is defined as the ratio of the peak value to the rms value of the waveform. The crest factor of the current reflected from the load to the output of the engine-alternator shall be ³ 3 for the ac output power requirements.

3.1.3 HARMONICS

Total harmonic distortion of a waveform is defined as the ratio expressed in percent of the sum of the mean squares of the harmonics to the mean square of the fundamental regardless of the phase. A pure sine wave only has the fundamental frequency and no higher order frequencies. It has 0 percent value for total harmonic distortion. The total harmonic distortion of the reflected current wave shall be =5% when connected to the engine-alternator operating within the output voltage.

3.1.4 INSULATION

Insulation shall be a minimum of Class F and have a 30-year shelf life with a minimum dynamic life of 10,000 hours at full load.

3.1.5 ALTITUDE AND TEMPERATURE RATINGS

The alternator shall be capable of continuously delivering its rated output at any power factor from 1.0 to 0.8 lagging, at +/- 5% of rated voltage, and at 60 Hz, at ambient temperatures from -20°F to 120 °F at altitudes up to 1500 feet above sea level. De-rating data shall be submitted for higher altitudes. This requirement must be met as well as those in 2.1.1.

3.1.6 OVERLOAD CAPABILITY (ALTERNATOR)

Alternators shall be capable of carrying, without damage, short term (5 minutes) overloads of 150% of rated capacity. The alternator, exciter and regulator combination shall be capable of withstanding without damage, application of any 2 second short circuit (either 3 phase, line to line, or line to neutral) at the alternator's terminals during operation at rated load, power factor, frequency and voltage. Sustained short circuit current shall not be less than 300% of the rated current for any of the short circuit conditions. Each alternator, exciter and regulator combination shall be capable of providing enough short circuit drive to activate the protective relays.

3.1.7 BALANCE

The rotors (alternator and exciter) shall be in mechanical and electrical balance at all speeds up to 125% of rated speed.

3.1.8 BEARINGS

Bearings shall be self-aligning, pre-lubricated, sealed anti-friction type.

3.1.9 DEVIATION FACTOR

The deviation factor of the alternator open circuit terminal voltage shall be below 6%. This deviation factor is determined by IEEE test code No.503, Paragraphs 1.190 and 1.191 for synchronous machines.

3.1.10 TELEPHONE INFLUENCE FACTOR

The balanced Telephone Influence Factor (TIF), based upon the 1960 weighting factor, shall not exceed the following values:

KVA rating of alternator	**Balanced TIF**
ALL Sizes	not to exceed 50

The line to line open circuit low frequency modulation shall not exceed 0.5 volts peak to peak in the frequency range of 5 to 30 Hz. The total open circuit harmonic content of any line to line or line to neutral voltage shall not exceed 5% with no single harmonic to exceed 1.5%

3.1.11 LEAD TERMINATION

The alternator leads shall terminate on the line side of the circuit breaker with circumferential crimp (compression) type copper connectors manufactured by either T&B or Burndy. Means shall be provided to prevent connectors from turning on breaker studs. Three phase alternators shall be the 12 lead type. **The exception to this requirement would be if the modification of any UL or approved third party certified device would violate the certification or void the warranty.**

3.2 EXCITER AND VOLTAGE REGULATOR

3.2.1 EXCITER REQUIREMENTS

A permanent magnet generator (PMG) will be provided for excitation power to the automatic voltage regulator. The exciter shall be of the brushless type using a rotating rectifier bridge circuit. The exciter shall be capable of delivering its rated current continuously and shall be capable of carrying short term loads (5 minutes) of 150% of rating without damage. Exciter field current shall be automatically controlled by the voltage regulator.

3.2.2 VOLTAGE REGULATOR REQUIREMENTS

3.2.2.1 TYPE

The voltage regulator shall be of a solid state, volts per hertz design and shall not be frequency sensitive between 55 and 67 Hz. The regulator shall sense all three phases of the alternator (on three phase machines) and shall be furnished with an adjusting rheostat that will allow the alternator voltage to be adjusted +/- 20% of its nominal value.

3.2.2.2 TERMINAL VOLTAGE CONTROL

The voltage regulator shall control the alternator terminal voltage to within 2% of no load voltage (with cross current compensation shorted out, if provided) under any combination of the following conditions:

- From no load to full load.
- From unity power factor to 0.8 lagging power factor.
- The governor adjusted for any droop between 0% and 5%.
- Over any 30 F (-1.1 C) change in temperature of the engine-alternator's surroundings.

The regulator shall hold the alternator terminal voltage to equal to or less than 2% Voltage change, over an ambient temperature range from -20°F to +120° F, with a speed change equal to or more than 5%.

3.2.2.3 LOAD CHANGES

When the full rated kW load is applied or rejected in one step, on sets of below 750 kW, the transient voltage sag shall not exceed 20% of the rated voltage and shall recover to and remain within 1% of the steady state voltage within 3 seconds. On sets of 750 kW or larger, block load of 500 kW or 50% of the set's kW rating, which ever is greater, shall be applied or rejected in one step. The transient voltage sag shall not exceed 20% of the rated voltage and shall recover to and remain within 1% of the new steady-state voltage within 3 seconds.

3.3 OUTPUT CIRCUIT BREAKERS

Set shall be provided with an ac output circuit breaker that is equipped with an adjustable magnetic trip (instantaneous trip) and thermal trip (longtime trip element), and a shunt trip control. The breaker shall shunt trip as a result of any MAJOR ALARM condition. All output circuit breakers will have lockout capabilities. The breaker shall be sized to appropriately accommodate the total rated load of the set plus 10%, at 0.8 power factor and shall be designated 'ALTERNATOR CIRCUIT BREAKER' or 'ACB'. The Alternator main breaker shall be tested according to the process found in Attachment 3.

3.4 GROUNDING

The engine alternator set shall be provided with an equipment grounding conductor sized per NEC 250-95 in the conduits or raceways that contain the phase leads to or from the alternator. Where multiple parallel conduits are used a full sized grounding conductor shall be run in each conduit. The equipment grounding conductors shall terminate within the alternator cabinet provided for lead termination of phase leads.

Termination may be made on a bus bar or a ground stud electrically bonded to the cabinet or directly to the cabinet interior with two hole copper crimp type terminals. The cabinet shall be electrically connected to the set frame by attachment hardware or by a bonding strap of cross sectional area equal to that of the grounding conductor specified above, or equivalent, to provide ground continuity between the entire set and the equipment grounding conductors.

The control cabinet, meter cabinet/panel, alternator and engine shall be bonded to the engine alternator metallic sub-base and/or skid.

3.4 GROUNDING(con't)

Such bonds shall be made with conductors designed to withstand engine alternator set vibrations. Two hole copper crimp type connectors shall be used.

Fuel day tanks (if equipped), engine set base/skid, start battery racks, and rectifiers shall be bonded to the Central Office Ground system with stranded copper grounding conductors per requirements in sub-section 3 of BSP 802-001-180MP. These requirements are outlined in Attachment 4.

The neutral of the alternator output shall not be grounded except through its unswitched connection to the commercial supply's neutral.

Ground fault indication shall be provided for all sets rated above 800 Amps. Sufficient space shall be provided in all other sets for the future addition of current transformers intended for ground fault protection.

3.5 CONTROL AND INDICATOR PANEL

3.5.1 ENCLOSURE

The control panel and enclosure shall comply with applicable NEMA standards to suit environment, and if engine mounted shall utilize anti-shock vibration mountings. All controls, instruments, alarms and indicator lamps shall be mounted on a single panel. Each control panel will be installed in such a way as to allow access for maintenance of all component of the engine alternator set. The control panel shall be illuminated by three dc lamps, one located inside the control panel and two located on the panel door.

3.5.2 CONTROLS

The control system of the engine alternator set shall utilize electromechanical relay logic, using a minimum number of different relay models. All relays shall be the plug-in type. Each model relay used shall be available from at least two major manufacturers. Controls to be located on the control cabinet door shall include:

- **Operation Selector Switch (OSS)** equipped with AUTO, MANUAL, OFF, and RESTORE (reset) functions (rotary). The MANUAL-RUN mode shall bypass, and in no way be dependent upon any electronic or microprocessor based circuitry in the control arrangement. All alarms and shutdowns shall remain operative in MANUAL-RUN mode.
- **Start push-button.**
- **Emergency Stop** push-button shall shunt trip output circuit breaker and activate engine air intake damper and lock out the starting circuit. An intake damper shall be installed on all 2 cycle engines and any other units over 50 kW where runaway is possible. The button shall be easily identifiable (red), non-locking and protected from accidental operation. A major audible alarm shall sound and panel mounted indicator alarm lamp shall light upon operation of the emergency stop button. This requirement may be met with an Allen-Bradley, non-locking push button or equivalent. This system shall be effective only when the engine is running. The vendor shall also be responsible for providing and installing a remote emergency stop button outside the engine room door (or at a location designated by the SBC LEC Power Equipment Engineer). The remote emergency stop button shall meet the same requirements and mirror the operation of the panel mounted emergency stop button.

3.5.2 CONTROLS(con't)

- **Frequency** raise-lower control, preferably lock type, with minimum adjustment range of 57 to 63 Hz per 3.2.2.1
- **Voltage** raise-lower control with a minimum 5% voltage range per 3.2.2.1.
- **Alarm Lamp Test** push button or push to test lamps.
- **Voltmeter switch**, 6 or 7 position, for 3 voltage readings phase to phase and 3 voltage readings phase to neutral for 3 Phase sets (off position permitted but not required).
- **Ammeter switch**, 3 or 4 positions, for phase current readings (off position permitted but not required).

If a circuit board design is used, ESD considerations must be observedΩ.

3.5.3 METERS

Meters shall be the recessed panel type with half bezels. The accuracy range, and any special markings shall be as required for the application and consistent with other sections of this document.

Ω Currently, PBS-005-300PT is the document used for ESD control standards.

THIS SECTION IS NOT VALID IF APPENDICES 1 IS ATTACHED. APPENDICES 1 OVERRIDES THIS SECTION.

3.5.4 ALARMS AND ASSOCIATED INDICATOR LAMPS

Visual alarms and status indications shall be provided by colored lamps (or LEDs) located on the control cabinet door. One distinctive lamp shall be provided for each alarm condition. An audible alarm that sounds during MAJOR or minor alarm conditions shall also be located in the control cabinet. All alarm and status lamps shall light when the alarm test push-button, or individual press to test lamps (described in 3.5.2) is/are depressed. All alarms and status indicators shall appear on a barrier screw type terminal strip (as form "C" contacts - two sets each), located within the control cabinet. Each terminal shall be identified with designations that agree with schematic diagrams per 3.8.1. The SBC LEC Power Equipment Engineer shall specify either a remote annunciator panel or an interface panel as described below. The SBC LEC Power Equipment Engineer shall designate the location of this panel near the existing alarm and remote monitoring terminals in the nearest power room (or another location specified by the SBC LEC Power Equipment Engineer). The vendor shall extend, terminate (and stencil the blocks) all specified alarm leads from the remote panel to a location designated by the Power Equipment Engineer (unless otherwise specified). A minimum set of alarms that are extended shall be: COMMERCIAL POWER FAIL, ENGINE FAIL, START/CONTROL BATTERY SYSTEM FAIL, BLOCK HEATER FAIL, ENGINE RUN, ENGINE RUNNING & OPERATING PROPERLY, START SWITCH IN OFF POSITION, LOW FUEL. Additional alarms that may be specified are TANK LEAK, DOOR OPEN .

3.5.4.1 ALARM INTERFACE PANEL

When the Power Equipment Engineer specifies an alarm interface panel the alarms shall be duplicated and properly identified on a terminal strip, in a NEMA 1 rated 12x12x3, wall mounted cabinet. The Power Equipment Engineer shall designate the location of this alarm interface panel.

3.5.4.2 ALARM ANNUNCIATOR PANEL

When the Power Equipment Engineer specifies an alarm annunciator panel it shall be configured in a similar fashion to the alarm interface panel described in 3.5.4.1 ALARM INTERFACE PANEL. The annunciator panel shall be equipped with indicators (colored lamps or LEDs) for the remotely monitored alarms and MAJOR and minor audible alarms. An alarm test feature (as specified in 3.5.4) shall be included. The minimum set of alarms specified by the Power Equipment Engineer shall be included. A non-latching alarm cut off feature shall be included and shall only disable the audible alarms.

3.5.4.3 MAJOR ALARMS

A "**MAJOR**" alarm indication (red lamps on panel) shall be displayed and the controls shall shut down the engine alternator and lock out the start circuit, shunt trip the alternator circuit breaker and operate the engine fail relay (and lamp) if one or more of the following conditions exist:

ENGINE FAIL (ENGALTFAIL)

- **Underspeed: (SHTDN|ENG FAIL)** Operates if the engine speed drops below 90% of the normal operating speed. **Engine malfunction resulting in a shutdown**.
- **ACB Trip: (SHTDN|ENG FAIL)** Operates if the alternator circuit breaker trips (over current or shunt trip). Engine malfunction resulting in a shutdown. Also will indicate when alternator circuit breaker is open. **Engine malfunction resulting in a shutdown**.
- **Under voltage: (SHTDN|ENG FAIL)** Operates if the alternator voltage is below the normal operating range by 15% or more. A suitable time delay shall be incorporated to allow compliance with transient voltage criterion 3.2.2.3. **Engine malfunction resulting in a shutdown**.
    - • **Mechanical Low Water Alarm: (PREHET|)** Indicates low water (Murphy or equivalent). For remote radiators, place Murphy switch, or equivalent, at header tank and/or engine level. Also indicates remote radiator low water indicated by Murphy or equivalent switch at remote radiator and remote radiator fan fail. **Pre-high temperature.**

- **Engine Control Fuse/Breaker Alarm: (SHTDN|ENG FAIL)** Any fuse/breaker that results in the loss of control power or otherwise disables or limits the unit shall operate the engine fail relay. This action will also activate an alarm that will be clearly marked on the control panel as a fuse/breaker alarm. Also will indicate a ground fault condition. **Engine malfunction resulting in a shutdown.**

ENGINE ALTERNATOR OIL PRESSURE LOW (ENGALTOILPRESLO)

- **Low oil pressure: (PRELOP|)** Operates if the oil pressure falls below the safe value recommended by the engine manufacturer. **Pre-low oil pressure.**

ENGINE ALTERNATOR OVER CRANK (ENGALTOVRCRANK)

- **Over-crank: (OC|)** Operates if the engine fails to reach a threshold speed within the time limit specified by the manufacturer. This alarm must operate upon the unsuccessful completion of the third (3rd) start attempt. **Over crank (engine shutdown).**

ENGINE ALTERNATOR OVER SPEED (ENGALTORVRSPEED)

- **Overspeed: (OS|)** Operates if engine speed exceeds 115% of normal operating speed. **Over speed (engine shutdown).**

- **Over voltage: (SHTDN|ENG FAIL)** Operates if the alternator voltage exceeds the normal operating range by 15%. A suitable time delay shall be incorporated to allow compliance with transient surge voltage criterion in 3.2.2.3. **Engine malfunction resulting in a shutdown**.

3.5.4.3 MAJOR ALARMS (con't)

ENGINE ALTERNATOR PRE-HIGH TEMPERATURE (ENGALTPREHITEMP)

- **High coolant temperature: (HET|)** Operates if the temperature of the coolant, measured immediately before and on the engine side of the thermostat, rises to a temperature exceeding manufacturer's limits. **High Engine temperature (engine shutdown).**

ENGINE ALTERNATOR EMERGENCY STOP (ENGALTEMERSTOP)

- **Emergency stop: (EMERST|)** Indicates operation of emergency stop button. This circuit shall be effective only when the engine alternator set is running to prevent accidental tripping. **Emergency stop switch enabled (engine shutdown).**

ENGINE ALTERNATOR FUEL (ENGALTFUEL)

- **High/Low day-tank: (LF|ENG FUEL)** Indicates fuel level in the day-tank or module tank is above or below the normal range (if equipped with day tank or module tank). **Low fuel level.**

- **Low Fuel: (LF|ENG FUEL)** Indicates low fuel condition. **Low fuel level.**

ENGINE ALTERNATOR BATTERY FAIL (ENGALTBATFAIL)

- **High/Low dc voltage: (BF|ENG BATT)**shall indicate a high or low voltage condition of the engine start batteries. **Start/control battery system failure.**

- **Rectifier Fail: (BF|ENG BATT)** Indicates that the start battery rectifier has failed. **Start/control battery system failure.**

ENGINE ALTERNATOR SWITCH OFF (ENGALTSWOFF)

- **OSS Off Normal: (SWOFF)** Indicates switch is NOT in the automatic position. Provide a terminal strip connection to allow a customer provided series loop for remote OSS switch. **Start switch is in the off position.**

3.5.4.4 MINOR ALARMS

A **"MINOR"** alarm indication (amber lamps on panel) shall be displayed if one or more of the following conditions exist: (These conditions indicate impending problems that may result in engine shutdown or other impairment if corrective action is not taken).

ENGINE ALTERNATOR FAIL (ENGALTHTRFAIL)

- **Low engine temperature: (LET|ENG LOW TEMP)** Block heater fail. **Low engine temperature, block heater failure.**

- ENGINE ALTERNATOR PRE TEMPERATURE FAIL (ENGALTPRETEMP)

- **Immersion heater failure: (LET|ENG LOW TEMP)** Indicates a heating element failure or coolant temperature drop to a level that may impair engine starting reliability. **Low engine temperature, block heater failure.**

3.5.4.4 MINOR ALARMS (con't

ENGINE ALTERNATOR ONLINE (ENGALTONLINE)

- **Transfer Switch Closed**: **(EP|ENG ONLINE)** office load on engine. **Transfer switch operated; office load on engine.**

ENGINE ALTERNATOR RUNNING (ENGALTRUNNING)

- **Engine Running**: **(ER|ENG RUNNING)** Operating properly. **Engine is running and operating properly.**

3.5.4.5 PROPER OPERATION INDICATION

A status indication (green lamp on panel) shall signify proper operation of the standby engine alternator system. A series loop that extends through auxiliary contacts in each automatic transfer breaker, as well as the engine ACB breaker and the engine run relay shall confirm that all breakers (in the automatic mode) have transferred to the engine alternator bus. This operation shall not operate an audible alarm.

3.5.4.6 ENGINE RUNNING INDICATION

Amber lamp on panel indicates that engine is running (for remote monitoring [IPS] and remote annunciator alarm panel). This operation shall not operate an audible alarm.

3.6 MECHANICAL AND PERFORMANCE CRITERIA

3.6.1 GOVERNOR

The governor shall meet the following requirements:

- An externally adjustable droop control, adjustable from isochronous to at least 5% droop.
- The minimum frequency adjustably (at control panel) shall be 57 to 63 Hz.
- The steady-state regulation shall be such that at any constant load, from no load to full load, the maximum frequency ripple for the ac output shall be ± 0.15 Hz at any frequency between 59 and 63 Hz (with stable governor temperature). Frequency variations within this range shall be periodic.
- Frequency drift due to changes in governor temperature shall not exceed 0.5 Hz for steady state operation at any load from no load to full load.
- For both increasing and decreasing loads, the change of alternator output frequency with load shall be within 0.25% of true linear response, with the governor set for any droop between 0% and 4%.
- Must be able to ramp start.

3.6.1.1 ELECTRONICALLY CONTROLLED FUEL INJECTION (EFI)

All performance conditions found in **3.6.1 Governor** will apply to this section.

3.6.1.2 TRANSIENT RESPONSE

The response of the engine alternator set to sudden changes in load should meet the following performance criteria:

- For any sudden 1/4 load change from no load to full load (increasing or decreasing the load) the frequency shall recover to and stay within the ±0.15 Hz band within 2 second and the frequency shall depart from the steady state value by no more than 3 Hz
- For any full load change on sets 500 kW and below (no load to full load or vice versa), the frequency shall recover to and stay within the ± 0.15 Hz band within 5 seconds and depart no more than 6 Hz from the steady state value
- Sets above 500kW must meet the above criterion at 500kW or 50% of rated kW which ever is greater.
- For all of the above, the frequency shall stabilize at the steady state value with no undampened oscillation.

3.6.2 FUEL SYSTEM

3.6.2.1 PRIMING PUMP

A manually operated, permanently mounted priming pump, wobble type, shall be incorporated in the on-set fuel system. This priming pump shall be capable of pulling fuel from the main tank with all fuel lines and the on-set fuel system drained. The priming pump shall be sized appropriately to lift at least 20 feet

of D2 fuel. This priming pump shall not be plumbed in line, but shall be switchable into the system with ball type valves.

3.6.2.2 HIGH LIFT FUEL PUMP

An engine driven high lift fuel pump shall be provided. It shall be capable of delivering at least 120% of the engine's fuel consumption rate while the set is operating at full load and the suction lift (including flow losses in pipe and fittings) is 20 feet of D2 fuel at 1500 ft. above sea level.

3.6.2.3 FUEL FILTERS AND STRAINERS

Fuel filters and strainers shall be commonly available, of the replaceable element type and of sufficient capacity to permit a minimum of 500 hours of continuous operation without requiring service. Strainer basket shall be stainless steel. The filter system shall include a duplex 30 micron water separation filter assembly equipped with ball type isolation valve. (i.e., a Racor centrifugal filter or the equivalent)

3.6.2.4 FUEL CUP

A fuel cup shall be provided in the fuel system on the pressure side of the high lift pump and on the vacuum side of the boost or injector pump to aid in engine starting. A small petcock, intended for fuel sampling, shall be installed in the fuel cup line.

3.6.2.5 FUEL HOSES

All fuel hoses shall be high quality flexible steel reinforced type rated at 50 psi or better. Fuel hoses shall not be painted.

3.6.3 LUBRICATION SYSTEM

Positive lubrication shall be provided for all moving parts in the engine. The lubricating oil pump shall be gear driven from the engine. Oil capacity shall be sufficient to permit unattended operation for a minimum of 72 hours, or as specified by the Power Equipment Engineer (to match available fuel reserve). An oil makeup system may be added to meet this requirement. The lubrication oil filter system shall be of the full-flow type and have a built-in bypass to permit oil to bypass the filter in the event the filter element

becomes clogged. Lubrication filters shall be commonly available and of the replaceable element type and adequately sized to permit a minimum of 500 hours of continuous operation without replacement of the elements. A lubrication oil pressure sensor shall be provided to shut down the engine if the oil pressure falls below a safe level recommended by engine manufacture (see section 3.5.4.3). An oil drain, equipped with a shut-off valve, shall be extended beyond the engine alternator sub-base.

3.6.4 STARTING SYSTEM

An electric starting system shall be provided that is equipped for auto-recycle for three start attempts. The starting system shall be adequately sized to permit a minimum of two start cycles (one start cycle consists of three start attempts) within five minutes without recharge, at the lowest temperature expected for the site (see 2.1.1), and shall consist of the following components:

- An appropriately sized, flooded lead acid 12 or 24 volt battery shall be provided (unless otherwise specified by the Power Equipment Engineer). The use of 12 Volt systems is restricted to sets below 100 kW. A mechanically secure battery stand meeting UBC seismic zone 4 requirements shall be mounted on the floor adjacent to engine alternator set (not on the base). A non-metallic case, capable of containing an acid spill shall be used to meet this requirement. An anti-corrosion coating shall be applied to all battery terminals and connections. Note: Vendor to provide documentation of conformance to UBC zone 4 requirements for critical facilities.

- An adjustable, dual rated battery charger adequately sized to recharge a fully depleted start battery within 24 hours shall be provided. If an onset alternator is provided, it shall be fully functional with an ammeter per 3.5.3. If no onset alternator is provided the charger shall be sized to recharge a fully depleted start battery within 8 hours. The charger shall be equipped with high and low output float voltage alarms (see section 3.5.4.4). The charger ac input shall be 120 volt, single phase. The charger shall be a La Marche, SENS or an approved equivalent.

- The Temperature of all components of the starting system shall remain within manufacturers specifications under any operating or test conditions.

3.6.5 EXHAUST SYSTEM

A critical exhaust silencer equipped with condensation drain, companion flanges, and flexible stainless steel bellow type exhaust fitting, properly sized, shall be furnished and installed according to the manufacturer's recommendation. The silencer shall be mounted so that its weight is not supported by the engine nor will forces due to exhaust system growth from thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed limitations specified by the manufacturer. A rain cap shall be provided if the exhaust stack terminates vertically. Installation shall meet UBC seismic 4 requirements for critical facilities and Bellcore Technical reference TR-EOP-000063 (latest issue). Documentation of compliance shall be supplied. The silencer and all indoor exhaust piping shall be insulated to a maximum surface temperature of 60 ° C (140 ° F), with a

3.6.5 EXHAUST SYSTEM (con't)

non-asbestos lagging. A spark arrestor shall be included in areas where there is a risk of fire from trees or roofs nearby the site.

The complete exhaust system shall not exceed the engine manufacturer's maximum recommended backpressure. This shall be verified by manometer test (see performance testing, section 4).

3.6.6 COOLING SYSTEM

The engine cooling system shall be adequately sized to cool the unit properly at 110% load at the site maximum temperature (see 2.1.1) or 110 ° F, whichever is higher. For water cooled engines the water radiator core and header shall be of suitable material for site conditions. The radiator shall be an air to water heat exchanger with a fouling factor of 0.001 allowed for the water side. The radiator shall have an easily accessible fill point for the addition of coolant. Drain connection and drain cock shall be provided at the bottom of radiator, and extended to a location where the radiator can be easily drained (left or right side of engine). The radiator shall be sized and materials shall be adequate for use of manufactures recommended coolant for site altitude and climate. The radiator fill and drain points shall be tagged with the capacity of the radiator and the manufactures recommended coolant formula.

All coolant hoses shall be of reinforced silicone rubber and shall not collapse under the most severe suction conditions. Coolant hoses shall not be painted. "T"-bolt clamps shall be used to attach all cooling system hoses. Radiator pressure cap shall meet the engine manufacturer's specifications for pressure. Temperature sensor shall be located in direct flow of coolant at engine jacket water discharge area. The cooling system shall be equipped with an internal sensing thermostatic valve to allow rapid engine warm up and regulated coolant flow. The set shall be equipped with a coolant recovery system that will prevent coolant overflow and spillage.

Water cooled engines shall be equipped with a Kim Hot Start canister type water jacket heater, or an approved equivalent. The heater shall be 120, 208 or 240 volt, single phase, Wattage as specified by

engine or heater manufacturer. Heaters shall be mounted on engine skid or base and not directly on engine. V-type engines shall have 2 heaters, each with its own thermostat. The heater system shall be connected to the engine cooling system in a way that minimizes heat loss through the radiator. The heater system shall include a coolant circulating pump, e.g. Grundfos Pump Corp., Model Series UP15-1850, to ensure uniform engine temperatures and extend heater element life. The heater shall be controlled by an externally adjustable thermostat (with an "off" position) that is set at the minimum point at which the engine will start reliably at the lowest expected temperature for the site (see 2.1.1). Ball type shut off valves shall be incorporated into system design to accommodate servicing of each water jacket heater.

Air cooled engines shall employ a heater to maintain lubricating oil temperature as recommended by the engine manufacturer.

3.6.7 INTAKE AIR SYSTEM

The engine intake air shall be taken from the engine room or the engine enclosure, if employed. The engine shall be equipped with a paper type, replaceable dry element air filter. The filter shall be adequate to permit a minimum of 500 hours of continuous operation under normal conditions without requiring maintenance. The filter shall be sized for air flow expected up to 110% load with minimal pressure drop and shall trap all airborne dirt or dust that may enter the engine and cause excessive wear. The filter system shall be equipped with a service indicator to automatically display air filter replacement indication.

3.6.7 INTAKE AIR SYSTEM (con't)

For turbocharged engines, the intake air system shall be sound attenuated to reduce high frequency turbocharger noise.

3.6.8 AIR BOX / VAPOR RECOVERY SYSTEM

The crankcase breather / draft tube must be provided with an air filtration system (AirSep or =). If the engine is equipped with an air box drain tube(s), it must be terminated in a drainable container. No oily vapor shall be vented into the engine room.

3.7 PRECAUTIONS

The engine alternator set shall be designed and constructed so that personnel hazards are minimized. Component parts shall be suitably arranged or guarded to minimize the possibility of accidental contact with hazardous voltages, rotating parts, sharp edges, or high temperature surfaces (lift off guards are preferred). The installed set shall comply with all applicable OSHA requirements.

3.7.1 HIGH TEMPERATURE SURFACES

Exposed surfaces with temperatures greater than 45 C (113 F) shall be marked with warning labels. Surfaces with temperatures greater than 60 C (140 F) shall be guarded as well as marked with warning labels. Non-asbestos insulation and/or ventilated guards shall be provided to protect the operator from accidental contact with the engine exhaust system parts and piping, or any other components with surface temperatures higher than 60 C (140 F).

3.7.2 ROTATING PARTS

Suitable guards (that meet OSHA requirements) shall be provided that protect any operator from being harmed by fans, blowers, rotating parts of alternators, and any other rotating parts associated with the engine alternator set to which the operator may be exposed. All set screws, bolts, keys or key ways shall have no projecting or sharp edges or they shall be suitably guarded. All in-running gears and sprockets

shall be completely enclosed or be provided with band guards around the face of the gear or sprocket. Operator shall not be able to touch any rotating part.

3.7.3 HAZARDOUS VOLTAGES

Voltages at or above 50 Volts dc or rms ac shall be enclosed or guarded to prevent personnel contact. Warning labels shall also be provided and conspicuously displayed with the guards in place or removed.

3.8 TRAINING, DOCUMENTATION AND SPARES

3.8.1 TRAINING

Training shall be available for operating company personnel in the following areas:

- Planning
- Engineering
- Operations
- Craft (maintenance)

3.8.1 MANUALS AND DRAWINGS

The vendor shall provide three operating and maintenance manuals covering the following:

- General description - including arrangement of the engine alternator plant, interfaces with support systems, and a general description of features.
- Equipment description, for the exact equipment being installed - including a detailed description of each major component or subsystem, its functions, features, sequence of operation and all engineering and interface information.
- A trouble indication flow chart.
- Manufactures recommended routine maintenance requirements and their intervals.

The vendor shall provide three sets of drawings covering the following:

- Material Safety Data Sheets (MSDS) shall be provided for all hazardous and potentially hazardous fluids.
- Site specific schematic providing circuit information for each part of the engine alternator set including ac power interfaces, controls, safety shutdowns and alarm interfaces, and support system interfaces.
- Circuit descriptions - information describing the purposes, functions, methods of operation, and maintenance of the unit.
- Wiring diagrams - drawings showing the physical wiring layout of all circuits and equipment, covering all stenciling and wire colors of the unit.
- Equipment drawings - depicting the layout and assembly of major mechanical components.

Other documentation to be provided shall include:

- List of alarm & shutdown threshold points.

- Manufacturer's parts list.
- Equipment design specifications - specifications providing engineering, ordering, and installation information for each major equipment unit making up the set.
- Alternator de-rating data (for altitude) per 3.1.3
- Certification of conformance with UBC seismic zone 4 requirements per 2.1.4, 3.6.4, and 3.6.5.
- Engine package data sheet per attachment 2.

The installation shall not be considered complete until all of the above documentation is furnished to the Power Maintenance Engineer at the time of site test.

3.8.2 SPARE PARTS

The vendor shall provide the following spare parts with the unit:

- One complete set of oil, fuel and air filters (including water separator filter and coolant filter, where applicable).
- One complete set of auxiliary drive belts.
- Touch-up paint to match unit.
- At least one of each type and size of fuse used in set.
- At least one of each type of lamp or LEDs used in set.
- At least one of each type of plug-in relays used in the set.
- At least one set of spare controller circuit packs (if applicable).

3.9 IDENTIFICATION AND MARKINGS

All major assemblies of the unit shall display nameplate identification. Nameplates shall be of sufficient size and so located that they can be read from a safe position. Nameplates shall contain information necessary for unambiguous identification of the assembly, generally including the vendor's model, part, and serial numbers as well as rating information.

All electrical and electromechanical components shall be assigned a functional designation (i.e., SDR for shut down relay). All terminal and component designations shall be shown on the circuit drawing (see 3.8.1). Functional and terminal designations shall be displayed on or adjacent to each component and terminal. Markings shall be of adequate size to be read with the naked eye in a color that contrasts with the background. Adhesive backed tape labels (i.e., dymo tape labels) are not acceptable for component designations. Ink stencil, silk screen or similar permanent designations are acceptable.

4 PERFORMANCE TESTING

4.1 SHOP TEST

For units less than 500kW, a documented shop test is required prior to ship. This test does not require a Southwestern, Pacific, or Nevada Bell presence during testing. For units of 500kW or larger, the vendor shall make available those facilities normally used for final in-shop operational testing. The vendor shall

contact the Power Equipment Engineer for scheduling and coordination of specified tests. These tests shall be conducted by the Power Maintenance Engineer.

4.1.1 COLD START (350 kW and smaller)

After it has been at rest (with water jacket heater{s} off) for a minimum of 10 hours, the engine shall be cold started.

a) The time required to reach rated no load speed shall be compared against the manufacturer's specifications and recorded.

The engine alternator set shall be loaded and brought up to operating temperature and then shut down.

4.1.2 HOT START

With the engine at operating temperature it shall be hot started.

a) The time required to reach rated no load speed shall be compared to manufacturer's specifications and recorded.

b) Verify the manual voltage regulator voltage range.

c) Verify the manual frequency adjustment range.

d) Record ac volts, frequency, speed, coolant temperature, oil pressure and ambient temperature.

e) Test each of the engine alternator's safety shutdown and alarm devices and systems described in section 3.5.4.

f) Test and record the transient response of the unit in quarter load steps from no load to full load and full load to no load and verify against requirements of section 3.6.1.2.

g) Test and record the transient response of the unit in full load steps from no load to full load and from full load to no load for sets 500 kW and below and 1/4 load steps thereafter. Note: Vendor shall provide a Gould model 2200S strip chart recorder, or equivalent for verification and recording of transient response tests f and g.

h) Apply 110% load at 0.8 PF for 1 hour and record ac volts, amperes, frequency, kilowatts, coolant temperature, oil pressure, and exhaust temperature every 15 minutes.

i) Reduce load to 100% at 0.8 PF for the time required to properly seat engine piston rings or 3 hours, whichever is longer. Record ac volts, amperes, frequency, kilowatts, coolant temperature, and oil pressure every 15 minutes.

Note: **tests (h) and (i) shall be a combined and continuous (uninterrupted) 4 hour run.**

4.2 ON SITE TEST

Operational testing shall be performed at the site after installation. These tests are to assure compatibility with the electrical, fuel and exhaust system, alarms, airflow, and compliance with the acoustic noise and exhaust emission requirements. The vendor shall provide all fluids (except fuel) required to perform the tests. The vendor shall also provide all equipment (including load bank) and

personnel for the on site test. The vendor shall notify the Power Equipment Engineer at least 7 days prior to the proposed test day so that scheduling arrangements may be made (this shall include APCD inspector, if required). The engine alternator set shall be run at full load for a minimum of 2 hours. All alarm and shut down systems shall be verified as well as any other criteria herein specified that may be considered appropriate by or the vendor. The engine exhaust shall be observed during the on site testing for obvious or excessive smoke that would violate local or state ordinances. Every effort shall be made to eliminate all visible exhaust smoke. A test shall be performed to determine that the maximum exhaust gas backpressure is less than manufactures published specification. A full on-site test that includes full transfer of building loads will be conducted prior to job/project acceptance.

REFERENCE

SHOP TEST - PROCEDURES

Estimated test time: 5 to 6 hours.

Purpose: 1. Relieve the communication problem during an engine test.
2. Provide a procedure for observers and tester to follow.
3. Make best use of available time.

Step

_____ 1. Review test procedures with observers and tester.

_____ 2. Check controls.

_____ 3. Check instruments.

_____ 4. Check fuel system.

_____ 5. Check lube system.

_____ 6. Check start system.

_____ 7. Check cooling system.

_____ 8. Safety Guards.

_____ 9. Test minor alarms.

_____ 10. Cold start engine.

_____ 11. Load engine to bring to operating temperature.

_____ 12. Verify voltage adjust range.

_____ 13. Verify frequency adjust range.

_____ 14. Test shut down features and major alarms.

_____ 15. Discuss the Transient Response and Load Test requirements.

_____ 16. Transient Response.

_____ 17. Tester (vendor) shall prepare an engine test run log.

_____ 18. Load test 110%, .8 pf, 1 hour.

_____ 19. Load test 100%, .8 pf, 3 hours.

_____ 20. Review results with vendor.

REFERENCE

SHOP TEST CHECK SHEET(4.1)

Conducted by:_____Date: _____
Observed by: Power Equip Engineering: _____
Power Maint Engineering: _____
kW: _____VOLTS: _____PHASE: _____
TEST LOAD = Resistive _____ Reactive _____Both _____ (preferred)
Cold Start (4.1.1.) _____ Hot Start (4.1.2.a) _____
Volts Adj Range (3.2.2.1)+-10% L= _____ H= _____
Freq Adj Range (3.2.2.1)57-63 L= _____H= _____
Readings: Volts=_____ Freq=____ Temp=_____ Oil Press=_____ Amb.Temp=_____

TRANSIENT RESPONSE & LOAD RUN

Frequency (3.6.1.2)	0	1/4	1/2	3/4	F		0-F	F-0	
Freq: 60 +-.15Hz	___	___	___	___	___	Same	____	____	
Dip/Rise: 3 Hz (57-63)		___	___	___	___	6 Hz	____	____	____
Time: 2 sec		___	___	___	___	5Sec	____	____	
Voltage (3.2.2.3)									
Volts: +-.5% (-)	___	___	___	___	___	+-1%	____	____	____
Dip/Rise:		___	___	___	___	20%	____	____	
Time: 1 sec		___	___	___	___	3sec	____	____	
Load Run (4.1.2)									
110% @.8pf, 1hr (4.1.2.h)		___							
100% @.8pf, 3hrs(4.1.2.i)		___							

MAJOR ALARMS (3.5.4.3)

	Alarm	Shut Down	Air Damper	Shunt Trip CB
Low Oil Press	_____	_____	_____	_____
Low Fuel	_____	_____	_____	_____
Over Crank	_____	_____	_____	_____
Over Speed	_____	_____	_____	_____
Under Speed	_____	_____	_____	_____
Over Voltage	_____	_____	_____	_____
Under Voltage	_____	_____	_____	_____
ACB Trip	_____	_____	_____	_____
Eng Cntl Brkr	_____	_____	_____	_____
Hi Coolant Temp	_____	_____	_____	_____
Emerg Stop	_____	_____	_____	_____
Mech Low Water	_____	_____	_____	_____
Start Batt. Sys Fail	_____	_____	_____	_____
OSS Off Normal	_____	_____	_____	_____

MINOR ALARMS (3.5.4.4)		**CONTROLS** (3.5.2)		**INSTRUMENTS** (3.5.3)	
Low Fuel	_____	Select Sw	_____	Voltmeter	_____
Low Eng Temp	_____	Start Sw	_____	Ammeter	_____

Prelim HCT	_____	Emerg Stop	_____	Freq Meter	_____
Prop Oper	_____	Freq R/L	_____	Hour Meter	_____
		Volt R/L	_____	kW Meter	_____
		Al Lmp Tst	_____	Oil Press	_____
		VM Sw (3ph)	_____	Water Temp	_____
		AM Sw (3ph)	_____	Power Fact	_____

FUEL SYSTEM (3.6.2)
Man Prime Pump _____
High Lift Pump _____

LUBE SYSTEM (3.6.3)
Filter By-Pass_____

START SYSTEM (3.6.4)
24V Battery_____
Charger _____

COOLING SYS (3.6.6)
Imm Heater _____

SAFETY (3.7 & 2.1)
Rot. Guards _____
Temp Guards _____

REFERENCE

SITE TEST - TEST PROCEDURES

Estimated test time: 3 to 4 hours.

Purpose:
1. Relieve the communication problem during an engine test.
2. Provide a procedure for observers and tester to follow.
3. Make best use of available time.

Step

_____ 1. Review test procedures with observers and tester.

_____ 2. Check start system.

_____ 3. Check exhaust system.

_____ 4. Check cooling system.

_____ 5. Check safety guards.

_____ 6. Check fuel system.

_____ 7. Test minor alarms local and remote, as appropriate.

_____ 8. Start and load engine to bring to operating temperature.

_____ 9. Check instruments.

_____ 10. Test shut down features and major alarms, local and remote, as appropriate.

_____ 11. Power Maintenance Technician shall prepare an engine test run log.

_____ 12. Load test 100%, 2 hours.

_____ 13. Check turn over items.

_____ 14. Review results with vendor.

REFERENCE

SITE TEST (4.2)

Conducted by: _____ Date: _____

Observed by: Power Equip Engineering:_____

Power Maint Engineering:_____

Power Maint DPMC:_____

kW: _____ VOLTS: _____PHASE: _____

TEST LOAD = Resistive _____ Reactive _____ Both _____ (preferred)

FULL LOAD TEST (2 hrs) _____

MAJOR ALARMS (3.5.4.3)

	Alarm	Shut Down	Air Damper	Shunt Trip CB
Low Oil Press	_____	_____	_____	_____
Low Fuel	_____	_____	_____	_____
Over Crank	_____	_____	_____	_____
Over Speed	_____	_____	_____	_____
Under Speed	_____	_____	_____	_____
Over Voltage	_____	_____	_____	_____
Under Voltage	_____	_____	_____	_____
ACB trip	_____	_____	_____	_____
Eng Cntl Brkr	_____	_____	_____	_____
Hi Coolant Temp	_____	_____	_____	_____
Emerg Stop	_____	_____	_____	_____
Mech Low Water	_____	_____	_____	_____
Start Batt. Sys Fail	_____	_____	_____	_____
OSS Off Normal	_____	_____	_____	_____

MINOR ALARMS (3.5.4.4)

Low Eng Temp_____

Prelim HCT _____

Prop Oper _____

CONTROLS (3.5.2)

Select Sw _____

Start Sw _____

Emerg Stop _____

Freq R/L _____

Volt R/L _____

Al Lmp Tst _____

VM Sw (3ph) _____

AM Sw (3ph) _____

INSTRUMENTS (3.5.3)

Voltmeter _____

Ammeter _____

Freq Metter _____

Hour Meter _____

kW Meter _____

Oil Press _____

Water Temp _____

Power Fact _____

START SYSTEM (3.6.4)

24V Battery _____

Charger _____

SAFETY (3.7 & 2.1)

Rot. Guards _____

Temp Guards _____

EXHAUST SYS (3.6.5)

Insulated _____

Non-asbestos _____

FUEL SYSTEM (3.6.2)

Man Prime Pump _____

Plumbing _____

Electrical _____

COOLING SYSTEM (3.6.6)

Imm Heater _____

TURN OVER (3.8)

Manuals (3) _____ Drawings (3) _____

Spares: Oil Filter _____ Fuel Filter _____ Air Filter_____
Belts _____ Ckt.Boards _____ Fuses _____
Lamps _____ Touch-Up Paint _____ Relays _____

REFERENCE

FORMULAS Use the following formulas to verify instrument readings.

3 PHASE SETS

$$I = \frac{kW \times 1000}{E \times 1.73 \times PF} = \frac{(\quad)}{(\quad)} \qquad I = \_\_\_\_\_$$

$$kW = \frac{I \times (E \times 1.73 \times PF)}{1000} = \frac{(\quad)}{1000} \qquad kW = \_\_\_\_\_$$

PF x 208V = 287.87
PF x 240V = 332.16
PF x 480V = 664.32

$$E = \frac{kW \times 1000}{I\,(1.73 \times PF)} = \frac{kW \times 724.64}{(\quad)} \qquad E = \_\_\_\_\_$$

$$PF = I(E \times 1.73) = \frac{kW \times 1000}{(\quad)} = PF\_\_\_\_\_$$

1 PHASE SETS

$$I = \frac{kW \times 1000}{E \times PF} = \frac{(\quad)}{(\quad)} \qquad I = \_\_\_\_\_$$

$$kW = \frac{I \times (E \times PF)}{1000} = \frac{(\quad)}{1000} \qquad kW = \_\_\_\_\_$$

PF x 208V = 166.4
PF x 240V = 192.0
PF x 480V = 384.0

$$E = \frac{kW \times 1000}{I \times PF} = \frac{kW \times 1250}{(\quad)} \qquad E = \_\_\_\_\_$$

$$PF = \frac{kW \times 1000}{(\quad)} \qquad PF = \_\_\_\_\_$$

I x E ( )

ATTACHMENT 1

THIS SPECIFICATIONS IS FOR INTELLIGENT POWER. THE ENGINE WILL BE EQUIPPED WITH THE FOLLOWING ADDITIONS TO THE MAIN ENGINE SPEC. ONE DEDICATED TERMINAL STRIP WITHIN THE ENGINE CONTROLLER THAT WILL ALLOW EXTENDED ALARMS THROUGH FORM "C" CONTACTS. THESE DIGITAL ALARM POINTS WILL INCLUDE THE FOLLOWING:

RFA -START BATTERY CHARGE FAIL
LOP -LOW OIL PRESSURE
HWT -HIGH WATER TEMP
LWT -LOW WATER TEMP
LCD -LOW COOLANT LEVEL
CRF -CRANKING FAILURE
OVS -OVER-SPEED
OVT -OVER VOLTAGE
LF -LOW FUEL
TL -FUEL TANK LEAK
OBC -ON SET BREAKER CLOSED
OSS -OPERATION SELECT SWITCH NOT IN "AUTO" POSITION
EMS -EMERGENCY STOP BUTTON ACTIVATED
ER -ENGINE RUN
PF -COMMERCIAL POWER FAIL
EF -ENGINE FAIL
PO -PROPER OPERATION
PCT -PRELIMINARY HIGH COOLANT TEMPERATURE
ACB -ALTERNATOR CIRCUIT BREAKER TRIPPED

THE FOLLOWING ANALOG POINTS WILL ALSO BE LANDED ON THIS TERMINAL STRIP.
NOTE: START BATTERY VOLTAGE AND COOLANT TEMPERATURE TO BE ACTIVE ON 24 HOUR BASIS

FUNCTION		OUTPUT
SBV	-START BATTERY VOLTAGE	= 0 - 30 VOLTS DC.
CWT	-COOLANT TEMP	= 4 TO 20 MILLIAMPS. (e.g. OMEGA TX35)
VAC	-OUTPUT VOLTAGE PHASES A, B, C	= 0 TO 1 MILLIAMP.

NOTE: IF 480 VOLT, 4:1 POTENTIAL TRANSFORMER IS TO BE USED;

AC- OUTPUT CURRENT PHASES A, B, C = 0 TO 1 MILLIAMP

ATTACHMENT 2

SHOP TEST INFORMATION SUMMARY

DATE _____CUSTOMER ID # _____ LOCATION _____
VENDOR _____ VENDOR REP _____
TELCO ENGINEER _____

ENGINE INFORMATION
MANUFACTURE _____ MODEL _____
DISPLACEMENT _____ CYLINDERS _____
RPM RATING _____ HP RATING _____
SERIAL # _____
DIESEL FUEL TYPE _____ FULL LOAD CONSUMPTION_____
FUEL FILTER TYPE _____ LUBE OIL FILTER TYPE _____
LUBE OIL TYPE _____ Wt. _____ Mfg. _____
COOLING SYSTEM CAPACITY _____ INHIBITOR _____ ANTIFREEZE _____
TURBOCHARGED? YES ( ) NO ( ) WARRANTY PERIOD _____
WATER JACKET HEATER Mfg. _____ TYPE _____

GENERATOR INFORMATION
MANUFACTURE _____ TYPE_____
SERIAL # _____ VOLTAGE _____
kW _____KVA _____
RPM RATING _____

CONTROL PANEL INFORMATION
MANUFACTURE _____ MODEL_____
W.O. # _____ VOLTAGE_____
PHASE _____ OUTPUT BREAKER SIZE_____

LOAD BANK INFORMATION
MANUFACTURE _____ SERIAL # _____
K. W. RATING_____VOLTAGE_____
PHASE _____ STEPS _____

BATTERY CHARGER INFORMATION
MANUFACTURE_____MODEL _____
SERIAL #_____

INPUT RATING VOLTS _____ AMPS _____
OUTPUT RATING VOLTS _____ AMPS _____

BATTERY INFORMATION
MANUFACTURE _____ MODEL_____
SERIAL # _____ AH RATING_____CCA_____

INSTALLATION TYPE_____

FUEL TANK LOCATION _____ TANK SIZE_____

ATTACHMENT 3
GENERATOR OUTPUT BREAKER TESTING

SCOPE OF WORK

Circuit Breaker - Low Voltage Air Frame

1. Mechanical procedure:
   a. The breaker shall be closed and tripped several times to check for smooth operation.

   b. The cubicle shall be vacuumed and the draw-out mechanism alignment shall be checked and lubricated. *

   c. The cubicle interlock shall be checked for proper operation. *

   d. The breaker shall be cleaned and inspected for cracked or broken fingers, springs, or retainers. *

   e. Arc chutes shall be removed, blown out, and inspected for signs of heating, cracks, or broken parts. *

   f. Main and arcing contacts shall be inspected for wear. *

   g. Main and arcing contacts shall be checked against the manufacturer's tolerance for wipe, closing sequence, open gap, and alignment.

   h. Controlled wiring shall be inspected and connections shall be checked for tightness.

2. Electrical tests:
   a. Minimum pickup current shall be determined, according to the manufacturer's specifications.

   b. The long-time delay shall be measured at 300% of the trip coil rating.

   c. Short-time pickup and delay shall be measured at settings, according to the manufacturer's specifications.

   d. Instantaneous pickup must be measured.

   e. Ground fault pickup and delay shall be measured at settings. *

   f. A millivolt drop test shall be conducted at the rated coil current as a measure of the contact resistance, or the contact resistance shall be measured with a low resistance ohmmeter.

   g. Breaker insulation resistance shall be measured with a 1000 Volt DC megaohmmeter.
      (1) Phase to phase - Breaker closed
      (2) Phase to ground - Breaker closed
      (3) Across contacts - Breaker open

* where applicable

GENERATOR OUTPUT BREAKER TESTING
(continued)

APPROVED CONTRACTORS FOR SWITCHGEAR TESTING:

Brar Electrical Systems Inc.
2181 Surveyor Circle
Huntington Beach, Ca. 92646
Contact person, Harry Brar - 714-536-6575

Electro Test Inc.
5370 E. Hunter Avenue
Anaheim, Ca. 92807
Contact person, Mike Bartlett - 714-779-8900

Electrical Testing and Control
2208 Sierra Meadows Dr.,
Rocklin, Ca 95677
Contact person, Bob Fisher – 916-630-1654

Power Systems Testing Co.
2267 Claremont Court P.O. Box 6005
Hayward, Ca. 94540
Contact person, Bill Kelly – 510-783-5096

Cornelius-Sing Consulting Group –AET
918 W. Main St.
Visalia, Ca 93291
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SBC LEC

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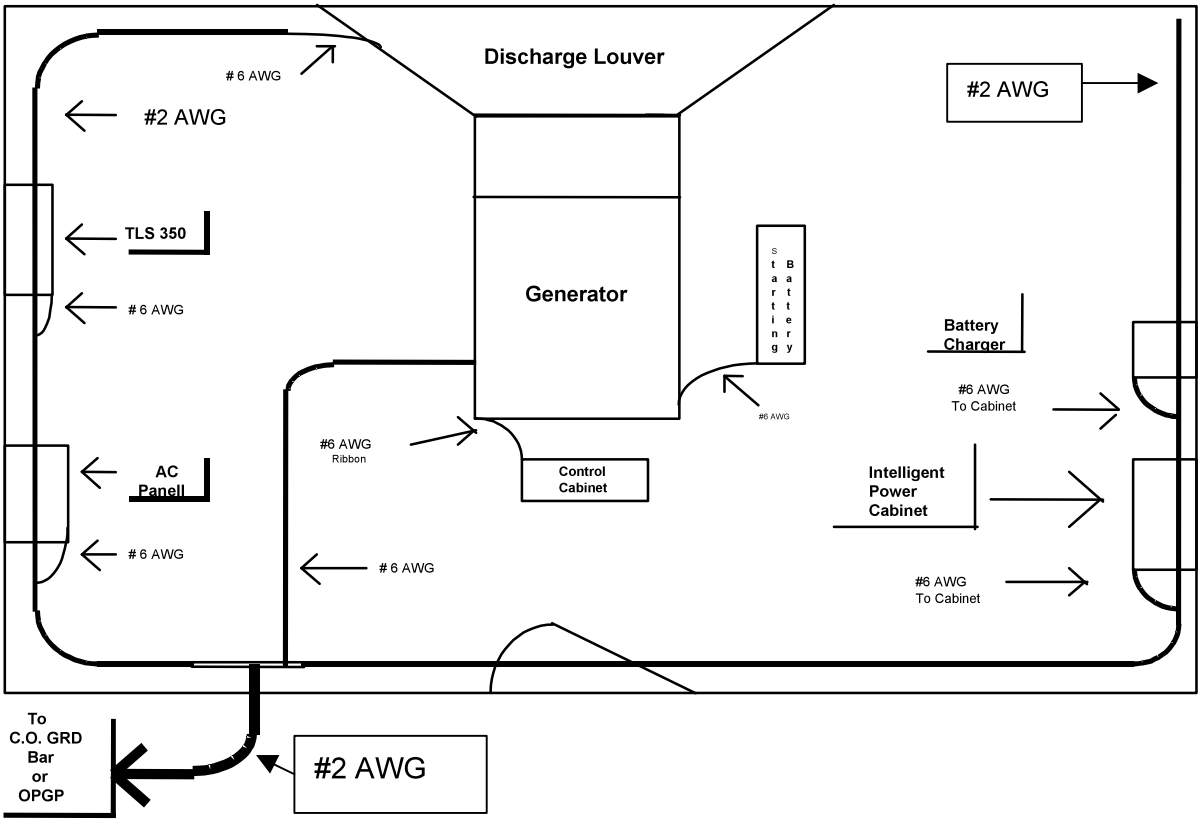
ATTACHMENT 4

Typical Engine Room
Grounding and Bonding

Top View



Notes:

1. All connections shall be two hole crimp type, mounted to a clean and treated surface.
2. There shall be NO SHARP TURNS

ATTACHMENT 5

SPECIFICATION FOR
WALK-IN MODULE ENGINE ALTERNATOR SETS

SUMMARY OF KEY INFORMATION

1. GENERAL

This specification describes the engineering requirements for a skid-mounted, enclosed, generator set to be used in standby applications. The requirements of this specification shall take precedence in case of conflict with the listed standards. Deviations from this specification shall be clearly stated in the bid proposal or during the bid walk.

2. ENCLOSURE

2.1 ENCLOSURE DESIGN

The engine alternator set shall be housed in a weatherproof self-contained dust-tight outdoor enclosure, which will provide sufficient filtered air for proper engine and generator operation. The enclosure shall have a sufficiently pitched roof so that standing water will not accumulate and snow pack will not occur. The enclosure shall be acoustically treated to contain engine alternator set noise to a maximum of 75 (seventy-five) dba two feet from the periphery of the unit at 0 to 5 feet above ground level. Fiber flaps will be provided on air intake and exhaust to stop air flow during non-operation. If the enclosure is equipped with a fuel tank, a step will be provided to aid in access to unit (and OSHA requirements). The enclosure shall be equipped with a thermostatically controlled room exhaust fan. The overall size and arrangement of enclosure shall be suitable for installation on a concrete slab. HILTI HSLB anchors shall be used to anchor base of walk in hut to concrete foundation. Clearance from the engine base to the enclosure shall be two feet minimum for walking space. All enclosure joints and seams shall be primed and treated during assembly to prevent rust and streaks. Enclosed within the weatherproof outdoor enclosure shall be:

a) a double walled or contained tank equipped with a lockable cap on fuel fill pipe, a fuel leak detector, and a fuel fill alarm set at 3/4 fill capacity.
b) a 48 volt emergency light (power feed provided by Telco in tap box).
c) AC. lighting, switched inside door entry.

THE LATCH ON THE DOOR WILL ACCOMMODATE A STANDARD “BEST” PADLOCK.

2.1.1 ENCLOSURE ELECTRICAL REQUIREMENTS

The enclosure shall be arranged to accept conduit runs from the top or either side of the unit. External conduit runs should be of a flexible, weatherproof type. A duplex outlet for a 20 amp, 115 volt, 3 wire AC circuit with ground fault circuit interrupter protection, shall be provided within the enclosure. All electrical cabling shall be ran in a safe manner (not in working or walking areas). The enclosure must adhere to all NEC requirements.

2.1.2 ENCLOSURE REQUIREMENTS FOR START BATTERY(S)

The batteries, battery stand and charger shall be mounted within the enclosure. The enclosure shall be designed so that standard battery maintenance (e.g. specific gravity, voltage readings, liquid addition and battery removal) can be performed without disassembly. Start batteries shall be mounted with a tray underneath so as to prevent spillage.

2.1.3 ENCLOSURE FUEL REQUIREMENTS

All fuel lines shall be ran in a safe manner (not in working or walking area). A 4" standpipe will be installed to allow the use of "TLS" Fuel Monitoring Probe. The overall height of the standpipe will accommodate a four foot probe.

2.1.4 ENCLOSURE ALARM REQUIREMENTS

Provide and connect door open alarm, along with all other standard alarms, to the engine controller for remote monitoring.

1. SPECIFICATION FOR LOW NOISE (REMOTE) RADIATOR SYSTEM.

- The fan will be a low speed type, core to be sized accordingly.
- The AC motor load will not diminish load carrying capacity of the motor generator system.
- Allowable noise level will be 65 dba five feet from radiator (per manufactures specifications). Noise measurement will be made on discharge side of radiator, at SBC LEC site.
- An expansion tank, equipped with sight glass, will be provided.
- A permanently attached ladder will be provided, to service radiator.

APPENDICES

APPENDICES 1
(Supersedes Section 3.5.2)

INTERMENTS

Instruments and engine monitoring gauges (e.g. Telcor or =) shall be a minimum of 3 ½ inches, shall be marked in conveniently scaled divisions (i.e. 1, 5, or 10 increments) and shall be located on the control cabinet door and shall include (but are not limited to):

- **AC voltmeter** (2% accuracy or better), permanently labeled for normal.
- **AC ammeter** (2% accuracy or better), permanently labeled for maximum.
- **Frequency meter** (2% total system accuracy or better), permanently labeled “60 Hz”
- **kW meter** (2% accuracy or better), permanently labeled for maximum.

All above meter markings shall be permanently marked on calibrated meter card. If digital meter is provided, permanent labels will be affixed to show maximum. However, analog meters are preferred.

- **Running time hour meter.** (Analog preferred)
- **Lubricating oil pressure gauge,** labeled for minimum. (Analog preferred)
- **Coolant temperature gauge,** labeled for maximum. (Analog preferred)
- **DC ammeter,** for engines equipped with start battery alternator. (Analog preferred)
- **Power factor meter,** on all sets rated over 200 kW. (Analog or digital)
- **Fuel pressure gauges,** located on the pressure side of the system. (Analog preferred)