STANDARD SPECIFICATION AND

PERFORMANCE REQUIREMENTS

FOR

ENGINE/ALTERNATOR SETS

SNET

Ameritech

Southwestern Bell

PACIFIC BELL

NEVADA BELL

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1. INTRODUCTION

The intent of this document is to cover all requirements on the engineering, provisioning, delivery, installation and performance criteria of a new or re-located automatic start Engine/Alternator set. This document is written to work in conjunction with the "Engine/Alternator Set Job Package". These documents are presently formally referred to as:

- BSP 790-100-658MP: "Standard Specification And Performance Requirements For Engine/Alternator Sets" – This document holds all minimum standards requirements for Engine/Alternator Set deployment within all 13 state within the SBC Communications regions.

- BSP 790-100-658JP: "SBC Communication Engine/Alternator Set Job Package" – This package holds all data sheets, test logs and acceptance forms required to properly deploy, monitor, and record the job specific requirements and test results of any new or augmentation Engine/Alternator project. This document is a compliment to BSP 790-100-658MP.

SBC personnel may presently find both documents on the Common Systems web site (http://home.sbc.com/commonsystems/). To locate the documents select tab 6, "Engineering, Installation, 'NEBS' and other documents", then select 'BSP's'.

NO DEVIATIONS WILL BE MADE FROM BSP 790-100-658MP WITHOUT THE WRITTEN APPROVAL OF THE SBC LEC POWER EQUIPMENT ENGINEER BEING RECORDED WITHIN BSP 790-100-658JP.

1.1 ENGINE/ALTERNATOR JOB PACKAGE OUTLINE OF CONTENTS

The SBC LEC Power Equipment Engineer shall work with the appropriate Power Maintenance/Operations Engineer, CRE (Corporate Real Estate), and the contracted design and construction team to complete the necessary information. All information entered into the Engine/Alternator Data Sheet shall be reviewed and approved by the SBC LEC Power Equipment Engineer to be considered a valid specification requirement. This package will require augments/additions to the data sheet as the project develops and information is obtained. It is the responsibility of the Engine/Alternator vendor to verify that the SBC LEC Power Equipment Engineer has approved each revision with a date and signature to authorize the required budget dollars associated.

- Engine/Alternator Data Sheet: This Data sheet includes all specific performance and design requirements for the engine/alternator set.
- Shop Test Procedures and CheckList: Recommended Tests and documentation for the Shop testing.
- On-site Test Procedures and CheckList: Recommended Tests and documentation for On-site testing.
- Formulas: Technical information appropriate for Engine/Alternator sets.

1.2 TEST DATA

Factory certified test data shall be submitted with the bid package including horsepower curves, alternator ratings, voltage dip and recovery, motor starting curves and engine injector pump manufacturer.

1.3 WARRANTY

All major components of the Engine/Alternator set and its associated equipment including switchgear, control systems components, paralleling gear, transfer switch(s), tank(s), and tank monitoring systems furnished shall be guaranteed against defective design, materials and workmanship for a minimum of two years unless otherwise specified within the Job Package. All warranties shall be active as of the date of the system operational acceptance by the SBC LEC representative. The Manufacturer shall provide all warranty parts at its expense F.O.B. job site freight included. The Manufacturer shall also be responsible for its labor cost and associated travel and subsistence expenses for work under warranty.

1.3.1 Parts and Service

All field replaceable parts within the completed unit shall be deliverable to the site within 24 hours of the request. An on-site qualified technician shall be available 24 hours a day, 7 days a week and be able to be dispatched and in route within 4 hours of notification by SBC representative.

1.3.2 Quality Standards

All materials and parts comprising the complete Engine/Alternator System shall be new and unused, of current manufacture, and of the highest grade, free from defects and imperfections. The purchased package shall comply with all applicable Society of Automotive Engineers (SAE) and Electrical Generating Systems Association (EGSA) 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.

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 and leveling devices. The alternator shaft shall be designed for site disassembly at the engine crankshaft joint.

1.3.3 Packing, Crating, and Shipping

The manufacturer shall ensure that all equipment is palletized and covered with waterproof material for shipping. The switchgear shall be capable of being handled individually with removable lifting eyes and/or rollers if needed. Each section shall also have clearly labeled instruction.

2. GENERAL REQUIREMENTS

The Engine/Alternator set shall conform to the requirements of NFPA 37, “Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines”, NFPA 30, “Flammable and Combustible Liquids Code”, and NFPA 70, and NEC (The National Electrical Code). Also all applicable SBC Technical Publications including the TP 76300MP “Installation Requirements”, the TP 76400MP “Engineering Guidelines”, and the TP76900 “Installation Testing Requirements” shall be followed.

2.1 EXHAUST EMISSION REQUIREMENTS

The completed and installed Engine/Alternator set shall be in compliance with all applicable Air Pollution Control Laws, including any and all Federal, State and Local laws, ordinances, guidelines and practices. Where subject to more than one emission law or standard, the more stringent law or standard shall apply.

All equipment provided shall meet EPA certification requirements, as well as meet all applicable federal, state and local air quality standards.

The Engine/Alternator vendor shall be responsible for obtaining and paying for all necessary permits and licenses for construction, installation and operation. These shall include those required by any local Air Quality Management District or commission. The permits and licenses shall cover the entire period of construction extending to acceptance and turn-up as well as the initial operational permits. The SBC LEC Power Equipment Engineer shall stipulated clearly within the Engine/Alternator Job Package any variations to this requirement if necessary and indicate what parties then hold that responsibility.

2.2 SEISMIC REQUIREMENTS

The Engine/Alternator set shall be completely mounted on a sub-base for installation onto a concrete pad or floor. The securing system shall be designed according to the appropriate seismic requirements for the Zone rating stipulated within the Engine/Alternator Job Package. Telcordia Technologies Generic Requirement GR-63 CORE, and “Network Equipment-Building System (NEBS) Requirements: Physical Protection” shall be followed.

2.3 OUTPUT VOLTAGE

The Engine/Alternator set shall provide output voltages within the Range A limits specified by ANSI C84.1-1995, “Electrical Power Systems and Equipment - Voltage Ratings (60 Hz)” and provide one of the preferred system voltages per Table 1 of that ANSI document.

2.4 WIRING

The wiring used within the Engine/Alternator set shall be certified by its manufacturer to meet one of the following standards:

- IEEE Standard 383
- Underwriters Laboratories (UL) Standard 1581
- 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 unless the ends are masked and identifying markings are protected.

2.5 BUILDING INTERFACES

The Engine/Alternator set installation shall comply with all relevant spatial and environmental requirements stipulated within the UBC (Uniform Building Code), BOCA (The Building Officials & Code Administrators Building Code), and all applicable local and state building codes.

The Engine/Alternator set critical building interface systems (intake dampers, fuel transfer pumps, etc.) shall be under the exclusive control of the Engine/Alternator set and not be controlled by any building environmental control system.

2.6 VIBRATION

2.6.1 TORSIONAL VIBRATION ANALYSIS

The complete Engine/Alternator set shaft system shall be designed for torsional loads the unit may experience during normal continuous operation, as well as transient and short circuit conditions. The torsional vibration analysis shall include reactions from 1st to 4th orders. The Engine/Alternator set 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 Equipment Engineer.

2.6.2 ENGINE/ALTERNATOR SET VIBRATION

Engine/alternator set vibration transmitted to the building structure shall be limited to 3 mils at 10 feet from the set, running at 100% load. Vibration isolators (spring type, e.g. CalDyn or equal) shall not permit any additional lateral motion, lifting, sliding or tipping. The Engine/Alternator set supplier shall furnish any hardware required for seismic compliance (i.e., angle/snubber brackets as required in for particular earthquake zones). Natural rubber or other materials susceptible to diesel fuel and/or oil deterioration shall not be used as isolation material.

All engine/alternator set-mounted control accessories shall be supported as to prevent degradation or failure due to the effects of engine vibration. Mechanical components shall be supported with brackets designed to withstand any residual vibration of the engine/alternator set.

2.7 CONNECTIONS

All wire and cable connections, #10 AWG and larger, shall be made using compression type copper connectors manufactured by T & B (Thomas & Betts) or Burndy. The finished crimp shall be circumferential and shall meet the SBC LEC requirements. 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. Any wrap used over the connection shall be clear or transparent and not obstruct viewing of the required embossment.

2.8 ACOUSTIC REQUIREMENTS

The completed Engine/Alternator set shall meet all applicable State, County and Local sound level requirements as well as any special requirements outlined in the Engine/Alternator Job Package.

2.9 100 % BLOCK LOAD TESTING

When the full rated kW load is applied in one step, the unit shall recover to and remain at steady state of nominal voltage and frequency within 10 seconds. When the full rated kW load is rejected in one step, the unit shall not overspeed and shutdown.

2.10 ENGINE/ALTERNATOR SET RATINGS

An Engine/Alternators set may be rated in one of three classes Standby, Continuous or Prime. The SBC LEC Power Equipment Engineer shall specify the rating of the Engine/Alternator set within the Job Package. Either standby or prime rated sets may be stipulated based upon site-specific requirements. However, it is recommended that Stand-by sets be deployed unless specific circumstances warrant the deployment of a higher performance set. The ratings are defined within BSP790-100-652MP.

2.11 FUEL SYSTEM

Any part of the fuel system that is added or augmented as part of the Engine/Alternator project shall be engineered and installed to meet all local, state, federal and SBC standards. The fuel system may include the deployment of a day tank, fuel transfer pumps, containment, alarming and a number of other job specific requirements. All tanks deployed shall be UL- listed. All job specific information on fuel tank sizing, location, required fuel level and environmental concerns shall be outlined within in detail within the Engine/Alternator Job Package.

2.12 TRAINING

The EF&I vendor shall ensure that formal training is available for all major components included in the engine/alternator package. Training shall be available to SBC LEC personnel covering operation and maintenance.

On-site operation orientation shall be provided as part of the engine/alternator installation. This training shall include system operating and routine maintenance procedures, as well as any special systems training associated with the specific installation.

2.13 REQUIRED DOCUMENTATION

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

- General Description: Including arrangement of the Engine/Alternator set, interfaces with support systems, and features.
- Equipment Description: For the exact equipment being installed, including a detailed description of each major component or subsystem, its functions, features, specifications with all serial and model numbers, sequence of operation and all engineering and interface information.
- Flow Chart: A clearly labeled trouble indication flow chart
- Maintenance Requirements: Manufacturer's recommended routine maintenance requirements and their intervals.
- Manuals: Detailed Shop Manuals covering all major components.

The vendors shall provide three sets of site specific system documents covering the following:

- Electrical Drawings: All electrical drawings including AC and DC schematics for both the Engine/Alternator Set and the building systems being altered, wiring diagrams, interface diagrams, parts list of components of the control panel, power interfaces, controls, safety shutdowns, alarm interfaces and support system interfaces.
- Circuit Descriptions: Information showing the purposes, functions, methods of operation, and maintenance of the unit and all associated systems.

- Wiring Diagrams: Diagrams showing the physical wiring layout of all circuits and equipment, covering all stenciling and wire colors of the unit and all associated systems
- Equipment Drawings: Drawing depicting the layout and assembly of all major mechanical components. All drawings, written designation, and nameplates shall match exactly their physical equivalent.

Other documentation to be provided shall include:

- MSDS (Material Safety Data Sheets) shall be provided for all hazardous and potentially hazardous materials.
- A list of alarm and shutdown threshold points.
- A manufacturer's parts list
- Equipment design specifications providing engineering, ordering, and installation information for each major equipment unit making up the set and all associated systems.
- Altitude alternator de-rating data
- Certification of conformance with UBC seismic requirements when required

An Engine/Alternator project installation shall not be considered complete until the appropriate SBC LEC representative receives all of the required documentation. The required documentation must be received prior to the final acceptance testing.

2.14 SPARE PARTS

All of the following spare parts shall be provided 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 fuse used in set
- At least one of each type of lamp and/or LEDs used in set
- At lease one of each type of plug-in relays used in the set
- At least one set of spare circuit packs (if applicable)

3. DESIGN AND PERFORMANCE REQUIREMENTS

All design and performance requirements stipulated within this document shall be met as a minimum. The SBC Power Equipment Engineer shall stipulate within the Engine/Alternator Job Package any required variations, upgrades, or customizations for authorization.

3.1 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 PMG (permanent magnet generator) sized using a minimum Class H standard. The pitch shall be that which is standard for the Engine/Alternator set being deployed unless a custom pitch is stipulated by the SBC LEC Power Equipment Engineer within the Engine/Alternator Job Package.

3.1.1 Harmonics

Open Circuit Harmonics: The 'line-to-line' open circuit low frequency modulation shall not exceed 0.5 Volts 'peak-to-peak' in the frequency range of 5 Hz to 30 Hz. The total open circuit harmonic content of any 'line-to-line' or 'line-to-neutral' voltage shall not exceed 5% and no single harmonic shall exceed 3%.

Connected Load Harmonics: The THD (Total Harmonic Distortion) of the reflected current wave shall not exceed 5%.

3.1.2 Telephone Influence Factor

The balanced TIF (Telephone Influence Factor), based upon the 1960-weighting factor, shall not exceed 50.

3.1.3 Insulation

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

3.1.4 Altitude and Temperature Ratings

The alternator shall be capable of continuously delivering its rated output under the following criteria:

- At any power factor from 1.0 to 0.8 lagging
- At ±5% of rated voltage at 60 Hz
- At ambient temperatures from -20°F to 120°F
- At elevations up to 1500 feet above sea level

De-rating data shall be submitted for application when at higher elevations. When de-rating is required it shall be clearly stipulated within the Engine/Alternator Job Package.

3.1.5 Overload Capability

Alternators shall be capable of carrying overloads of 110% of stand-by-rated capacity, for not more than 10 minutes, without damage. The alternator, exciter, and regulator combination shall be capable of withstanding an application of any 2-second short circuit. Those short circuits, 3 phase, 'line to line', and 'line to neutral' shall not cause damage when applied to the alternator's terminals during operation at rated load, power factor, frequency and voltage. The alternator shall be capable of sustaining 300% 'line to line' or 'line to neutral' short circuit current for up to 5 seconds for fault clearing and activation of over current protection devices.

3.1.6 Balance

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

3.1.7 Bearings

All bearings shall be self-aligning, pre-lubricated, and sealed anti-friction type.

3.1.8 Deviation Factor

The deviation factor of the alternator open-circuit terminal voltage shall be below 6%.

3.1.9 Lead Termination

Three phase alternators of 1000kW and smaller with voltages under 600 V shall be 12-wire re-connectable type. Means shall be provided to prevent connectors from turning at termination points.

3.2 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 150% of rating for up to 5 minutes without damage. The voltage regulator shall automatically control exciter field current.

3.3 VOLTAGE REGULATOR REQUIREMENTS

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 phases, and shall allow the voltage to be adjusted ±20% of its nominal value.

3.3.1 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 (16.7°C) change in temperature of the engine/alternator's surroundings

The voltage regulator shall hold the alternator terminal voltage to $\leq$ 2% voltage change, over an ambient temperature range from -20°F to +120°F, with a speed change $\leq$ 5%.

3.3.2 Load Changes

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 5 seconds, when the full rated kW load at a .8 power factor is applied or rejected in one step.

3.4 OUTPUT CIRCUIT BREAKERS

The Engine/Alternator set shall be provided with an AC output circuit breaker that is equipped with an adjustable magnetic/instantaneous trip, thermal/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 accommodate the total rated load of the set plus 10%, at 0.8 power factor and shall be designated 'ACB' (Alternator Circuit Breaker). The Alternator main

breaker shall be tested according to the process found in the Engine/Alternator Job Package. It is recommended that adjustable trip control breakers be deployed.

3.5 CIRCUIT BREAKER ENCLOSURES

All circuit breaker enclosures shall be NEMA 1 specification. The enclosure shall be sized to accommodate the NEC required bending radius and fill. All enclosures shall include a ground bar, and an insulated neutral bar in four wire configurations. The Engine/Alternator sets busbar-to-breaker line-side cabling and duct should be provided and installed by the Engine/Alternator set vendor.

3.6 GROUNDING

Within all conduits or raceways that contain phase leads, to or from the alternator, an equipment-grounding conductor shall be provided and sized per Article 250 of the NEC. When 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 termination of phase conductors. Termination shall be made directly to a non-insulated ACEG bus bar.

To provide ground continuity between the entire set and the equipment-grounding conductors, the alternator cabinet shall be electrically connected to the set frame in one of the following manners:

- By attachment hardware
- By a bonding strap of cross-sectional area equal to that of the grounding conductor specified

The set mounted control cabinet, meter cabinet/panel, and Engine/Alternator set shall be bonded to the Engine/Alternator metallic sub-base and/or skid. When present a factory installed bond is sufficient. Such bonds shall be made with conductors designed to withstand Engine/Alternator set vibrations.

When present, fuel day tanks, Engine/Alternator set base/skid, start battery racks, and battery chargers shall be bonded to the Central Office Ground system with stranded copper grounding conductors per requirements in BSP 802-001-180MP.

3.7 CONTROL AND INDICATOR PANEL

3.7.1 Control Panel Enclosure

If the Engine/Alternator set control panel is set-mounted it shall utilize anti-shock vibration mountings. All controls, instruments, alarms and indicator lamps shall be mounted on a single panel. Each control panel shall be mounted at eye-level and be installed in such a way as to allow access for maintenance of all components of the Engine/Alternator set.

There shall be adequate lighting provided by DC lamps located both inside and outside the control panel. These lights shall be fed by the start battery system, and separately fused from the DC control circuit.

3.7.2 Controls

The control system for the Engine/Alternator set may be relay logic, solid state or microprocessor controlled as specified within the Engine/Alternator Job Package. Microprocessor controllers shall be of the same manufacturer as the Engine/Alternator set, unless otherwise stipulated by the SBC LEC Power Equipment Engineer within the Engine/Alternator Job Package.

The following controls/indicators shall be located on the control cabinet. When touch screen technologies are being deployed some of the control/indicators may be touch screen icons when approval of the substitution is stipulated within the Engine/Alternator Job Package.

- Operation Selector Switch (OSS) will be equipped with AUTO, MANUAL, and OFF positions. All Alarms and Shutdowns shall remain operative in MANUAL-RUN mode.
- Reset Switch may be either a separate push button or a function of the OSS.
- Start Push Button (optional)
- Emergency Stop option shall shutdown the Engine/Alternator set, shunt-trip the output circuit breaker, and lock out the starting circuit. The button shall be red, non-locking. A major audible alarm shall sound and panel mounted indicator alarm lamp shall light upon operation of the emergency stop option. This requirement may be met with an Allen-Bradley, non-locking push button or equivalent. This system shall be active only when the Engine/Alternator set is running. The vendor shall also be responsible for providing and installing remote emergency stop buttons, at all locations designated within the Engine/Alternator Job Package. Remote emergency stop buttons shall meet the same requirements and mirror the operation of the panel-mounted emergency stop button.
- Frequency Raise-Lower Control, A 10-turn locking type rheostat or a raise/lower switch shall control frequency remotely with a minimum 5% adjustment range.
- Voltage Raise –Lower Control, A 10-turn locking type rheostat or a raise/lower switch shall control voltage remotely with a minimum 5% voltage adjustment range.
- Alarm Lamp Test , push button or push-to-test lamps
- Voltmeter Selector, for 3 voltage readings ‘phase-to-phase’ and/or 3 voltage readings ‘phase-to-neutral’, for 3 phase sets. An OFF position is permitted but not required.
- Ammeter Selector, for phase current readings. An OFF position is permitted but not required.
- No External Controls shall by-pass the safety shutdowns.

The following control/indicators shall be provided when required by the SBC LEC Equipment Engineer within the Job Package:

- Emergency Service Switch: Function where the Engine/Alternator set safeties can be manually by-passed for the sets to be manually operated under

emergency conditions. The Emergency Service Switch when installed shall comply with the following criteria:

- Clearly labeled as "DANGER – OPERATION OF THIS SWITCH WILL BY-PASS ALL SAFTIES AND SHUTDOWNS ON THIS ENGINE"
- Be red
- Operate only while in manual run mode

- Block Heater Control Switch: A switch that will disable the block heaters and circulating pumps.

3.7.3 METERS REQUIEMENTS

All analog meters shall have the following features:

- A minimum size of 3 ½" dial
- Meter card / scale markings shall be appropriate to the application and full load at 75% of scale.
- Flush-mounted
- 2% accuracy or better

All digital meters shall have the following features:

- Flush-mounted
- 2 % accuracy or better
- The number of digits appropriate to the application

The following meters shall be provided:

- Voltmeter (reading alternator voltage)
- Ammeter
- Frequency meter
- Watt-meter
- Hour-meter

The following meters may be required as designated within the Engine/Alternator Job Package:

- Power factor
- Tachometer
- Watt/Hour meter
- Engine exhaust pyrometer

3.7.4 GAUGES

The following gauges shall be provided

- Engine Oil Pressure
- Water temperature

The following gauges may be required as designated within the Engine/Alternator Job Package:

- Fuel pressure

- Fuel temperature
- Inter-cooler temperature
- Engine Oil temperature
- Differential oil pressure
- Charge battery voltage
- Charge battery amperage

3.8 ALARMS AND STATUS INDICATORS

Colored lamps or LEDs shall provide visual alarms and status indications. One distinctive lamp/LED shall be provided for each alarm condition and located on the control cabinet door. An audible alarm that sounds during major or minor alarm conditions shall also be located in the control cabinet. Each panel shall have a lamp test function capability. All alarms and status indicators shall appear on a barrier screw type terminal strip, located within the control cabinet. The SBC LEC Power Equipment Engineer shall specify either a remote annunciator/control panel or an interface panel within the Job Package.

The recommended minimum set of alarms to be extended is the following.

- COMMERCIAL POWER FAIL
- ENGINE FAIL
- START/CONTROL BATTERY SYSTEM FAIL
- LOW COOLANT TEMPERATURE
- HIGH COOLANT TEMPERATURE
- ENGINE RUN
- PROPER OPERATION
- SWITCH NOT IN AUTO
- LOW FUEL
- FUEL LEAK
- LOW FUEL PRESSURE

The SBC LEC Power Equipment Engineer shall specify all job specific alarm requirements within the Job Package. Any alarms that are not duplicated by other required and included alarm systems shall be extended to the proper monitoring group. A common fuel system alarm is permissible if the tank monitoring system is equipped with this provision, and such that the cause of the alarm (low fuel, high fuel, leak, water in tank, liquid in sump, etc.) is indicated at the monitoring system console or panel.

All alarm circuits shall be cabled to the distribution frame termination block. Per SBC Alarm Standards, certain alarm conditions will be transmitted to the surveillance center (i.e.; Network Operation Center (NOC), Switching Technology Center (STC), etc.). These discrete conditions are further defined in the Alarm Standards document BSP 801-601-900MP.

3.8.1 Major Alarm Conditions

Low Oil Pressure: Occurs when the oil pressure falls below the minimum value recommended by the Engine/Alternator set manufacturer.

Over-Crank: Occurs when the Engine/Alternator set fails to start after a single start-cycle, consisting of a minimum of 3 start attempts. This alarm must operate upon the unsuccessful completion of the final start attempt.

Over-Speed: Occurs when the Engine/Alternator set speed exceeds 115% of the normal operating speed.

Over-Voltage: Occurs when the alternator voltage exceeds the nominal operating voltage by 15%. An adjustable time delay shall be incorporated to allow compliance with transient surge voltage criterion.

Under-Speed: Occurs when the engine speed drops below 90% of the normal operating speed. An adjustable time delay shall be incorporated.

ACB Trip: Occurs when the ACB (alternator circuit breaker) trips as a result of over-current or shunt trip.

ACB Open: Occurs when the ACB (alternator circuit breaker) is manually placed in the open position.

Under-Voltage: Occurs when the alternator voltage is below the nominal operating voltage by 15%. An adjustable time delay shall be incorporated to allow compliance with transient voltage criterion.

High Coolant Temperature: Occurs when the temperature of the coolant, measured immediately before and on the engine side of the thermostat, rises to a temperature exceeding the Engine/Alternator set manufacturer's limits.

Low Water Level: Occurs when the coolant level within the system falls below the manufacturers' minimum level.

Engine Control Panel Power Fail Alarm: Occurs when a fuse or breaker operation results in the loss of power to the control panel.

Emergency Stop: Occurs when the emergency stop button has been activated. This circuit shall be effective only when the Engine/Alternator set is running to prevent accidental tripping.

Engine Fail: Occurs when any major Engine/Alternator set malfunction is present resulting in a shutdown.

Remote Fan Fail: Occurs when a remote radiator fan unit becomes inoperative.

Switch Not In Auto: Occurs when the Engine/Alternator set or the remote radiator is not in the automatic mode.

Tank Leak: Occurs when a leak is detected in a base or day fuel tank.

Alternator Over-Temp: Occurs when an over-temp condition is present in the alternator windings.

3.8.2 Minor Alarm Conditions

Low Engine Temperature /Engine Heater Fail: Occurs when a heating element fails or the coolant temperature drops to a level that may impair Engine/Alternator starting reliability.

Engine Run: Occurs when the Engine/Alternator set is running.

Charger Fail: Occurs when then start battery charger fails.

High/Low Fuel Day Tank: Occurs when the fuel levels are outside the predetermined thresholds.

High/Low Battery Voltage: Occurs when the start battery voltage has deviated from adjusted values.

Low Fuel Main Tank: Occurs when the fuel level in the Engine/Alternator sets main tank falls below the required limits.

Open Door: Occurs when the access door associated with an outside Engine/Alternator enclosure is open.

Pre-High Temp: Occurs as a warning that coolant is approaching shutdown temperature.

Pre-Low Oil Pressure: Occurs as a warning that oil pressure is approaching shutdown level.

3.8.3 Status Indicators and Push-Button Switches

Proper Operation Indication: An indication lamp shall be provided on the panel to 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 ACB and the engine run relay, shall confirm that all breakers, in the automatic mode, have transferred to the stand-by Engine/Alternator bus. This operation shall not create an audible alarm.

Engine Running Indication: For all remote control/monitoring panels, an indication lamp shall be provided on the panel to indicating when the Engine/Alternator set is running. This operation shall not create an audible alarm.

Lamp / LED Test Switch: A push-button shall be provided to test all lamps and LEDs on each control panel. This test shall not cause the Engine/Alternator set to shutdown.

Audible Alarm Silence: A push-button shall be provided on the panel to silence the audible alarm, and shall auto-reset.

3.8.4 Annunciator Panel Requirements

Alarm Annunciator Panel: An alarm annunciator panel shall be provided. The SBC LEC Power Equipment Engineer shall determine the location of the panel(s). The panel(s) shall meet the following requirements:

- Be in a NEMA 1 rated cabinet
- Equipped with indicator lamp/LEDs for remotely monitored alarms and major/minor audible alarms
- Equipped with a lamp/LED test switch and an alarm test feature
- Be totally self-contained, relying on no external voltage supply other than that supplied by the Engine/Alternator set.
- Equipped with a barrier terminal strip that is located in an easily accessible location within the annunciator panel and terminated with all alarm leads identified.
- Contain only closed loop type alarm signals
- Contain an audible alarm
- Contain an Alarm Cut-Off (ACO) switch
- Contain a labeled “EMERGENCY STOP” button

Alarm Interface Panel: The alarm interface is the location where all Engine/Alternator set alarms are configured and extended for remote surveillance. The SBC LEC Power Equipment Engineer shall specify when and where an external alarm interface panel is required. When required, all alarms shall appear and be properly identified on a terminal strip in a NEMA 1 rated cabinet.

3.6.5 Alarm and Status Indicator Matrix

ALARM	POA MJ/MN/CR	LAMP	ACTION
Commercial Power Fail	CR	Data Sheet	N/A
Engine Fail	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Start/Control Battery System Fail	MJ	Yellow	N/A
Low Coolant Temperature	MN	Yellow	N/A
Engine Run	MN	Green	N/A
Proper Operation	MN	Green	N/A
Switch Off Auto	MJ	Red	N/A
Fuel Leak	MJ/CR	N/A	N/A
Low Oil Pressure	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Over-crank	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Over-speed	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Over-voltage	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Under-speed	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
ACB Trip	MJ	Red	N/A
ACB Open	MJ	Red	N/A
Under-voltage	MJ	Red	N/A
High Coolant Temperature	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Low Water Level	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Engine Control Panel Power Fail Alarm	MJ	Red	N/A
Emergency Stop	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Engine Fail	MJ	Red	Engine Shut Down/ Trip Breaker/ Lock Out
Remote Fan Fail	MJ	Red	N/A
Tank Leak (Main or Day Tank)	MJ	Red	N/A
Alternator Over-Temp	MJ	Red	N/A
Low Engine Temp / Engine Heater Fail	MN	Yellow	N/A
Charger Fail	MN	Yes	N/A
High/Low Fuel Day Tank	MN	Yes	N/A
High/Low Battery Volt	MN	Yes	N/A
Low Fuel Main Tank	MN	Yes	N/A
Open Door	MN	No	N/A
Pre-High Temp	MN	Yes	N/A
Pre-Low Oil Pressure	MN	Yes	N/A
Day Tank monitoring System Trouble Alarm	MN	No	N/A

3.9 MECHANICAL AND PERFORMANCE CRITERIA

3.9.1 Governor & EFI (Electronically Controlled Fuel Injection) Specification

All governors deployed shall meet the following criteria, and the EFI system shall also meet all performance criteria.

- Have an externally adjustable droop control, adjustable from isochronous to at least 5% droop
- Have minimum frequency adjustability at the control panel of 57 Hz to 63 Hz.
- Have steady-state regulation that at any constant load (from no load to full load), the maximum frequency ripple for the AC output shall be ±0.15 Hz for any frequency between 59 Hz and 63 Hz while maintaining stable governor temperature.
- Any 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 the alternator output frequency with load shall be within 0.25% of true linear response. The governor shall be set for any droop between 0% and 4%.
- Be able to ramp start

Transient Response

The response of the Engine/Alternator set to sudden changes in load shall meet the following performance criteria:

- For any sudden ¼ 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 seconds and the frequency shall depart from the steady state value by no more than 3 Hz.
- For any full load change on sets 750 kW and below (no load to full load and 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 750 kW must meet the above criterion at 750 kW or 50% of rated kW, whichever is greater.
- For all of the above, the frequency shall stabilize at the steady state value with no un-dampened oscillation.

3.9.2 FUEL SYSTEM

Priming Pump

A manually operated, wobble type, permanently mounted priming pump shall be incorporated in the on-set fuel system. This priming pump shall be capable of pulling fuel from the main tank or day tank, when present, with all fuel lines and the on-set fuel system drained. The priming pump shall be sized appropriately to lift at least 18 feet of D2 fuel. This priming pump shall not be plumbed in line, but shall be switchable into the system with ball type valves.

High Lift Fuel Pump

An Engine/Alternator driven high lift fuel pump shall be provided unless otherwise stipulated. It shall be capable of delivering at least 120% of the Engine/Alternator sets fuel requirements for both combustion and cooling. It shall meet these requirements while the set is operating at full load and the suction lift, including flow losses in pipe and fittings, is 18 feet of D2 fuel at 1500 ft. above sea level.

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).

Fuel Cup

A fuel cup should be provided in the fuel system on the discharge side of the high lift pump and on the suction side of the boost or injector pump to aid in Engine/Alternator set in starting. A small petcock shall be installed in the fuel cup line.

Fuel Hoses

All fuel hoses shall be rated at 200 psi or better, be of proper length without any looping, sharp bends, or excessive slack. High quality flexible stainless steel external braid, reinforced type hoses may be specified within the Job Package. Fuel hoses shall not be painted.

Fuel Piping

All Engine/Alternator set fuel piping shall meet the following criteria:

- All fuel piping from the engine to the day tank shall be Schedule 40 black steel with class 300 fittings, minimum size ½" and equipped with a ball type shut off valve at the Engine/Alternator on the supply side.
- Pipe sealant shall be used on all fittings (e.g.: gasola red).
- If piping presents a trip hazard, it shall be covered with a diamond plate walkway and painted with yellow and black stripes.
- Piping shall be run on the floor or low on walls with no overhead piping of fuel lines unless no other route is possible. If overhead piping is unavoidable, loss of prime must be addressed.

3.9.3 Lubrication System

The Engine/Alternator set lubrication system shall meet the following:

- Positive lubrication shall be provided for all moving parts in the Engine/Alternator set.
- The lubricating oil pump shall be gear driven from the Engine/Alternator set.
- Oil capacity shall be sufficient to permit unattended operation for a minimum of 72 hours, unless otherwise specified by the SBC LEC Power Equipment Engineer. That may be necessary to match available fuel reserve, and 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 spin-on type and adequately sized to permit a minimum of 500 hours of continuous operation.
- A lubrication oil pressure sensor shall be provided to shut down the Engine/Alternator set if the oil pressure falls below the acceptable level recommended by the manufacturer.
- An oil drain, equipped with a shut-off valve, shall be extended beyond the Engine/Alternator sub-base.

3.9.4 Starting System

With a start attempt being defined as a crank period of approximately 15 seconds, the electric starting system shall auto-start at a single cycle of a minimum of three start attempts. The starting system shall be adequately sized to permit a minimum of three start cycles within five minutes of each other without recharge, at the lowest temperature expected for the site.

The starting system shall consist of the following components:

- An appropriately sized, lead acid or Ni-Cd 12 or 24 volt battery system shall be provided as specified within the Job Package. The use of 12-volt systems is restricted to sets below 100 kW.
- A mechanically secure battery stand meeting UBC seismic ratings shall be mounted on the floor adjacent to Engine/Alternator set. It shall not be mounted on the base. Where required, a non-metallic case, capable of containing an acid spill, shall be used. Anti-corrosion coating (e.g. No-Ox-ID A) shall be applied to all battery terminals and connections. The vendor is responsible for providing documentation of conformance to UBC Zone 4 requirements for the required critical facilities.
- An adjustable, dual rated battery charger adequately sized to recharge a fully depleted start battery within 8 hours shall be provided. On-set alternators shall not be provided unless specified within the Job Package. The charger AC input shall be single phase, 120/208/240 volt as designated within the Job Package. The charger shall be a LaMarche, SENS or an approved equivalent.
- All components of the starting system shall have a temperature that remains within manufacturer's specifications under normal operation and/or test conditions.
- The charger shall provide the following alarms; high and low battery voltage, charger fail and AC fail. These alarms shall be both remote sending and illuminate a local lamp/LED. All remote charger alarms shall be grouped into one alarm within the charger.
- The battery cables shall be secured to prevent chaffing.

3.9.5 Exhaust System

A critical grade exhaust silencer equipped with condensation drain, companion flanges, and flexible stainless steel bellow type exhaust fittings shall be provided. The system

shall be properly sized, furnished and installed according to the manufacturer's recommendation. The silencer shall be mounted so that the Engine/Alternator set does not support its weight, nor will the forces due to exhaust system growth from thermal expansion be imposed on the Engine/Alternator set. Rain protection shall be provided if the exhaust stack terminates vertically. Installation shall meet all seismic requirements for the specific zone rating that applies. The silencer and all indoor exhaust piping shall be insulated to a maximum surface temperature of 60°C (140°F), with a 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/Alternator sets manufacturer's maximum recommended backpressure. This shall be verified by manometer test.

3.9.6 Cooling System

The site-specific considerations such as, location, snow loading, radiator orientation, noise direction, and optional system requirements shall be specified within the Job Package.

All cooling systems shall meet all of the following general requirements:

- Be adequately sized to cool the unit properly at 100% rated load at the site maximum outside air temperature or 110°F, whichever is higher
- Equipped with a coolant recovery system that will prevent coolant overflow and spillage
- Be equipped with an internal sensing thermostatic valve
- The temperature sensor shall be located in direct flow of coolant
- A small coolant sampling ‘T’ with pet cock shall be placed between the block and the heater hose ball type shut off valve

<u>Radiator requirements</u>

- Radiator shall be an air-to-water heat exchanger with a fouling factor of 0.001 allowed for the waterside
- Radiator shall have an easily accessible fill point for the addition of coolant
- Drain connection and drain cock shall be at the bottom of the radiator, and extended to a location where the radiator can be easily drained
- Radiator shall be sized and materials shall be adequate for use of manufacturer’s recommended coolant for site altitude and climate
- Radiator fill and drain points shall be tagged with the capacity of the cooling system and the manufacturer’s recommended coolant type, formula, ratio and inhibitor type and amount
- For engine-mounted applications, the radiator shall be equipped with a duct adapter flange
- Radiator pressure cap shall meet the Engine/Alternator set manufacturer's specifications for pressure

<u>Hoses Requirements</u>

- 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. In applications that call for clamps of a size smaller than commercially available, the use of silicon hose clamps is acceptable.

Specific water-cooled set requirements

- The water radiator core and header shall be of suitable material for site conditions
- Be equipped with a Kim Hot Start ®canister type water jacket heater, or an approved equivalent

Block Heaters

- The heater shall be single phase 120, 208, or 240 volt
- Heaters shall be mounted on the Engine/Alternator sets skid, base or floor. Heaters shall not be mounted directly on the Engine/Alternator
- V-type engines shall have two heaters, each with its own thermostat
- Heater system shall be connected to the Engine/Alternator set cooling system in a manner that minimizes heat loss through the radiator
- Heaters shall be controlled by an externally adjustable thermostat that is set at the minimum point so the Engine/Alternator set shall start at the lowest expected temperature for the site
- Ball type shut off valves shall be incorporated into system design to accommodate servicing of each water jacket heater
- The heater shall include a coolant-circulating pump (e.g. Grundfos Pump Corp.®, Model Series UP15-1850)

Specific Remote Radiators Requirements

"Remote" refers to any radiator that is not located on the Engine/Alternator set skid

- Radiator piping shall have braided stainless steel flexible lines with finished ends, flange coupled, at the Engine/Alternator set and radiator
- Ball, gate or butterfly type isolation valves shall be installed at both the radiator and engine for water jacket and inter-cooler piping as applicable
- Isolation valves shall be located as close to the Engine/Alternator set and radiator as practical and be rated for 250 degrees and for use with coolant
- Radiator piping shall not be supported by the radiator stand
- Radiator piping shall be painted with a high temperature outside paint
- AC conduit shall contain a flexible connection and not be supported by the radiator stand
- Remotely monitored radiators shall not exceed manufacturer recommendation for static pressure
- Bleeder valves shall be provided as determined for site-specific conditions
- A service drain valve shall be placed on the hard pipe side of the isolation valve at the lowest point

- Remote radiator mounted electrical boxes shall be NEMA 4 weatherproof or stainless steel
- All expansion tanks shall be equipped with a water level switch; the expansion tank may be the tank on top of the radiator.
- An AC service disconnect shall be mounted at the radiator
- All piping shall be directionally labeled and isolation valves shall be position labeled
- When a remote radiator control and monitoring panel is required it shall be provided with a “HAND/OFF/AUTO” switch, a “NOT IN AUTO” alarm and lamp/LED in series with the Engine/Alternator set control panel “NOT IN AUTO” alarm, and a “FAN RUN” green lamp/LED
- The fan shall be powered from the line side of the Engine/Alternator breaker through a fused disconnect
- The fan may be thermostatically controlled
- The radiator shall be equipped with a “FAN FAIL” alarm at the control panel
- A 120 volt duplex outlet should be mounted in the vicinity of the remote radiator

3.9.7 Intake Air System

The Engine/Alternator set intake air shall be taken from the engine room or enclosure. The Engine/Alternator set intake air filter system shall meet the following:

- Be equipped with a replaceable 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 airflow expected up to 110% of rated load and shall trap airborne dirt or dust that may enter the Engine/Alternator set and cause excessive wear
- The filter system shall be equipped with a service indicator to automatically display air filter replacement indication.

3.9.8 Air Box / Vapor Recovery System

The crankcase breather and air box drain tube(s) shall be equipped with an oil demist system (AirSep, Racor or approved equal). No oily vapor shall be vented into the atmosphere.

3.10 SAFETY AND ENVIRONMENTAL

The Engine/Alternator set shall comply with all applicable OSHA requirements, contain no sharp edges, un-guarded rotating parts, unprotected high temperature surfaces or unprotected hazardous voltages as specified below.

3.10.1 High Temperature Surfaces

Exposed surfaces with temperatures greater than 113°F (45°C) shall be marked with warning labels. All exhaust parts and piping as well as any other high temperature surfaces shall be insulated so that the surface temperature of the insulation does not exceed 140°F (69°C).

3.10.2 Rotating Parts

Suitable guards meeting OSHA requirements shall be provided to protect any operator from being harmed by fans, blowers, any rotating parts associated with the Engine/Alternator set to which the operator may be exposed. All set-screws, bolts, keys or key-ways with projecting or sharp edges shall be suitably guarded. All in-running gears and sprockets shall be completely enclosed or provided with band guards around the face of the gear or sprocket. The operator shall not be physically able to touch any rotating part.

3.10.3 Hazardous Voltages

Voltages at or above 70 Volts DC or 50 RMS AC shall be enclosed or guarded to prevent accidental contact. Warning labels shall also be provided and conspicuously displayed with the guards in place or removed.

3.10.4 Labeling and Identification Requirements

All major assemblies of the unit and the standby AC plant shall display nameplate identification. All terminal and component designations should be as shown on the circuit schematic and assigned a functional designation.

All nameplate identification and labeling shall meet the following requirements:

- Nameplates shall be of sufficient size and located in a way that they can be read easily from a safe position with the naked eye, and in a color that contrasts with the background.
- Nameplates shall be adjacent to each component and terminal
- All nameplates shall match exactly the drawing designations
- All control panel(s) labeling shall be permanent, legible and suitable to the application. Acceptable methods would be, silk screen, metal tag, engraved plastic labels, etc.

The following labels shall be included in all Engine/Alternator sets:

- The Engine/Alternator set shall have a label “DANGER AUTO START” displayed in a conspicuous location
- All electrical connections on a component shall be assigned a terminal designation.
- All test points shall be assigned a distinguishing designation
- Functional and terminal designations should be displayed on or adjacent to each component and terminal.
- Any cabinet containing high voltages, those over 70 volts DC or 50 V RMS AC, shall have “CAUTION HIGH VOLTAGE” clearly labeled on the front of the cabinet.
- The Engine/Alternator set AC panel shall have its source labeled clearly.
- All fuel and radiator coolant lines shall be directionally labeled.
- All original manufacturer nameplates shall remain attached to their components. They shall remain legible and not be painted over.

4 REMOTE MONITORING SYSTEM INTERFACES

The SBC LEC Power Equipment Engineer shall determine when an intelligent monitoring system shall be deployed. That stipulation as well as all specific requirements concerning its deployment shall be outlined within the Job Package.

An intelligent monitoring system transmits real time data on the condition of the Engine/Alternator set, transfer switch and the building AC from a DAU (Data Acquisition Unit). On a day to day basis that may include items such as the Start Battery Condition, Engine Block Temperature, Engine Room Temperature, and any Engine/Alternator set alarm(s) present. This allows SBC LEC Personnel to monitor equipment status from a remote location for planning, as well as an interactive interface for system analysis and trouble diagnostics. When deployed with energizing relays, the Engine/Alternator set may also be started and stopped through the interface.

4.1 DATA POINTS

It is recommended to achieve that level of intelligence that the following minimum set of data points be monitored:

<u>Engine Mechanical</u>

- Oil Pressure (discrete analog)
- Fuel Pressure (discrete analog)
- Coolant Temperature (discrete analog)
- Oil Pressure (binary)
- Coolant Temperature (binary)
- Oil Level (binary)
- Air Damper (binary)
- Louvers
  - Intake (binary)
  - Exhaust (binary)
- Overspeed (binary)
- Cranking (binary)
- Start Battery Voltage

<u>Alternator Electrical</u>

- Voltage: A-B, B-C, C-A
- Current: A, B, C ∅
- Frequency
- kW's

<u>Utility Electrical</u>

- Voltage: A-B, B-C, C-A

<u>Environmental Conditions</u>

- Engine/Alternator Room Ambient Temperature

5 ENCLOSURES

In some situations it may be necessary to place a stationary Engine/Alternator set outside the Central Office in an enclosure. That enclosure could be one of two types: a walk-in or drop-over enclosure. The SBC LEC Power Equipment Engineer shall determine when and which type is required. It is not recommended that drop-over enclosures be used unless site specific conditions restrict the engineer from first placing the set within the Central Office and secondly from deploying a walk-in enclosure. All enclosures shall comply with the following engineering and installation requirements as well as those stipulated in Sections 1 & 2 of this document. The enclosure and Engine/Alternator set shall be completely wired and available for inspection by SBC LEC personnel prior to shipment and all wiring diagrams on the module shall be included with the Engine/Alternator set specification manuals.

5.1 WALK-IN MODULES

5.1.1 Enclosure Construction

The module enclosure shall be of dimensions that will accommodate the Engine/Alternator Set, all associated peripheral equipment, and all required clearances.

The access door(s) shall meet the following:

- Be exterior type, heavy duty, cam adjustable, gasket type door that is 7 feet high and at least 40 inches wide
- Enclosures with multiple doors shall all be keyed alike
- Door hinges shall be constructed of stainless steel.
- Door hardware shall be of either a Panic Bar type with 3-point lock functionality or a “walk-in cooler/freezer” type latch. It shall be constructed of die cast zinc with a forged brass handle and be chrome plated. Latch shall be equipped with an inside release handle to prevent accidental entrapment. Latch shall be equipped with a padlock hole of 3/8” diameter. Latch must be similar to a McMaster Carr® cooler latch, part number 1267A1, 2 or 3.
- Door and associated hardware shall be of a rust proof and waterproof material and construction.

The enclosure itself and the roof shall meet the following:

- Be constructed of pre-cast concrete, stainless steel (316-type better), or class ‘A’ corrosion resistant aluminum (3000 series or better)
- Be rust proof and waterproof in material
- Have a 4-foot long piece of rain shield placed directly over the access door to redirect rain runoff
- Have a pitch suitable to prevent excessive accumulation of snow or rain
- Be seamless or full welded with no penetrations.

<u>Mounting</u>

The SBC LEC shall provide the concrete pylons or pads for the enclosure mounting. Pylons shall be placed in all four corners for the enclosure. They shall be at least 40 inches deep and extend 1 foot above grade level.

Air Plenum Access
A minimum of one panel on each air plenum at the ends of the enclosure shall be removable for access to the plenum. Plenum access doors may be provided in lieu of removable panels.

Barrier Protection
Barrier protection shall be installed wherever the possibility of motor vehicle damage to the module exists. An 8 foot high, chain link fence with a 60-inch wide gate is recommended to be installed to surround the enclosure. Local building codes shall be consulted for maximum fence height allowances.

Sound Absorption
The enclosure shall be equipped with all required sound absorption materials on or within the walls and ceilings. The sound proofing material shall have an Oxygen Index of at least 28 or greater.

Clearances
There shall be a walkway clearance of at least 28 inches on three sides of the Engine/Alternator set except where stricter local codes exist.

Loading
The deck of the enclosure shall be rated at a minimum of 150-lbs./square foot. The deck of the enclosure shall also be leak proof by the manufacturer.

Insulation
The enclosure shall be insulated on the ceiling, sides, and floor. Insulation shall have a minimum rating of R15 and an Oxygen Index (LOI) rating of 28 or greater.

Lighting
All enclosure lighting shall be installed with a timing device. The enclosure shall also be equipped with three DC powered lights. At least two of these lights are to be placed inside the enclosure and one is to be placed above the access door outside the enclosure.

The outside light fixtures associated with the enclosure shall be weatherproof and encased in a wire guard to prevent breakage by accident or vandalism.

The enclosure shall also be equipped with three 120 VAC incandescent lights, 150W, protected by the appropriately sized breaker. Two switches shall be provided to control the AC powered lights. One switch shall control the inside lights and another one shall control the single outside light. The switches are to be located just inside the latch side of the enclosure door. All electrical wiring installed must adhere to all state and local codes.

Outlets
The enclosure interior shall be equipped with two ground fault interrupter 110 VAC standard NEMA 5-20R duplex outlets, one mounted on each sidewall.

Connection Box

There shall be an externally mounted, weatherproof GFI connection box as part of the enclosure. The connection box shall be equipped with a standard weatherproof duplex 110 V AC NEMA 5-20R outlet.

5.1.2 Start Batteries

The Engine/Alternator set start batteries shall be mounted on an approved battery stand. Batteries are not to be placed on the enclosure floor.

5.1.3 Louvers/Dampers

The enclosure shall be equipped with proper louvers and dampers. The rear inlet louver shall be interlocked with the exhaust louver so they both operate simultaneously. Bird screening shall be installed on the inside of all louver openings.

All motor driven dampers shall power closed and spring open, and be under the exclusive control of the Engine/Alternator set, including the transfer switch. Any 'Loss of Power' or 'Engine Start' signal shall open dampers. If a thermostatically controlled cooling fan is to be provided within the enclosure, the intake damper shall automatically open when the fan runs.

5.1.3 Exhaust Outlet

The Engine/Alternator set exhaust outlet shall be enclosed in an insulated sound chamber. This chamber shall dissipate sound and heat from the Engine/Alternator set. All interior exhaust piping, turbo charger, exhaust elbow and exhaust flex shall be wrapped in permanent insulation blankets. The Engine/Alternator set radiator louvers/dampers shall be equipped with an anti-vibration flange between the Engine/Alternator Set and the exhaust louvers.

Intake air louver and damper openings shall be sized for a velocity not greater than 900 FPM. Exhaust air louver and damper openings may be designed for a velocity greater than 900 FPM, but the velocity shall not impede the overall airflow or exceed the maximum allowable pressure drop for the radiator. The intake and exhaust air opening(s) shall be located such that there is no re-circulation of warm exhaust air into the intake opening(s).

5.1.5 Heaters and Cooling Fans

The enclosure may require a remote wall mounted Chromaolox®, thermostatically controlled space/unit heater or equivalent. When required, the heater shall be of adequate size to heat and hold a temperature of 55° F inside the enclosure when outside temperatures are at a maximum of -25° F.

The enclosure may also be required to have a switch controlled, adequately sized cooling fan that is to exhaust hot air outside the enclosure. The fan switch when deployed shall be interlocked with the space heater via a heating/cooling thermostat and shall be able to operate between 55° F and 110° F.

5.1.6 Emergency Shutdown

The enclosure shall have an emergency Engine/Alternator shutdown switch located just outside the access door. The shutdown switch shall be energized by the Engine/Alternator set and shall not operate unless the set is running. The shutdown switch shall also be weatherproof.

5.1.7 Fire Sensing

The enclosure shall be equipped with fire sensing heads as specified by local standards and codes. These fire detector heads shall be connected to the existing fire detection system of the facility being served.

5.1.7 Fuel System

For a tank provided inside the enclosure, the vent piping shall be routed outside the enclosure, and shall be provided with an approved venting cap. An exterior fuel fill spill containment box shall be provided, be readily accessible for refueling, and shall be designed for easy clean up**.**

All fuel tank(s) shall be engineered and installed in accordance with SBC and applicable federal, state, and local environmental standards. They shall be equipped with the following:

- Double walled construction
- An emergency vent valve
- An anti-siphon valve (as required)
- A lockable cover on the fill pipe
- A fuel gauge
- Overfill prevention (an exterior alarm horn or shut-off valve in the fill pipe)
- Tank monitoring system providing low level, high level, and leak alarms

All fuel piping shall be Schedule 40 black steel with class 300 fittings. There may be situations that dictate that flexible fuel lines be required between tank/tank slab and the enclosure/enclosure pylons to prevent stress from being placed on the fuel lines or fittings due to frost movement or enclosure/tank position change. When flexible lines are stipulated within the Job Package, they shall be a maximum of three feet in length, armor braided and approved for outdoor use.

5.2 DROP-OVER / WALK-UP ENCLOSURES

Drop-Over/Walk-Up style enclosures are not recommended in regions that regularly experience heavy snow or rain. When this type of enclosure is determined to be necessary by the SBC LEC Power Equipment Engineer it will be outlined within the Job Package, and at a minimum meet the following requirements.

5.2.1 Enclosure Construction

All drop-over style enclosures shall be designed to mount on a double walled UL base tank. The enclosure shall have a minimum of six doors for easy access to all components of the Engine/Alternator set for maintenance. All doors shall be lockable and keyed alike. All additional internal bracing of large panels shall be welded in place.

The Engine/Alternator set enclosure shall have a one-piece roof and be weatherproof. All doors shall have gasket seals to prevent water leakage.

The enclosure shall be 12-gauge cold rolled steel with 14-gauge doors. All enclosures shall be phosphate washed, epoxy primed and finish painted with two part industrial polyurethane, equal to Sherwin Williams® B65 Series/B60V2 and must be Ultraviolet resistive. All external hardware shall be stainless steel and painted.

5.2.2 Exhaust

The radiator and combustion exhaust shall be top exit, with all openings equipped with bird screening. The air velocity shall not exceed 1100 FPM. Baffles must be installed to reduce water vapor in flow during Engine/Alternator set operation. The intake and exhaust air opening(s) shall be located such that there is no re-circulation of warm exhaust air into the intake opening(s).

There shall be an exhaust silencer mounted inside the enclosure. Exhaust flex shall be stainless steel from the Engine/Alternator set to the silencer, steel piping shall not be allowed. Silencer mounting shall be placed to allow for easy replacement; it shall not be welded into place.

5.2.3 Sound Attenuation

The enclosure shall be designed to for the site-specific sound attenuation requirements. Depending on the required level of sound attenuation there shall be various types of polyurethane foam permanently glued to the interior of the enclosure. Only nitrile based glue that is temperature rated to 210° F shall be used. All polyurethane foam shall have facing and be flame retardant, meeting UL #94.

5.2.4 Base Tank

All pipe and fittings shall be Schedule 40 black steel with class 300 fittings. The vent shall vent outside the enclosure and an approved venting cap shall be provided. The fuel fill shall be readily accessible for refueling and shall be designed for easy clean up. The fuel monitor system shall be Tramont® or equivalent and shall show fuel level, provide alarms for spill basin, low fuel and high fuel.

6 PARALLELING SYSTEMS

In some situations it will be necessary to install a system with multiple Engine/Alternator sets in parallel vs. that of a single set of larger size. The SBC LEC Equipment Engineer shall determine when the site conditions require the deployment of an Engine/Alternator set paralleling arrangement and outline the detailed specification within the Job Package. When required a complete paralleling system consisting of paralleling switchgear with all necessary equipment, software design, system controls, shop drawings, labor, material and testing shall be provided. The vendor shall comply with all quality, engineering and installation requirements contained within this document for single Engine/Alternator sets with the following augmentations and additions. Additional ANSI standards for paralleling gear would be ANSI C37.20.1 –198X 1069.

6.1 DOCUMENTATION

In addition to all documents required in the general requirements of this document the vendor shall supply the SBC LEC Power Equipment Engineer with three copies of all paralleling documents required herein. All documents are to be provided by the dates specified in the Job Package, and prior to construction. The Manufacturer shall also provide the contractor with the number of copies they requested including the cost of the system.

6.1.1 Technical Proposal

The technical proposal shall include the following:

- One-line diagram including all relays, acronyms, definitions and legend.
- Outline drawings of all proposed equipment in the plan and elevation views including overall dimensions, weights and clearances required.
- Complete list of components with catalog cut sheets and other descriptive material of major components.
- Detailed system-operating description.
- A brief resume of a typical training program for proposed system.
- Statement of Warranty
- Documented verification that proposed circuit breakers are designed for the intended application. Documentation shall include anticipated life and recommended maintenance interval for breakers based upon 110 operations per year.
- References shall be made available upon request with telephone numbers for proof that the switchgear manufacturer has experience in the building of generator control switchgear of this type.
- Delivery schedule including on-site start-up.
- List of recommended spare parts kits required for full preventative maintenance agreement, including current price. Price of spare parts kits are not to be included in the price of switchgear but are to be quoted separately.

6.1.2 Shop Drawings

Shop drawings shall include the following:

- Complete structural drawings showing arrangement, a dimensional plan with all elevation views, conduit entrance locations with elevations, dimensions and weights of shipping splits.
- Full system description and operation.
- Interconnection wiring diagram indicating the number of conductors and type required between each cabinet, switchgear and Engine/Alternator set.
- List of sub-assemblies, devices and part numbers.
- Base plan, showing dimensions of base and anchoring.
- Parts list and other engineering data that may be required for the installation including circuit breaker trip characteristics and full size coordination curves.
- All component bulletins.

6.1.3 Warranty

The warranty shall include all items outlined in section 1.3 of this document as well the following:

- Regular and systematically examining all circuit breakers, switchgear, monitoring and control system relays, switches and accessories pertaining to the system.
- Tests and written reports which warrants that all relays, protective devices and control/monitoring systems have been tested and found to be in satisfactory condition.

6.1.4 Manuals

The switchgear manufacturer shall provide the required number of copies of the Operational and Maintenance manuals for switchgear and controls. The manufacturer shall also maintain a complete set at its offices, specifically identified as pertaining to this project, to be available to manufacturer maintenance technicians.

At a minimum these manuals shall include the following:

- Circuit wiring diagrams
- Illustrations
- Identification of wiring
- List of special tools
- Software logic diagrams
- Complete list of numbered replacement parts
- Operating and Maintenance Instructions
- Disk of all software including base program and system specific logic
- All drawings shall be 11” $\times$ 17” maximum or provided in reducible form (Mylar)

6.2 GENERAL REQUIREMENTS

In addition to all the requirements outlined within section 1.3, when paralleling systems are deployed the vendor shall provide the following additional services;

- All necessary technical/service personnel to carry out system start-up and on-site system testing
- Two days of on-site installation review (during installation, consisting of two separate trips)
- Ten days of system integration testing
- Two days of operational training of SBC LEC personnel.

6.3 EQUIPMENT REQUIREMENTS

The paralleling switchgear system shall be designed to control the operation of a specified quantity of Engine/Alternator sets. The quantity, size, voltage, and phasing (including number of wires) shall be specified Job Package. All equipment associated with the deployment of the paralleling switchgear system shall comply with the following design and engineering requirements as well as those outlined within this document for single Engine/Alternator sets and those in the TP76400. Grounded metal barriers shall isolate all major components of the primary circuits such as circuit breakers, transformers and busses.

6.3.1 Switchgear and Cabinet Construction

All paralleling gear shall consist of completely enclosed, grounded metal units and auxiliary compartments. The construction shall comply with the following.

- Be free standing, floor mounted, indoor type, metal-enclosed switchgear.
- Be fabricated on a die formed steel base or base assembly welded or bolted together to rigidly support entire shipping unit for moving on rollers and floor mounting.
- Be designed to meet all seismic requirements specific to the location of deployment.
- Be designed to withstand any mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses that occur during operation of the assemblies.
- Consist of rugged steel assemblies with bracing, reinforcing gussets and jig welding to assure rectangular-rigidity.
- Each switchgear section shall have an open bottom as required for ready installation and termination of conduits.
- All side and top panels shall be removable, attached by bolts and small enough for easy handling by one man.
- Be equipped with all full-length front and rear doors, hinged mounted, with lock type operating handles for easy access.
- Be equipped with bolts, nuts and washers that are rustproof metal.
- Have all steel parts prepared for painting by a five step cleaning, phosphatizing and sealing process. The parts shall then be painted ASA #61 gray, utilizing polyester powder coating applied by the electrostatic method, cured in a bake oven. The finish shall be suitable for outdoor as well as indoor application.
- Have suitable means provided near top and bottom of the switchgear to insure adequate ventilation for all equipment within assembly.
- Have adequate gutter space provided in all sides of switchboard section. Arranged for clearance to permit good accessibility of feeder conductors and bus ducts into switchgear.
- Have all metal barriers completely grounded. Sheet steel inter-unit barriers shall be extended the full height and depth of the unit for isolation. The stationary units shall be equipped with a ground bus that shall extend through the complete line up.

6.3.2 Circuit Breakers

All circuit breakers deployed shall meet with the following requirements.

General

- Breakers shall be electrically operated and of the draw out type with a stored-energy closing feature. The racking mechanism shall be operable form a stand off position with positive stops provided to prevent over-travels. Guides shall be furnished to provide breaker position indication and to disconnect control circuits when the breaker is racked out of the cubicle or is in the disconnect position. Auxiliary switches shall provide remote indication and/or alarm or breaker position. Mechanical and electrical interlocks shall be provided to prevent removal of the breaker in the closed position and operation of the breaker in an intermediate position.

- Breakers shall be provided with close “a”, open “b” contacts and position switches as required for control sequences plus two “a” and “b” contacts wired to a terminal strip for owners use.
- All breaker ‘close and trip’ circuits, “a” and “b” contacts and position switches shall be connected to the main PLC through a communication bus and input/output modules to provide complete control and monitoring.
- Breaker control voltage shall be 120 V AC with status indicating lights fed by 24 V DC Engine/Alternator set control voltage or 48 V DC power plant control voltage (best battery source).
- Circuit breakers shall be installed in individual front compartments with separate doors.
- Breakers shall be 100% rated with equipment electronic trip and metering units to provide protective relaying. Metering and event reporting and remote communication to the power meter circuit may also be required.

GB (Generator Breakers)

- Shall provide all necessary Engine/Alternator set paralleling output breakers tied to paralleling bus.
- Breakers frame size shall allow for 110% of full Engine/Alternator set nameplate rating.
- Breakers shall have interchangeable trips, equipped for long time (L), short time (S), and instantaneous (I). Each breaker trip shall be coordinated to provide the proper Engine/Alternator protection.
- Provided with a set of three potential transformers, ratio as required, draw out type, complete with current limiting primary fuses and low voltage secondary fuses for metering, and relaying.
- Provided with a set of three current transformers, ratio as required, complete with current limiting primary fuses and low voltage secondary fuses for metering and relaying.
- Be provided with all required control wiring, fuses, fuse blocks, and terminal nameplates.
- Be equipped with a separate back lit incandescent annunciator for ‘Circuit Breaker Open’, ‘Circuit Breaker Closed’, and ‘Circuit Breaker Draw Out’ status indications.
- Be equipped with one reverse power relay (Device #32), ASEA Brown Boveri type ABB-32R.
- Be equipped with one ground fault relay (Device #51), for monitoring and alarm only, ASEA Brown Boveri type ABB-51.
- Be equipped with one impedance relay, loss of excitation (Device #40) for loss of field protection, ASEA Brown Boveri type ABB-40.
- Be equipped with a switchboard type trip-close pistol grip control switch with Red (close) and Green (open) indicator lights.

6.3.3 Paralleling Bus Bar

The paralleling switchgear shall be engineered to operate as an integrated system, which will interface with distribution switchboards as defined by the SBC LEC Power Equipment Engineer within the Job Package. The system shall provide complete control of all

paralleling gear and distribution switchboard main breakers while in accordance with all of the following requirements.

General Requirements

- All busses and stub connections shall be silver plated copper.
- Sized such that the current density is not greater than the current carry capacity of the rectangular copper bars as required by NEMA standards. Heat and rise tests shall be in accordance with ANSI standards.
- Horizontal and vertical busses shall be insulated in such a way that when the rear panel of a vertical section is open, the only exposed “live” bare parts will be the load terminals of the feeder breakers.
- Bus Bar and interconnecting joints shall be silver-plated constant high-pressure type with Grade 5 steel bolts, nuts and compressions washers.
- All bracing shall be 100,000 RMS symmetrical at the rated voltage. Bus Bar capacity shall be equal to or greater than frame rating of paralleling gear distribution breakers.
- Bus Bar designation shall be from front-to-back, top-to-bottom, and left-to-right with labels ‘A’, ‘B’, ‘C’ respectively when reviewed from the front.
- The bus bar that run outs from the breaker shall be sized for full breaker frame size and not the trip rating.
- Provide four hole NEMA rated drilled bus with all required two hole hydraulic compression fittings for cable connections as shown on the drawings.
- Provide each line up with a unit mounted hoist to install and remove the breaker elements form their cubicles for inspection and maintenance.
- Each breaker shall be equipped with a solid state trip unit with target status indicating light or display on the trip unit. The trip shall provide the functions indicated as LT (Long Time), ST (Short Time), I (Instantaneous), GFI (Ground Fault), and provide metering.

Paralleling Bus Requirements

- Breakers frame size shall allow for full bus ampacity.
- Breakers shall be equipped to allow for all required interchangeable trips, L, S, and GF.
- Each breaker trip shall be coordinated to provide the proper distribution protections.
- Be equipped with a set of three potential transformers, draw out type, complete with current limiting primary fuses and low voltage secondary fuses for metering, relaying.
- Be equipped with a set of three current transformers, complete with current limiting primary fuses and low voltage secondary fuses for metering, and relaying.
- Be equipped with proper control wiring, fuses, fuse blocks, and terminal nameplates as stipulated in the appropriate sections.
- Be equipped with a switchboard type trip-close pistol grip control switch with Red (close) and Green (open) indicator lights.

- Be equipped with a separate back lit incandescent annunciator for 'Circuit Breaker Open', 'Circuit Breaker Closed', and 'Circuit Breaker Draw Out' status indications.

6.3.4 Power Metering System

The paralleling system shall be provided with a power metering system. The necessary power supplies for that system shall be fed from the switchgear control power. The system shall meet the following requirements.

Element Requirement

- Capability of displaying parameters from individual circuit breaker units
- An operator interface panel to monitor the breakers installed in that unit.
- All necessary hardware and software necessary for communication with the main PLC.
- Capability to communicate with the breaker trip unit as outlined above.

Electrical Parameters

The following shall be available for local display at the power metering system:

- RMS phase currents, phase voltages, and line voltages
- Frequency
- Real Power
- Total KVA
- Trip indicator and cause

6.3.5 Controls

Each EGCC (Engine Generator Control Cubicle), and MCC (Master Control Cabinet) shall have a light with a switch and maintenance duplex receptacle. These devices shall be wired to a single terminal strip in the MCC for connection to the building service by owner.

Instruments and Control Wiring Requirements

- Instrument and control wiring within the switchboard sections shall be flame retardant type "SIS" #14 gauge stranded copper minimum approved for switchboard use.
- All wiring to equipment and devices mounted on hinged doors and/or panels shall be extra flexible copper, stranded type.
- Wire terminations at terminal blocks, meters, relays and other similar devices shall be made with ring tongue or cup washer type terminals.
- All wiring between shipping sections shall be installed by the manufacturer. Wiring that must be disconnected at one end for shipping shall be fully labeled.
- Each additional interconnecting wire shall be identified by means of a suitable permanent marker at each end. Wiring numbers shall match the manufacturers interconnect drawing. Wire markers attached with adhesives are not acceptable.
- Terminal blocks shall be supplied and clearly marked for wiring, which will be installed or reconnected by the installing contractor, including wiring between shipping sections.

- CT's, PT's, shunt trips, protective relaying, auxiliary contacts and control connections shall be connected via labeled terminal strips.

Nameplate Requirements

- Externally visible, permanent nameplates shall be provided to identify each instrument, instrument switch, meter, relay, control switch, indicating light and circuit breaker compartment. Equipment and terminal blocks within the compartments shall also be suitably identified. Relays shall be designated for their use and for the phase to which they are connected.
- All nameplates shall be laminated plastic and attached with screws. Characters shall be white on a black background.
- The owner shall review all nameplate inscriptions when the shop drawings are submitted for review. All physical nameplate designations shall match their drawing designation exactly.
- In addition to any manufacturer designation of cubicles and control switches, special nameplates shall be provided for each breaker and control device (letter, number or series of letters and numbers). This shall be provided on a laminated nameplate with a distinctive color. The SBC LEC Power Equipment Engineer shall provide special nameplate designations within the Job Package.

Instrument Requirements

- All instruments shall be electronic/digital type or 4 ½ " switchboard type, true RMS, 1% ACCURACY, 250° scale. Edgewise and 2% accuracy instruments are not acceptable.
- Instruments and switchboard control switches shall be heavy-duty rotary switchgear type, equal to Electro-Switch Company® Type 24. All other controls shall be industrial duty oil tight.

Transformers

- Current transformers shall be 5 A secondary, wound type, with single secondary winding and primary/secondary ratio are required, burden and accuracy consistent with connected metering and relay devices, 60Hz.
- Potential transformers shall have 120 V single secondary, with primary and secondary fuse protection, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60Hz.
- Current transformers shall monitor paralleling bus current.
- Potential transformers shall monitor paralleling bus voltage.

Relays

- Relays, associated wiring and printed circuit cards shall be rated 20 A, 120 V AC or provided with accessible fuse protection.
- Control relay systems (sensors, sequence relays, synchronizer, etc.) shall be mounted on removable plates and connected through terminals to facilitate removal and testing.
- All failure and synchronizing relays shall be provided with plug-in bases to facilitate removal and testing.

EGCC (Engine Generator Control Cubicle)

Relays and controls shall control the entire Engine/Alternator set control and monitoring system. The EGCC shall be furnished with the following basic components and any additional equipment necessary to provide for a complete and dependable system.

- AC voltmeter, scaled to system voltage
- Voltmeter selector switch reading phase-to-phase.
- AC ammeter selector switch (four position)
- Kilowatt meter (0-1200 kW , 920 kW unit, 480 V) or (0-800 kW, 565 kW unit, 480 V)
- Be equipped with a heavy-duty Engine/Alternator starting system. The system shall be arranged to control the operation of the Engine/Alternator set through the engine selector switch mounted on the front door of the enclosure. The automatic starting system shall utilize heavy-duty engine control relays.
- Be equipped with mounting and wiring of the governor control unit, as supplied by the Engine/Alternator set supplier (Device #65).
- Engine/Alternator supplier shall provide and mount the voltage regulator and power factor controller when required.
- Be equipped with a synchroscope switch – switchboard type selector interlocked so the handle is removable only in the “OFF” position to set proper operation of system synchroscope. It shall also have the proper “ON-OFF” nameplate.
- Be equipped with a frequency meter switch – switchboard type selector interlocked so the handle is removable only in the “OFF” position to set proper operation of system frequency meter. It shall also have the proper “Bus-OFF-Gen” nameplate.
- Be equipped with switchgear type control switch, pistol style –“Trip-Close” with breaker open, closed and drawn out indicator lights.
- Be equipped with an Engine/Alternator set selector switch with the proper “Lockout-Reset-Off-Auto-Run” nameplates.
- Be equipped with an “Engine/Alternator Service Switch” that is a two position, maintained contact key operated selector switch – “Normal – Service”.
- Be equipped with a “Test Lamp” push button.
- Be equipped with an automatic synchronizer with adjustable phase angle, voltage trip level and time delay, with Electro-mechanical control relays for circuit breaker close signal and the voltage raise-lower signals. Frequency raise-lower electronic signal will be directly connected to the governor control (Device #25).
- Be equipped with a “voltage adjust” 10-turn potentiometer.
- Be equipped with a “frequency adjust” 10-turn potentiometer.
- Be equipped with a running time meter.
- Be equipped with a set of control wiring, fuses, fuse blocks, terminals, nameplate with all wiring to be numbered at both ends.

MCC (Master Control Cabinet)

The MCC shall provide all remaining necessary controls for the Engine/Alternator Paralleling System and shall interface with the EGCC to provide for a complete and dependable system. The MCC shall include all of the following:

Components

- Two programmable controllers in standby back-up mode with necessary analog/digital cards, and power supplies as required. PC used for load demand system with load shed and add features.
- A master control and synchronizing relay panel to control the operation and synchronization of the Engine/Alternator set as described here.
- A bus voltage/frequency failure relay.
- A set of control wiring, fuses, fuse blocks, terminals, and nameplates with all wiring to be numbered at both ends.
- A solid state, best battery selector system for use to obtain 24 V DC control power from the Engine/Alternator set cranking batteries or station battery.
- Provide digital output whenever any Engine/Alternator set is operating.

Operator Controls

- A register access and data display panel.
- “Annunciator Lamp Test” push button.
- A “System Test” three-position key operated switch “No load – Normal – Full Load”.
- A “Voltage/Frequency Failure Reset” push button.
- An “Alarm Horn Silence” push button.
- A “ Shed Non-Essential Load” push button.
- A “ Re-Add Non-Essential Load” push button.
- A “Load Demand” two-position key operated selector “On-Off”.
- An “Increase Generator Capacity” push button.
- A voltmeter selector switch reading phase to phase
- A station alarm horn and Annunciator panel.
- A “Lockout Reset” push button.
- A switchboard type “Master Control Switch”, pistol grip two position “Auto-Manual”.

Synchronizing Swing Panel

There shall be a synchronizing swing panel for two way viewing. This panel shall include the following:

- A Bus AC Voltmeter scaled to system (0-600 V, 480 V system)
- A Synchroscope
- Synchronizing lamps
- A frequency meter for station bus and Engine/Alternator units, dial type 55-65 Hz.

Annunciator Panel

There shall be an Annunciator panel provided with the following alarm and fail circuitry.

- Overload (A) Alarm

• Eng/Alt Bus Over Voltage (R)	Shutdown
• Eng/Alt Bus Under Voltage (A)	Alarm
• Eng/Alt Bus Over Frequency (A)	Alarm
• Eng/Alt Bus Under Frequency (A)	Alarm & Local shed
• Eng/Alt Synch On (W)	Indication
• DC Control Power Trouble (A)	Alarm
• Load Shed on (W)	Indication
• Main PLC Trouble (A)	Alarm
• Back-up PLC Trouble (A)	Alarm
• Start Signal Present (G)	Indication
• Utility Power Available (G)	Indication
• System Under Test (W)	Indication
• Load Demand Active (W)	Indication
• Eng/Alt Capacity Decrease (W)	Indication
• Eng/Alt Capacity Increase (W)	Indication
• Load Control By-pass (W)	Indication
• PLC Back-up Control Power Battery Trouble	Alarm

6.4 SYSTEM DESIGN

6.4.1 System Controls and Monitoring

The Engine/Alternator Set Paralleling System shall be controlled by dual programmable controllers operating in a main/back-up/stand-by configuration. It shall not be in parallel operation. The programmable controller will be used for a system control and monitoring of the Paralleling Switchgear and Secondary Distribution switchgear, power monitoring and SCADA interface through multiplexed communication bus. The system DC control power shall be derived from the Engine/Alternator set controls through the 'best battery' selector. The following elements shall be provided with the paralleling system.

PLC (Programmable Logic Controller)

Two PLC's with dual processors, non-synchronized back-up mode, necessary DC power supplies chassis and input/output analog cards.

Data Display Panel

A programmable controller Register Access and Data Display panel shall be provided to allow the operator access to the PLC without having to implement software changes to timer settings. This panel shall control load demand, load control points, and load demand Engine/Alternator set sequence positions. Access panel functions shall allow the user to modify control for varying field conditions, and shall be password protected. During normal operation the panel shall display the Engine/Alternator sets starting sequence and the total system load demand. The following minimum registers shall be provided.

- Register #1 – Password [0 – 9999] set at 5555
- Load Demand Timer [0 – 60 min.] set at 10 minutes
- Overload Timer [0.0 – 99.0 sec] at 5 seconds

- Increase Engine/Alternator Capacity Timer [1-100 sec] set at 10 seconds
- Decrease Engine/Alternator Capacity Timer [1 – 100 sec] set at 10 seconds
- Overload Set point [90 – 125%] set at 110%
- Load Demands Decrease [40 – 60%] set at 40%
- Load Demand Increase [70 – 100%] set at 80%
- Engine/Alternator #1 Sequence [1 – N] set at 1
- Engine/Alternator #N Sequence [1 – N] set at N
- Minimum Number of Engine/Alternator Sets [1 – N] set at 1
- Utility Restored Timer Preset [0 – 30 min] set at 15 minutes
- Ramp Rate [10 – 120 sec] set at 20 seconds

Graphic Panel
Illuminated graphic panel depicting the system one line with LED breaker (open, closed, in position) and system including all controlled Secondary Distribution Breakers. The LED's shall flash during any timing sequences or alarm condition until reset.

Interface
Communication hardware and software to interface with the power monitors supplied with Paralleling and Distribution Switchgear

6.4.2 Operating Modes

Coordination
All functions of the paralleling switchgear and the circuitry of the various selector switches shall be coordinated to insure that no setting available is capable of causing malfunction in the intended system operation.

All system operation and control functions shall be coordinated and integrated such that during automatic and/or manual operation, no unsafe condition or malfunction of intended operation shall occur.

Load Control
Loads shall be shed based upon 'under frequency' sensing on the Engine/Alternator bus. The loads shall be shed based on their assigned priority. There are a minimum of three priorities:

- Priority one – highest priority – last to shed
- Priority two – midlevel priority – second to shed
- Priority three – lowest priority – first to shed

The system shall be designed to determine which loads are to be shed and shall also determine which loads are out of service prior to the shed command. The paralleling system shall also be designed to start up any off-line Engine/Alternator sets when loads have been shed. Loads shall be picked up when the added Engine/Alternator set has been provided.

The "load control" selector switch located on the MCC shall allow manual control of loads. The selector switch shall work with the following modes:

- "Normal Mode" : The PLC shall control priority loads
- "By-Pass Mode": The operator shall control the priority loads by activating the pushbuttons for either "shed non-essential loads" or "add non-essential loads".

The pushbutton controls for non-essential loads shall operate in that, depressing the pushbutton once shall shed or add the next priority load. When additional priority loads are available, depressing the appropriate pushbutton the second time will shed or add the next load.

Register Access and Data Display Panel

The register access and data display panel on the MCC shall set the Engine/Alternator sets starting and stopping sequence. If the sequence should be changed during any automatic operation, any Engine/Alternator set that is on-line shall remain on-line. If the Engine/Alternator set selected, as the base Engine/Alternator set not be on-line it will be immediately started and placed on-line.

The first Engine/Alternator set that is selected, as sequence position #2 will be the first added to the Engine/Alternator bus and the last subtracted. Should an Engine/Alternator set be locked out of the system, it will be skipped over and the next Engine/Alternator set in sequence will be started or stopped as required.

The Engine/Alternator set 'Cool Down Timer' delay shall be accessed by the Register Access and Data Display panel located on the MCC.

System Test Switch

A "System Test" selector switch located on the MCC shall provide the capability to perform a 'no load' test of the Engine/Alternator set. When the main switch is placed in the test position, automatic start of Engine/Alternator sets shall occur and all Engine/Alternator automatic synchronizing and control functions will be completed. Engine/Alternator sets shall be automatically synchronized and paralleled to the Engine/Alternator bus at 'no load'. Returning the test switch back to 'Normal' position shall trip the Engine/Alternator set breakers, shut down the Engine/Alternator set after the cool-down time and restore all equipment to normal operation.

Automatic Synchronizer

There shall be one automatic synchronizer for each Engine/Alternator set to provide phase matching of the Engine/Alternator to the Engine/Alternator bus control of closing the appropriate Engine/Alternator breakers (GB1, GB2, through GB'N') located in the appropriate EGCC.

The automatic synchronizers shall have all circuitry housed in a rugged semi-dust tight enclosure suitable for switchboard mounting. It shall contain all control adjustments and input-output terminals legibly marked. The inputs shall consist of 120 V AC, nominal, 60 Hz signals from the selected power sources. A separate terminal shall be provided to ground the enclosure.

The outputs shall consist of the following:

- The bipolar DC signal for driving the electronic governors described in BSP 100-790-658MP.
- A Sync Contact Closure that shall operate the selected power breaker when the incoming voltage has the same amplitude, frequency and phase as the main Engine/Alternator bus.

The synchronizer shall become operative when the incoming voltage source reaches approximately 88% of nominal voltage. It shall assume control to match the frequency and phase of the Engine/Alternator set with that of the main Engine/Alternator bus rapidly, and close the selected power circuit breaker with a minimum system disturbance. Power circuit breaker closures outside the present limits shall not occur. Within approximately one second after the power circuit breaker closure, the synchronizer shall automatically relinquish control to the electronic governor and go into idle mode.

The synchronizer controls shall consist of the following:

- A synch-check relay
- A phase window control to adjust the phase angle acceptable band of +/- 4° to +/- 30° for 60 Hz.
- A sync-time control to adjust the synchronizer speed to the particular Engine/Alternator set being used.
- A gain control to optimize the synchronizing damping to the particular Engine/Alternator set being used.
- A sync-delay control to allow the phase angle to stabilize with the phase angle acceptable band before sync-relay closure.

A mode switch shall be provided for the following modes of operation:

- Auto – Normal automatic phase-lock operation with the control over engine/alternator set voltage, frequency and phase to provide a sync-relay contact closure.
- Sync Check – No control over engine/alternator set voltage, frequency or phase, but provides a sync-relay contact closure when parameters are within preset limits.
- Test – Normal automatic phase-lock operation with control over engine/alternator set voltage, frequency and phase but with no sync-relay contact closure when sync conditions are met.
- OFF – No control over engine/alternator set voltage, frequency, and phase, no sync-relay contact closure.

The synchronizer shall operate over an input voltage range of 80% to 125% of nominal indefinitely over ambient temperature range of 0° C to 40° C. The synchronizers shall be capable of meeting dielectric and surge-arresting capabilities as set forth in IEEE Standards 472 and ANSI C37.90a.

An over and under voltage/frequency relay shall be supplied to monitor bus voltage and frequency and provide alarms and initiate load shedding, when required within the Engine/Alternator Job Package. It shall include red failure lights, a reset pushbutton,

auxiliary contact, and an alarm in the MCC section will be energized to indicate an abnormal voltage or frequency condition.

A “fail-to-close” and “fail-to-trip” logic function shall be provided to prevent the system from allowing a de-energized bus during automatic or manual control sequences.

6.5 ENGINE/ALTERNATOR SYSTEM REQUIREMENTS

6.5.1 Controls and Monitoring

The Engine/Alternator Set shall be controlled by relay logic unless the SBC LEC Power Equipment Engineer specifies PLC within the Engine/Alternator Job Package.

Selector Switch

A four-position Engine/Alternator set selector switch shall be provided and labeled “Lockout/Reset-Off-Auto-Run” on each EGCC. Each outlined position shall meet the following.

- Lockout/Reset: The Engine/Alternator set shall be locked out. Whenever the selector switch is placed in this position. While the Engine/Alternator set is operating, it shall immediately shut down and its circuit breaker shall trip.
- OFF: The Engine/Alternator set shall shutdown with normal delay to allow proper cool-down after operating under load. Whenever the Engine/Alternator selector switch is placed in this position while the Engine/Alternator set is operating, the Engine/Alternator circuit breaker shall trip, but the Engine/Alternator shall continue to operate until the expiration of the time delay setting of the idle relay.
- Auto: The Engine/Alternator set shall operate automatically in conjunction with “Auto” position on the MCC, the programmable controller system, the sequencing system and the automatic synchronizer. When the Master Control System signals the Engine/Alternator set to shut down, the Engine/Alternator circuit breaker shall be tripped, and the Engine/Alternator shall continue to operate for the cool-down period before shutting down.
- Run: The Engine/Alternator set shall start and come up to speed. It shall continue to run until the selector switch is returned to “OFF” or to “Lockout/Reset” position. This is to be used for testing and manual operation.

Engine/Alternator Breaker

The Engine/Alternator breaker shall not be allowed to close unless the Engine/Alternator mounted main breaker is closed. If the Engine/Alternator main breaker is opened when an Engine/Alternator set in on-line the Engine/Alternator set shall be shutdown and locked out.

Reverse Power Monitoring Unit

The paralleling configuration shall include one reverse power monitoring unit per Engine/Alternator set to detect excessive reverse power flow caused by motorizing of a failing Engine/Alternator set. It shall be self contained, single phase, solid state type with inverse time characteristics. Upon detection of a true reverse power flow, the monitor

shall signal the alarm circuits to immediately disconnect the Engine/Alternator set. The reverse power monitor shall automatically reset upon Engine/Alternator power disconnect, and shall include the following features:

- An Adjustable time delay dial shall be provided with reverse time characteristics.
- Adjustable tabs 13 to 150 W
- Single pole, normally open contacts rated to close 30 A at 250 V DC. The contacts shall be made of silver with sufficient wipe to insure a positive contact.

The monitor shall be equipped with a draw-out case. The removable chassis will permit rapid interchanging of similar relay units without requiring panel-wiring changes. Chassis units shall be easily removable for test and inspection purposes. The current transformers secondary shall be automatically shorted when the relay chassis is removed from the case. The draw out case will have a dust-tight removable cover. The relay shall be provided with manual reset targets to indicate trip condition.

There shall be a reverse VARs monitor provided. This monitor shall indicate the loss of the Engine/Alternator excitation field, and shall have the same features and capabilities as the “Reverse Power Monitor”.

Fail to Synchronize Time Delay

A “Fail to Synchronize” time delay relay shall be provided to terminate the operation of synchronizer and sound a warning horn in the event the Engine/Alternator sets are unable to be synchronized within the time frame of 0 – 3 minutes. After failing to synchronize automatically, the operator shall be able to connect either one or all machines to the Engine/Alternator bus by turning the Master Control Switch on the MCC to the “Man” position, operating the manual synchscope system and appropriate Engine/Alternator set circuit breaker “Trip-Close” control switch.

Shutdown / Lock Out

Each Engine/Alternator set control section shall be provided with separate alarm relays and alarm lights to shut down the associated Engine/Alternator set, disconnect it form the Engine/Alternator bus and illuminate a light to indicate the nature of the failure. Depending upon the seriousness of the failure, the Engine/Alternator shall be shut down immediately or shall be operated long enough to start the next Engine/Alternator set in sequence, if necessary.

When the Engine/Alternator set(s) are running automatically with the Master Control Switch located on the MCC in the “Auto” position, the fail light shall be accompanied by a lockout light and relay that locks the Engine/Alternator out of the automatic mode of operation.

To reset an Engine/Alternator after failure while in automatic operation, the Engine/Alternator selector switch on the appropriate EGCC shall be rotated to “Lockout/Reset” position. The Engine/Alternator set shall then be returnable to its operating condition by returning the selector switch to the “Auto” position.

Selector Switch Coordination
The Engine/Alternator set shall be equipped with Selector Switch Coordination to coordinate the functions and circuitry of the various selector switches, to insure that the various settings available do not cause malfunction in the intended system operation.

Load Control
The Engine/Alternator sets shall be controlled by the "Load Demand/Spinning/Reserve" sub-routine for load demand control.

Cranking System
The Engine/Alternator cranking system shall permit a minimum of eight cranking attempts of a 5 to 40 sec duration, with a rest period of 10 seconds. A means shall be provided to allow a continuous cranking cycle when requested.

Failure Alarms
Each back-lit incandescent annunciator shall be of the "Ring-Back" type. Any time the alarm horn is silenced for a failure, the next failure or alarm shall re-energize the station alarm horn.

6.5.2 Operating Modes

All Engine/Alternator set capacities shall be set in the PLC on a per set basis. The ratings of Engine/Alternator (1, 2…N) shall be set based on unit capacity. The ratings entered into the PLC shall be the prime ratings.

Start Up and Shut Down Sequencing
All Engine/Alternator Sets available for service shall start after a predetermined start delay once the 'utility loss' signal is received. The first set to reach 90% voltage and frequency shall close to the dead bus. All remaining sets shall parallel and close to the bus as proper conditions are satisfied within each ECGG synchronizer.

The system shall transfer back to utility and shut down the Engine/Alternators Sets when all conditions and time delays are satisfied. Timers associated with 'Utility Load' and 'Utility Restored' shall be adjustable through the operator interface panel located on the MCC.

Overload Functions
The "Overload Set Point" shall be field adjustable through the Register Access and Data Display panel on the MCC and be adjustable form 90 to 125% of the Engine/Alternator set rated capacity.

The "Overload Timer and Increase Engine/Alternator Capacity Timer" time delays shall have "inverse time characteristics" the higher the loading – the shorter the time delay. The setting shall be programmable through the Register Access and Data Display panel.

Loading
The PLC shall control 'Spinning Reserve / Load Demand' Mode. The 'Spinning Reserve or Load Demand' Mode shall be annunciated when active through a back-lit window.

Each back-lit window shall flash during the timing phase of each mode, after which the annunciator shall be steadily illuminated.

The system shall have an Engine/Alternator decrease/increase capacity feature, which shall be timed. The increase timers shall have an inverse time constant feature based upon kW load, sensing of the generator bus, and number of Engine/Alternator sets on line.

The Engine/Alternator sets starting/stopping, increase/decrease load set points and timing duration shall be changeable through the RAP (Register Access Panel) located on the MCC. The Engine/Alternator sets shutdown sequence is then based on RAP input and PLC programming. Adding of Engine/Alternator Sets to the bus shall be done in reverse sequence. Locked out Engine/Alternators shall be skipped and the next available Engine/Alternator in sequence added.

An annunciator with back-lit indicating windows shall be provided on the MCC to illuminate when the loading of the Engine/Alternator system reaches the presets “Load Increase”, “Load Decrease” and “Overload” set points. These back-lit windows shall flash when timed out.

Manual Operation

The Engine/Alternator set shall be designed to accommodate manual operation. Manual Operation will occur whenever the Master Control Switch on the MCC is placed in the manual position. At that position the entire Engine/Alternator set can be operated as a manual set with starting and stopping of the set through the “Run” positions of the Engine/Alternator set selector switch. This shall allow manual paralleling of an Engine/Alternator set to the Engine/Alternator bus by operation of the “Trip-Close” control switch when synchronized. A swing panel shall be provided with synchroscope, synchronizing through the circuit breaker control switches, the synchroscope switches and the frequency meter switches on the EGCC door. The swing panel shall be an integral part of the MCC door. The swing panel shall be an integral part of the MCC door.

Normal Mode

When the “Engine Service Switch” two position maintained contact key operated selector switch is in the “Normal “ position the Engine/Alternator set shall operate as normal in the “ Manual” or “Automatic” modes. The key shall not be removable in this position.

Service Mode

When the “Engine Service Switch” is placed in the “Service” position an annunciator with back-lit indicating windows shall be illuminated and the Engine/Alternator set controls shall be inoperable. The key shall be removable in this position. When inserted in a “sister” “Engine Service Switch” two position maintained contact key operated selector switch located at the Engine/Alternator set and placed from “Normal” to “Service” the Engine/Alternator set shall start but not parallel to the Engine/Alternator bus. The Engine/Alternator breaker cannot be closed when in the “Service” position.

Emergency Stop Operation

The 'Emergency Stop' operation shall shutdown and lock-out the Engine/Alternator set, illuminate a back-lit indicating window and sound the annunciator.

6.6 SCADA (Supervisory Control and Data Acquisition) Systems

All PLC controlled paralleling systems require a SCADA system. Continuous inverted AC that has a 48 V DC source shall support the SCADA system.

6.6.1 System PC Requirements

Each system shall include one compatible computer that meets the following.

- IBM Pentium 500MHz or better
- Minimum 2.1 Gig hard drive
- 128 Meg RAM
- 19 inch color monitor
- Printer arranged for desk mounting
- Modem and a UPS unit capable of maintaining system for 15 minutes. Continuous inverted AC that has a 48 V DC source may be substituted by SBC LEC Power Equipment Engineer when stipulated within the Job Package.
- System application shall be Windows 98 or better
- Capability of interfacing with "Wonderware, Simplicity or equivalent SCADA Package"
- Capable of remote access
- Use Ethernet communications (to meet required speeds to capture all real time events with accurate time stamps)
- Designed to provide graphic display of system operation and log the required events.

6.6.2 System Operation and Log Events

All SCADA data, screens, alarm names, messages and information presentation shall be reviewed and approved by the SBC LEC Power Equipment Engineer. The required system operations and log events for the SCADA unit are as follows:

- Report all system alarms as well as PLC communication or logic card failure with addresses
- Event(s) logs shall display all system events including alarms, logons and diagnostics with the following minimum displays and printout capabilities: Swtichgear, control sequence, generator alarms, breaker operations including PLC output to external devices. That shall include event logging of origination and termination and all key inputs and outputs to and from the PLC to the control equipment.
- Communication Bus Alarms and 'State of Operation' indication
- Separate screen for the display of only ACTIVE alarms
- Separate screen for all logged events. Such events shall have a real time stamp within 1/100 of a second, and shall be sortable on both name and event nomenclature.
- Custom report capabilities with easy to follow instruction

- Graphic display of load transfer and retransfer condition
- One-line diagrams for the system substation and the Engine/Alternator sets paralleling bus. These diagrams shall include voltages, currents, all loads on each substation and bus, and change of state from utility to engine/alternator information.
- Engine/Alternator run time reports including number, kW produced, run time summarized on a per hour, week, month or year.
- Number of user defined graphics screens stipulated within the Job Package.

7 PERFORMANCE TESTING

7.1 SHOP TESTS

All Engine/Alternator sets require a documented shop test prior to ship. The vendor shall notify the SBC LEC Power Equipment and Power Maintenance Engineers of impending shop tests and make available those facilities normally used for in-shop operational testing for observation by the SBC LEC representatives. It is recommended that a SBC LEC representative witness the testing of all Engine/Alternator sets of 500kW and above.

7.1.1 Cold Start (350 kW and smaller)

After it has been at rest, with water jacket heater off for a minimum of 10 hours, the Engine/Alternator set shall be cold started. The time required reaching the 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.

7.1.2 Hot Start

With the Engine/Alternator set at operating temperature, it shall be hot started and meet the following requirements:

- The time required to reach rated 'no load' speed shall be compared to the manufacturer's specifications and recorded
- Verify the manual voltage regulator adjustment range
- Verify the manual frequency adjustment range
- Record AC volts, frequency, speed, coolant temperature, oil pressure and ambient temperature
- Test all of the Engine/Alternator set safety shutdown and alarm devices and systems.
- Test and record the transient response of the unit in ¼ load steps from no load to full load and full load to no load, and verify against requirements published within this document.
- 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'. The vendor shall provide a Gould® Model 2200S strip chart recorder, or equivalent, for verification and recording of transient response tests.
- On Prime Rated units only, apply 110% load at 0.8 PF for 1 hour. Reduce load to 100% at 0.8 PF for the time required to properly set Engine/Alternator set

piston rings or for 3 hours, whichever is longer. Record AC volts, amperes, frequency, kilowatts, coolant temperature and oil pressure every 15 minutes for the entire 4-hour period.

- On Standby rated units apply 100% load at 0.8 PF for the time required to properly seat Engine/Alternator set piston rings or for 4 hours, whichever is longer. Record AC volts, amperes, frequency, kilowatts, coolant temperature and oil pressure every 15 minutes for the entire 4-hour period.

7.2 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 systems, alarms, airflow, and compliance with the acoustic noise and exhaust emission requirements.

The vendor shall be responsible for the following:

- Providing all fluids (except fuel) required to perform the tests
- Provide all equipment (including load bank) and personnel for the on site test
- Notify the SBC LEC Power Equipment Engineer and the Power Maintenance Engineer at least 7 days prior to the proposed test date so that scheduling arrangements may be made (this shall include any inspectors, if required)

The Engine/Alternator set shall be tested in the following manner:

- Run at full load for a minimum of 3 hours
- All alarm and shutdown systems shall be verified as well as any other criteria herein specified that may be considered appropriate by the SBC LEC Power Maintenance Engineer or the vendor
- Exhaust shall be observed during the on site testing for obvious or excessive smoke that would violate local or state ordinances
- To determine that the maximum exhaust gas backpressure is less than manufacturer's published specification
- A full on-site test that includes automatic start and full auto-transfer of building loads will be conducted prior to job/project acceptance.

After the completion of all tests a sample of all Engine/Alternator set fluids shall be taken and provided to our authorized laboratory for authenticity and initiation of records. This testing process should not exceed 10 business days.

7.2.1 Switchgear Testing

All new electrical systems and new interfaces to existing systems shall be tested. The SBC LEC Power Equipment Engineer, based on site-specific needs, shall determine appropriate level of testing by a qualified testing agency. Typical testing specifications are outlined within the "Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems ", developed by the International Electrical Testing Association (NETA)[1].

[1] NETA: PO BOX 687, 106 Stone St, Morrison, CO, 80465 #303-467-8441